



**SANREM CRSP**  
**Annual Report 2002-2003**

*Scaling Up Sustainability: Community Management in a  
Global Landscape*

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**Annual Report 2002-2003**

Kristen R. Miller  
Editor

Sustainable Agriculture and Natural Resource Management

Collaborative Research Support Program

1422 Experiment Station Road

Watkinsville, Georgia, 30677, USA

Cover Photograph by Todd Crane

# Contents

SANREM Andes.....	5
Decision Support Systems.....	32
SANREM Global Impacts and Information Exchange.....	63
SANREM Southeast Asia.....	73
SANREM West Africa.....	117





# SANREM Andes

## Project Overview

The SANREM-Andes program is dedicated to interdisciplinary, intersectoral and participatory community-based research for improving the livelihoods and landscapes in mountainous regions throughout the world. Based on its main pilot research site in Cotacachi, Ecuador, the Andes team of Ecuadorian and US scientists generated during 2002-2003 significant research results, methods, and decision support tools which have been extrapolated to other mountain communities and development programs. In addition, the Andes program sponsored several awareness raising events (conferences, workshops, and e-conferences) while individual PIs served on Executive Boards and presented papers and keynote addresses in international conferences connected to the UN-declared International Year of the Mountain. Due to their significant research publications and impacts on mountain communities, SANREM-Andes investigators were honored this year with several national and international research awards. Cotacachi, the pilot site, has been declared an "Ecological Canton" and awarded the prestigious Dubai Award for its creative efforts in participatory development.

The Andean program represents the very essence of interdisciplinary sustainability science through the interlocking synergy of its six thrusts that address key human drivers (culture, economics, and institutions) and biological impacts (agro/biodiversity,

soils, and water). Over the past year, a great deal of energy has gone into integration of data and findings so that linkages between human activity and land/water impacts can be traced and solutions sought. The database—stored at Catholic University-Quito, in Cotacachi with UNORCAC, and at UA—is now 90% complete and is being produced as a general CD and in the Toolbook format for general and scientific consumption. Six books or monographs related to SANREM-Andes have been finalized for publication, several peer-reviewed articles have been submitted, and ten professional presentations have been made in conferences. Other outreach decision support tools include a 3-D model of Cotacachi, a documentary film on biodiversity, a Ecuador Water Watch Data CD (relational database), community soils reports, and training-of-trainers for community-based natural resources management. A landuse change analysis (1962-2000) has been completed and coupled with initial findings of land tenure change over the same period. Economics modeling on water values looked at "willingness to pay" and "contingent values" for irrigation and potable water while two soils models (EPIC and DSSAT models) were completed on erosion and productivity. The manuscript of a book (in Spanish) on soils of the Cotacachi area is completed. This information, in GIS platform, is being linked to changes in water, agrobiodiversity, and soils at the landscape and sub-watershed scales.

Through workshops and interactions with decision-makers in communities and in the region, this information is being translated and made into images so that Cotacachinos can understand how their actions affect the landscape and can plan for better choices.

The results of SANREM-Andes are poised to have a measurable policy impact on sustainable development in the Andes and other mountain areas. Through the Global Mountain Initiative and activities of Chapter 13, Agenda 21, the results and methods of SANREM-Andes are being applied in hill and mountain regions of Africa, Asia and the US. Canton Cotacachi is a very dynamic context for the study of trade-offs and conflicts arising in multiple stakeholder settings that are being impacted by globalization and decentralization. However, creative and revolutionary solutions are being produced by the citizens of Cotacachi—in collaboration with SANREM and other projects—which may well help the developing world re-think paths to sustainability. SANREM research will be central to the creation of these new models that, no doubt, will have a global audience.

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
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**July 2003  
Annual Report  
AND-01**

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## **Andes Coordination and Networking**

### **OBJECTIVE 1**

Provide timely administration and coordination support to Principal Investigators of Andean projects; link with Management Entity (ME) and other regional projects.

### **Achievements**

The Institute for Behavioral Research has provided budgetary oversight and has responded immediately to numerous requests for budgetary reporting from the ME.

Full-time coordinator (Mr. Shiloh Moates) provided backstopping at the field site in Cotacachi until May 15, 2003, when he was replaced by Xavier Zapata (Ecuadorian national) as the new in-country coordinator.

On-site transportation and housing is fully operational for team research. Due to full-time presence of Program Manager, Robert Rhoades, in Ecuador, the databases in Catholic University and Cotacachi (UNORCAC) were systematically revised and re-organized.

Mr. Milan Shrestha, Dr. Rhoades' Laboratory Manager at University of Georgia (UGA), assisted Dr. Rhoades in Ecuador through communications and coordination in the finalization of Year 6 proposals and budgets developed by Auburn, UGA, Ohio State, and Iowa

State University scientists and their host country collaborators.

### **OBJECTIVE 2**

Manage an organized central database and facilitate communication and information exchange among Andean SANREM researchers as well as among other partners and collaborators in the Andean region.

### **Achievements**

All three database nodes (Catholic, Cotacachi, and UGA) have advanced considerably in last year in terms of both data and integrated framework. Database is now approximately 90% complete. Requests for database information from Ecuadorian NGOs (Maquipucuna Foundation, UNCODEP, Heifer Project, Jantun Sacha/CDC), international development projects (World Bank, International Plant Genetic Resources Institute, and FAO), and academic institutions (Catholic University-Ibarra, University of Texas) have increased as evidenced by written requests for materials.

Three database workshops were held in Cotacachi under guidance of Monsarrath Mejia (Catholic) and Hernan Velasquez (MAG) to gain input from the cantonal government and UNORCAC on needs and outputs.

**Principal Investigator**  
Robert Rhoades

**Co-Principal Investigators**  
Juan Hildalgo

Rafael Guitarra

UNORCAC requested and received from the SANREM coordinator a full report of all data on Cotacachi collected by SANREM. SANREM-Andes was moved within UNORCAC to the Natural Resources unit for better integration with other projects.

In March, 2003, a four day intensive data integration coordination meeting was held in Quito and Cotacachi in preparation for the final year of Phase II. All activity projects and all but one PI were represented in the workshop also attended by Carlos Perez (SANREM Director) and Robert Hedlund (USAID). Two face-to-face meetings were held with the USAID-Ecuador Mission staff responsible for sustainable agriculture and natural resource management. Through collaboration with the Communities and Watersheds Program of CIAT (Jose Ignacio Sanz, Program Director) a decision was made to shift to "Toolbook" presentation of SANREM-Andes data (Cotacachi Andean Landscape) and the Atlas format (Canton Cotacachi) led by Laboratory of Geomatics, Department of Geography, Catholic University-Quito. On April 24, 2003, a SANREM-Andes/CIAT workshop and training session on Toolbook was held in Quito and attended by 18 individuals representing 7 Ecuadorian organizations. The basic SANREM-Andes Toolbook format was designed in this workshop which was followed by 3 additional working days of database development involving the SANREM and CIAT team.

### **OBJECTIVE 3**

Link the SANREM Andean project with the global interagency initiative for Chapter 13, Agenda 21 (Sustainable Mountain Development).

### **Achievements**

SANREM-Andes co-sponsored with the Mountain Forum (Latin America) an electronic conference on "Local Communities and Natural Resource Planning" in which more than 300 people participated representing NGOs, governments, international organizations and the private sector. This is triple the number which participated in a previous electronic forum held in 1998 on the same topic.

The proceedings have been published and widely disseminated.

Robert Rhoades gave a keynote address in the conference "Mountains 2020" held in Huaraz, Peru. An article by Robert Rhoades based on his keynote address in the International Year of the Mountain conference in Huaraz was published as part of the proceedings. Three leaders (President of UNORCAC and two council women) from Cotacachi also travelled to Peru and participated as well. In addition, SANREM-Andes sponsored an official conference trip to Cotacachi of delegates to the Second International Meeting of Mountain Peoples held in Quito, Ecuador (Sept. 20-24).

Robert Rhoades continued his membership on the Board of the Mountain Forum and contributed to several policy debates on mountains during IYM. On May 20, 2003, Rhoades presented a distinguished lecture on "Place, Identity, and Politics in Cotacachi, Ecuador" to the Fulbright Commission in Quito.

### **Advances**

**In Research:** This is a coordination activity which will not generate research outputs per se. However, it is the critical link between research activities responsible for managing the organized central database, coordinating all planned research activities, and dissemination to the broader international audience. As witnessed by achievements of the three objectives, it is clear that coordination and management of the integrated database is on target. Full-time coordination is in place, the database is organized and progressing, and SANREM Andes continues to play a visible role in advancing the objectives of Chapter 13 (Sustainable Mountain Development), Agenda 21, at the local, national, and international levels.

**In Capacity Building:** Capacity building has taken place primarily through the core research of each activity. Catholic University-Quito (where students are involved in the database management and assessment/mapping of water systems) and UNORCAC (Jambi Mascaric) where indigenous youth and technicians working in the project are taught how to

use computers, store data, take and manage photographs, and filing of documents. Through the community histories project (AND-02 and -07), local youth are trained in methods of oral history and landscape reconstruction. Numerous Ecuadorian and U.S. graduate students continue to be provided opportunity for advanced study and field research. UNORCAC, as an indigenous organization, and Catholic University have received SANREM support for improving human resources and skills through SANREM.

**In Scaling Up:** Scaling up has occurred primarily through the core research projects (AND-02, AND-03, AND-05, AND-07 and AND-08). However, coordination activity AND-01 and scaling up activity AND-09 have been the vehicles which provide the platform for outreach. As the activity which links with Agenda 21, Chapter 13, and International Year of the Mountain events, it provided information about SANREM's lessons learned and principles of sustainability. The lessons learned from SANREM have been scaled-up through publications (see individual projects) and participation in e-conferences and international events organized under the International Year of the Mountain. Evidence of scaling up can be seen in number of request for information and guidance from other integrated watershed projects.

**In Policy Impact:** SANREM-Andes databases and publications are being widely used in Ecuador and Tropical America to advise specific projects (e.g., the Choco-Andean Corridor funded by GEF) as well as large scale projects such as the trans-Andean pipeline running near the Nanegal site. SANREM-Andes has provided information for a new large-scale World Bank project on integrated watershed management for the Ambi Watershed (involving Cotacachi) in 2005. Multiple decision makers from Cotacachi have started a dialogue on natural resource policy needs as a result of SANREM initiatives.

**In Improved Environment In Natural Resource Management:** As the coordination activity, AND-01 facilitates the advances in improved environment and natural resource management of the other activities. By providing case studies, publications,

technologies, and methodologies on sustainable mountain development, the SANREM-Andes project plays a concrete role in advancing improved highland environment and natural resource management on a local, national, and global scale.

## Publications

### Book Chapters

Rhoades, R., J. Ives, and B. Messerli. 2002. Agenda para el Desarrollo Sustentable de Montanas. Pp. 601-614 in Sarmiento, F. (ed.) *Montanas de Mundo: Una Prioridad Global con perspectivas Latino Americans*.

## Other Major Outputs in this Period

### Proceedings

Rhoades, R. 2002. Human Organization and Development Policy for Natural Resource Management in Mountain Areas: Reflections to 2020. Pp. 25-34 in *Mountains Toward 2020. Proceedings of International Congress on Mountain Ecosystems*. International Congress held in Huaraz, Peru. Foreign Ministry of Peru: Lima, Peru.

SANREM-Andes and InfoAndina (Mountain Forum). Municipios Rurales y Gestion Local Participativa en Zonas de Montana. 2002. Electronic Conference in the Andes with a hard copy proceedings. 289 pages.

## Degree Training

Karla Vasquez, Ph.D., 2002-2003  
Shiloh Moates, Ph.D., 2003-2006

## Non-Degree Training

### Workshop

*Database Management* was attended by 18 person(s) and lasted 3 days.

# SANREM CRSP

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## Ethnoecology: Stakeholder Perceptions and Use of Andean Landscape Maps and Models

**Principal Investigator**  
Virginia Nazarea

### OBJECTIVE 1

To map local realities and stakeholder perceptions as input to “future scenarios” planning exercise.

#### Achievements

The legends/myths research related to natural resources has been completed and translated into English, Spanish, and Quichua and delivered to Abya Yala for publication in July, 2003.

The methods book *Recoleccion de plantas y conocimientos ancestrales: un Programa de Ensenanza y Capacitacion* on memory banking is being published by Abya Yala along with a teachers guide book *Programa de Ensenanza y Capacitacion*.

A book on local food and healing preparations and sayings is in draft form and will be published by Abya Yala in August, 2003.

Histories of eight participating communities were written jointly with AND-07 based on community history workshops and will be returned in booklet form to the communities in July as an expression of thanks.

Almost 20 hours of unedited film footage was shot on landuse, rituals, landscapes, and other aspects during the year. A CD entitled *Conservation with a small "C"*:

*Biodiversity Conservation as a Way of Life* will be completed in July.

The participatory 3-D model ("maqueta") was completed and presented to UNOR-CAC in March, 2003. The 3-D model was developed jointly with the Cotacachi communities and involved the various stakeholder groups defined in our work-plan.

Indigenous assistants in the ethnoecology project continued oral history research with taped and transcribed interview on landscapes (e.g., sacred and profane), indicators of well-being, and thresholds of overexploitation.

The manuscript on landscapes and memories among the indigenous people of Cotacachi will be finalized for the SAN-REM annual meeting in July, 2003.

### OBJECTIVE 2

To “groundtruth” scientific models, rules, and predictions regarding land use change.

#### Achievements

Activity in this objective has to move in tandem with the modelling and projections of other activities, especially AND-07 and AND-08. Due to delays in the apriori multitemporal landuse change analysis, our work on this theme will continue in year 6. Three students (1 Ph.D. and 2

**Co-Principal Investigator**  
Rocio Alarcon

Communities of  
Nanegal and  
Cotacachi

Magdalena Fueres

M.A.) will be fielded in summer, 2003, to look at issues connected with local visions of the past and the future. For Nanegal, where the modeling projections have been completed, different groups of stakeholders (stratified by age, gender, marital status) were engaged to interpret photo-simulations of the model. In Cotacachi, where the modelling is not yet finished, Cotacachi myths, legends, and other interpretations of the landscape have been collected and analyzed.

A final paper for the SANREM-Andes II monograph is in progress. This research will be presented in September, 2003, before the British Academy of Social Sciences in London. The structure and content of myths and legends have been examined and will be used to construct story completion tests as soon as the land use change models for Cotacachi are completed.

### **OBJECTIVE 3**

To put Decision Support Information to use by supporting local initiatives in biodiversity conservation emphasizing the role of local youth and of women.

### **Achievements**

AND-02 participated in and/or organized four workshops/biodiversity fairs with endangered Andean crops, traditional foods, women and health. In conjunction with the International Year of the Mountain (IYM) Peoples conference visit to Cotacachi, SANREM sponsored (with AND-09) a traditional food fair for the participants in which village women brought and prepared meals. More than 45 international participants interacted (from North America, Europe, Africa, Latin America and Asia) with dozens of local women and their families in the central Plaza in the SANREM organized fair.

The memory banking project has joined with AND-07 "Farm of the Ancestral Futures" by utilizing the youth-led memory banking component to help identify seeds and knowledge for the annual Ancestral farm planting in Ushipungo. Twelve school children interviewed elders, collected seeds,

and helped with the preparation and planting of the Ancestral farm. The demonstration garden at Jambi Mascaric continued this year with a strong emphasis on medicinal plants. Two local NGOs (UCODEP and Proyecto Ally Tarpuy) utilized the SANREM memory banking protocol and developed a bilingual brochure *Guardando Semillas* (Spanish) or *Muyukunata Wakaychinchik* (Quichua) for use in local schools.

The dissertation of Maricel Piniero, *Biodiversity and Marginality: Dilemma of Economic Development*, has been completed and readied for distribution. This dissertation is based on Nanegal and Cotacachi and focuses on women. The PI participated in the IYM meeting in Huaraz, Peru, and was interviewed on Peruvian national television on her work in Cotacachi on in situ conservation.

The video CD "Conservation with a Small "C": Biodiversity as a Way of Life" is 90% complete.

In preparing the Phase III proposal, contacts were made throughout the Andes (especially with genebank managers and legal scholars) to which our SANREM findings were distributed. Plans for year 6 include organizing an international conference on this theme.

### **Advances**

**In Research:** One Anthropology Ph.D. dissertation completed and defended (August, 2002). One memory banking manual and a teaching packet published in Spanish. Archives of life histories, myths, and legends, recipes and cures established in Jambi Mascaric. Two to three local publications of myths and legends, recipes and cures to be published by Abya Yala Press. Three to five scientific articles and presentations, including chapter for SANREM-Andes Phase II monograph. A video CD documentary on "Conservation with a Small c: Biodiversity Conservation as a Way of Life" is near completion.

**In Capacity Building:** Ph.D. student (from the Philippines) in Anthropology graduated. Two local indigenous assistants trained in data collection and computer data base management. Fifty local youth

trained in memory banking. Over 100 women trainees in Biodiversity Fair. Over 200 community members and visitors reached.

**In Scaling Up:** Adoption of memory banking and in situ conservation methods in the U.S. (Southern Seed Legacy, Native Seed Search, USDA Vietnamese Germplasm Collection and Conservation) and internationally (CGIAR System-wide Initiative on Urban and Peri-urban Agriculture, System-side In Situ Conservation Network, and International Potato Center/User's Perspective with Agricultural Research and Development Participatory Methodologies). In addition, materials and methods made available to in situ network in Peru and Bolivia through the Centro Internacional de la Papa and 142 communities of the UN program "Conservacion in situ de Cultivos Nativos". Also, NOAA Fisheries and The Rural School and Community Trust of the U.S. has started a project "Local Fisheries Knowledge Pilot Project" based on the memory banking concept. PI is a member of the advisory committee to NOAA Fisheries. Memory banking of indigenous knowledge associated with rice germplasm is being adopted by the International Rice Research Institute starting with the rice collection from Laos.

**In Policy Impact:** The activity is informing various bodies, including IPGRI and U.S. National Genetic Resources System, involved in advising governments and international agencies on issues surrounding legal and policy issues of access and benefits related to indigenous common property genetic resources. Funded by another venue, the PI will produce a policy-oriented monograph on traditional resource rights and legal frameworks in AND-02.

**In Improved Environment In Natural Resource Management:** Improved methods of community decision making), enhanced biodiversity in Andean communities, greater recognition and support of the role of women and children in biodiversity protection, and further spread to seed saving organizations of proven approaches to community in situ conservation.

## Publications

### Books

Nazarea, V. 2003. *Marginalities of the Mind: Countermemory in the Persistence of Biodiversity*. University of Arizona Press.

Nazarea, V. and N. Parra. 2003. *Recetas por la Vida (Compiladores)*. Quito, Ecuador: Abya Yala Press.

Nazarea, V., R. Guitarra, M. Piniero, C. Guitarra, R. Rhoades, and R. Alarcon. 2003. *Los Cuentos de Creacion y Resistencia*. Quito, Ecuador: Abya Yala Press.

### Other Major Outputs in this Period

#### Tools

Nazarea, V., M. Piniero, R. Rhoades, R. Alarcon, and J. Camacho. 2003. *Recoleccion de plantas y conocimientos ancestrales: Un Programa de Ensenanza y Capacitacion*. Quito, Ecuador: Abya Yala Press.

### Degree Training

Maricel Piniero, Ph.D., 1995-2002  
Juana Camacho, Ph.D., 2001-2005

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July 2003  
Annual Report  
AND-03

## Integrated Institutional Management: Social Capital, Institutional Capacity and Environmental Capital in the Andes

Principal  
Investigator  
Jan Flora

### OBJECTIVE 1

Identify and analyze Sustainable Natural Resource Management (SNRM) issues and decision points within local, regional, national, and international context.

### Achievements

Two papers were completed and one paper published. The papers involve synthesis of the collected data and information. This will aid in writing the three papers to which AND-03 is committed to for the book that will synthesize the accomplishments of the Andean team during SANREM-Phase II.

In Ecuador, Heifer Project-Ecuador (HP-E) has acted in a support role to the Union of Peasant Organizations of Cotacachi (UNORCAC), employing knowledge gained through the SANREM project, in particular the Advocacy Coalitions Framework. Seven workshops and one conference were carried out by HP-E with UNORCAC during this 12-month period on the following topics: leadership and environmental management (1) (see Objective 3 for more detail); participatory systematization process in the Pitzambitze and Cuichic Cocha watershed experience with a focus on incorporating young people of the community in the process of gathering information and

reflecting on the results with the objective of forming new leaders in UNORCAC (3); reflection on women's perspective on Natural Resource management (1); developing UNORCAC's Strategic Plan (1); design and discussion of UNORCAC's new structure (1); and analysis of UNORCAC's participation in the Cantonal Assembly (1). Of particular note among the workshops, UNORCAC requested that HP-E aid them prior to the Cantonal Assembly in September 2002 to help them carry out a more effective role in this experiment in citizen input into local policy. Also, HP-E conducted two workshops with UNORCAC that resulted in a change in structure of the organization that involves a degree of decentralization and an increase in the capacity to act more quickly in four areas: natural resources, economic development, social development, and political and organizational strengthening. There is a tendency for UNORCAC's leadership to call on their technical personnel to make decisions on issues that may appear to be technical, but are at their core, political. While reorganization does not directly address this issue, HP-E continues to work with UNORCAC to help them confront this issue. A clear recognition of the difference between political and technical issues is essential for full utilization of the Advocacy Coalition Framework in the organization's decision making.

Co-Principal  
Investigator  
Cornelia Flora

Florencia  
Campana

Mary Garcia  
Bravo

Maria Mayer  
Scurrah

The Pitzambitze and Cuychic Cocha watershed planning process received support from OCODEP, an Italian NGO, which collaborated with HP-E in elaborating the management plan, a process that was initiated with SANREM funds in year 4. SANREM played a modest role in the watershed planning effort in year 5 by supporting the three workshops mentioned above.

Grupo Yanapai in Perú has expanded the ACF methodology to an additional community in the central highlands. The subcommunity or annex of Rangra (within the larger peasant community of Quilcas) has initiated the ACF process. Grupo Yanapai conducted two workshops which resulted in defining five issues of importance to the community: 1) sub-community boundary issues, 2) insect problems in crops (potato weevil, potato blight), 3) animal disease, 4) school issues (frequently teachers fail to show up), and 5) lack of medical attention. Subsequent to the workshops a number of acute problems arose: the PETT (a government agency that defines community boundaries) defined the boundary between Rangra and the rest of the Community of Quilcas leaving Rangra's animal dipping facility outside its boundaries. This generated conflict between the parent community and its annex. More importantly, a landslide occurred in this mountaintop village, sweeping away two houses and damaging several others. The Civil Defense, a state agency, assessed the danger of future such occurrences. The mayor of the Municipality of Quilcas interpreted the report in such a way that it appeared that the entire settlement would have to be moved to the other side of the ridge. This was in the interest of the Municipality since most Rangra members are registered to vote in the closer neighboring Municipality of Ingenio; shifting the community to the other side of the ridge would put it more in the ambit of the mother community. These sticky issues will be dealt with in a workshop to be conducted in June 2003. Once the issues to be address are redefined in relation to the new realities, interviews with interested parties can be scheduled following the ACF methodology. The community of San Pedro de Saños has suffered from poor leadership and it has not until near the end of this reporting period that leadership that is acceptable to the majority of community members was elected. A

meeting is planned in June 2003 with the new community council to discuss their participation in the ACF methodology.

Two members of UNORCAC participated in a farmer tour in Peru, which involved farmers from the highlands (communities where Grupo Yanapai is working), coast (Cañete and Mala, Peru) and one Iowa corn and soybean farmer. HP-E did a mini-workshop with the two Ecuadorian participants prior to the visit, and, upon their return, the two Ecuadorian farmers presented what they had learned to UNORCAC. The farmer tour and exchange was supported by the USAID Mission in Lima, through the Association Liaison Organization exchange program between ISU and the National Agrarian University-La Molina in Peru. SANREM supported the participation of the two Ecuadorians in the exchange.

## **OBJECTIVE 2**

Develop Decision Support tools for encouraging sustainable natural resource management (SNRM) that are appropriate for different institutional levels and different institutional actors.

## **Achievements**

We planned to write up two manuals on how communities or secondary-level organizations can use participatory advocacy coalition research and practice to resolve problems among market, state, and civil society entities at the local and national levels. Progress on this objective has been slowed by illness of the graduate assistant on the project, who contracted hepatitis while in Peru in 2001. Recovery took nearly a year. Her thesis will be completed in fall 2003, which will generate articles, provide input for the CD described below, and allow time to work directly on the "systematization" effort. Plans during year six are to systematize the participatory ACF experience by developing a CD using the Toolbook software that incorporates different levels of analysis. It will be accompanied by a written handbook that discusses conceptual issues. In May 2003, Mary Garcia and Florencia Campana received training from CIAT on how to use the software. They will collaborate in the devel-

opment of the CD, which will be useful to peasant organizations, NGOs, and development professionals interested in implementing a similar research-action approach.

### **OBJECTIVE 3**

Disseminate SNRM Decision Support tools and publications to appropriate actors at appropriate levels throughout the Andes and beyond; train people to implement and evaluate efficiency and effectiveness of Decision Support (DS) tools.

### **Achievements**

A paper on strategic visioning for community building has been prepared for journal submission. The paper argues that creation of a common vision can only be accomplished by understanding the progression through which individuals and groups move from initial contact to networking to the development of collaboration.

We published an article that shows how the Advocacy Coalition Framework (ACF) relates to social and other kinds of capital and to community development in a book in Spanish that was organized by the Economic Commission for Latin America and the Caribbean (ECLAC or CEPAL), along with Michigan State University (See publications section). CEPAL is an important development forum within Latin America and the paper should reach development specialists throughout Latin America.

In Ecuador, HP-E personnel participated in various meetings and workshops related to making decisions around the issues studied using the Advocacy Coalition Framework (ACF). Most of those meetings were focused on how decentralized management of the Cotacachi-Cayapas Ecological Reserve might be carried out.

An example of this was the December 2002 conference organized by HP-E and UNORCAC on Leadership and Environmental Management. Funds came from SANREM and from Heifer Project-USA. It was primarily for middle and upper leadership of UNORCAC, but leaders of two other

indigenous secondary level organizations and NGOs that work with them were invited along with technical people in the Ministry of Environment. There were 13 presentations over a period of three days. The topic of greatest interest was decentralization and the environment (including issues of gender), with presenters from the Ministry of Environment, from the Global Environmental Fund, and from Ecociencia (a respected national NGO). Other presenters at the conference included the Director of the Ecuadorian Ecology Network (Coordinadora Ecuatoriana de la Ecología-CEA) and the president of FENOCIN, a national indigenous confederation.

In Peru, the organization Manuela Ramos, which works with rural women's groups, is using the advocacy coalition methodology throughout the country with grassroots organizations. They have found it a very effective, participatory way to involve women in natural resource decision-making through identification and interviews with the key institutional groups that influence agricultural and natural resource management in their geographic area.

In addition, expansion of the ACF methodology to additional communities in the central highlands of Perú will make the assessment of the ACF experience richer, since each community presents a different initial relationship with the NGO Grupo Yanapai. Colpar (where the ACF was first applied) has had a long relationship with Grupo Yanapai, Rangra (the second community) has worked with Yanapai occasionally in the past, and San Pedro de Saños has not had previous experience with the NGO. We should learn how central a long-term, trusting relationship is for implementing this methodology for coalition building around issues that are important to the community.

### **Advances**

**In Research:** In both countries, community groups as well as government agencies valued scientific knowledge and rules of evidence. There was frustration that there were not good measures of heavy metal contamination of water. In Ecuador, some NGOs and community groups had rules of evidence

that stressed ground truthing of scientific findings, showing a distrust of the source, rather than the type, of evidence. Presentations have been presented at the Rural Sociological Society, the American Association of Agronomy, the Community Development Society, and the Agriculture, Food and Human Values Society on advocacy coalitions and their role in sustainable agriculture and natural resource management.

**In Capacity Building:** The Masters thesis on multi-institutional decision-making for sustainable agriculture and natural resource management will be defended at the end of the summer. A paper will be presented to the FIDA Andes group in Peru.

**In Scaling Up:** Four NGOs in Peru are utilizing an advocacy coalition framework in participatory action research and community organizing. As Cornelia Flora has joined the board of directors of CONDESAN, continued presentations will be made in a variety of Andean countries.

**In Policy Impact:** SANREM information will be used in work with the World Bank in Peru to formulate a research agenda for the next five years.

**In Improved Environment In Natural Resource Management:** Determination of land boundaries, through the use of advocacy coalition methodology, has resulted in discussion of ways to overcome overgrazing in Peru.

## Publications

### Book Chapters

Flora, J. and C. Flora. 2003. Desarrollo comunitario en las zonas rurales de los Andes. Pp. 555-578 in Atria, R. and M. Siles (eds.) *Capital Social y Reducción de la Pobreza en América Latina y el Caribe: En Busca de un Nuevo Paradigma*. Santiago, Chile: Economic Commission for Latin America and the Caribbean and Michigan State University.

## Journal Articles

Banerjee, D. and C. Flora. 2003. Shared vision: A journey from Power to Empowerment. To be submitted.

## Other Major Outputs in This Period

### Research Reports

Campana, F. and M. Bravo. 2002. *The Discourse of Advocacy Coalitions: Desired Futures and Natural Resource Issues*. Heifer Project-Ecuador, Quito Ecuador.

Flora, J., C. Flora, F. Campana, M. Bravo, and E. Fernández-Baca. 2003. *Social Capital and Advocacy Coalitions: Examples of Environmental Issues from Ecuador*. Department of Sociology, Iowa State University.

### Degree Training

Edith Fernandez-Baca, M.A., 1999-2003

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
Funded by the U.S. Agency for International Development (USAID)**

**July 2003  
Annual Report  
AND-05**

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## **Water Resources and Environmental Education in Two Andean Watersheds**

**Principal  
Investigator**  
Bryan Duncan

### **OBJECTIVE 1**

Provide technical support to citizen monitoring groups for collection of data on water quantity and quality at Nanegal and Cotacachi sites.

### **Achievements**

Nicolas Gomez has become the principal actor in UNORCAC's water monitoring activities and other community-based activities. He is the main contact in Cotacachi regarding the water quality monitoring. He has represented SANREM and UNORCAC when assisting training courses. He is the principal representative of UNORCAC in the water work, and is UNORCAC's contribution to the water quality effort.) Mr. Gomez has also been asked to give numerous talks and to send reports of the water quality data collected in the last few years in the area. Data report requests included the Asamblea Cantonal, the municipality of Cotacachi and several NGOs. Nicolas Gomez has also conducted some training sessions on water quality monitoring in Cotacachi. The Ecuador Water Watch Data Base (a relational database) has been installed in Cotacachi and PUCE-Q, has been tested, and is now routinely used. Also significant progress (95% complete) has been done on the presentation online of the water quality data collected by citizen monitors, as part of the Global Water Watch (GWW).

Thousands of data graphs are now generated automatically and updated on a regular basis so as to only be few clicks away from anybody with Internet access. From June 2002 through April 2003, 36 sites on 29 different water bodies were sampled and 80 physico-chemical records generated. A presentation was made to the cantonal asamblea, and the UNORCAC annual general assembly. These presentations, will continue and will be a regular feature of the project into year 6. A 16-page, attractive publication in Spanish is about 60% complete. This publication will describe (for the Cotacachi area) water quality data and water monitoring activities and concerns, and will document the importance of water data for community-based action strategies, policy formulation, etc. It will be distributed to participating communities, local government, local institutions and other interested agencies and persons.

**Co-Principal  
Investigator**  
William Deutsch

A training of trainers course and training in data analysis and use of the Global Water Quality Database was planned to be conducted at Auburn University for participants from several countries. Inability of the two invited Ecuadoran technicians to obtain visas prevented their attendance. This need will be met in Ecuador, rather than the U.S., during year 6.

## **OBJECTIVE 2**

Establish partnerships and linkages for research, outreach, and training/education activities in Andean region.

### **Achievements**

Talks were conducted with the Mayor of the City of Cotacachi and leaders of the Asamblea Cantonal that has resulted in support for continuation of water monitoring activities in the Canton. The Asamblea Cantonal is a strong candidate for continuing support for water monitoring when the SANREM program concludes. The Mayor of the Municipality of Cotacachi and the President of UNORCAC have signed an agreement of cooperation to continue water monitoring activities in the Canton at the suggestion of SANREM personnel.

A presentation of the SANREM water activity in Ecuador was prepared and made to the natural resources office of the USAID/Ecuador mission, in response to USAID reorganization and formulation of USAID program objectives for Ecuador.

## **OBJECTIVE 3**

Assist Andean program leader with overall coordination of Andean project as well as backstop efforts at assessing the impact of water monitoring research.

### **Achievements**

Few activities have been conducted assisting the coordination of the Andean project, since there is a UGA student living in Cotacachi who has undertaken coordination at the study sites. Meetings, conference calls and a trip to Ecuador were part of the assistance in the assessment of the impact of water monitoring research.

Dr. Rosemary Fernholz, an Auburn sociologist, reviewed problems and opportunities for the ANDES water project. She produced a report: "Taking Care of Our Water: Institutional Experience and Prospects for CBWM in Cotacachi." Her methodology included 40 hours of

interviews of key persons in key institutions in Quito and Cotacachi. The result was a resetting of project strategy for year six to improve the probability of sustainability of water monitoring activities, and to maximize community participation. A proposal for year six activities was developed and submitted based largely upon the findings of her study.

## **OBJECTIVE 4**

Write a monograph on the topics of developing community capacity for bacteriological assessment of water and protection and restoration of aquatic resources.

### **Achievements**

Objective 4 has been broadened to include several documents, each for a different audience and each treating aspects of Community-Based Water Monitoring (CBWM). These documents will be widely distributed to assist and promote CBWM.

Leading to the writing of a synthesis monograph on Citizen Based Water Monitoring that is near completion, several planning meetings, conference calls, and a great deal of work was undertaken. This will be a multi-authored document of about 75 pages on the past ten years of community-based watershed assessments in SANREM and their impacts. The document will include the broader process of "water watch" activities in Alabama, the Philippines, and Ecuador, and extension of these activities to other countries that have not participated in SANREM. This book targets water group leaders, policy makers, educators, and members of the scientific community who interact with multiple stakeholders in some form of holistic watershed management. The book will be successful if it is used to better organize and initiate locally-led water projects that ultimately improve environmental quality, water policy, education, public health, and sustainable livelihoods.

The second document, a 16-page paper with photos, simple graphs, and illustrations describing the history and benefits of community-based bacteriological and physico-chemical assessments of drinking

and surface water in Cotacachi, is 60% complete. This short, practical piece will be a tool for use by local government decision makers, NGO technicians, and possibly other audiences.

The existing chemical and bacteriological training manual that had been revised was revised in October 2001 was not printed for use until year 5 at the resumption of training activities (see reference below). The audience is water monitors and trainees.

## **Advances**

**In Research:** From June 2002 through April 2003, 36 sites on 29 different water bodies were sampled and 80 physico-chemical records generated. A presentation was made to the cantonal asamblea, and the UNORCAC annual general assembly.

Research data was provided for the integrated database managed by Catholic University and developed by those responsible for the Toolbook CD.

Better access to internet has resulted in more timely submission of water quality data to the GWW database at Auburn. Improved computer equipment would result in better analysis and reporting and presentation of data to stakeholders at the project site in Cotacachi.

Kits have been maintained and supplied with fresh reagents. In the future it will be necessary for local partners to arrange for importation of kits in order to sustain monitoring activities.

**In Capacity Building:** Concerns about water quality and quantity are high in the agenda of local government and organizations in Cotacachi, Ecuador, and a water-monitoring project was started in 1999 to address these. Yet after 4 years, local peoples have not formed water watch organizations to carry out the tasks. Research on this issue has shown there are two main reasons for this: there are distortions that cause the undervaluing of water quality by local peoples and agencies, and issues of organization and logistics have not been given adequate attention in the project. There are many factors that exist at present time that favor a continuation of the

project: almost 100 people in the community have been trained as water monitors, there is a favorable political situation in the country at different levels, the project has direct channels to policy makers, the project and program have created much goodwill, and there is growing awareness of the value of safe water especially with a water related health crisis in a nearby area. What is needed now is education campaigns to correct the distortions, and a well-designed and participatory project strategy that will achieve the organizational and policy objectives.

**In Scaling Up:** Several conversations were conducted with the Director of the Institute for the Eco-Development for the Ecuadorian Amazon Region (ECORAE) leading to assistance with community-based water quality monitoring and environmental management in the Amazon region of Ecuador. Mr. Alex Hurtado Borbua, ECORAE Director, visited Auburn University in August 2002, seeking a formal agreement of cooperation between the two institutions. A memorandum of understanding (in English and Spanish) for academic and cultural exchange has been revised and is pending signatures. Discussions are taking place to define the details.

**In Policy Impact:** With SANREM facilitation an agreement was developed and signed between Cotacachi Municipality and UNORCAC to conduct water quality monitoring in the watersheds of the Canton as part of a general plan for natural resources management.

A member of the Cantonal Assembly, Jomar Cevallos, chairman of the cantonal committee on the environment, has a strong interest in water quality monitoring. He has provided entry into several communities, transportation for the UNORCAC monitor, and funds to print a manual. It is hoped that this relationship will lead to stronger partnering by local government.

Carlos Zorrilla, president of the cantonal committee on natural resources management, contacted SANREM for assistance in collecting data relevant to natural resource management planning. This committee will be a partner in the workplan for year 6.

**In Improved Environment In Natural Resource Management:** Bacterial surveys identified problems with surface and drinking water in several communities. Results were presented to leaders in each community who are taking actions to solve the problems. As a result of water monitoring in the Cambugan System that provides water to six large communities affiliated with UNORCAC, a distribution tank is being constructed with funds leveraged from German assistance. Fencing is also being erected to exclude animals from critical points in the system.

## **Other Major Outputs in This Period**

### **Research Reports**

Fernholz, R. 2003. *Taking Care of Our Water: Institutional Experience and Prospects for CBWM in Cotacachi.*

### **Tools**

Auburn SANREM Staff. 2001. *Manual de Certificacion Basica Monitoreo de Control de Calidad del Agua.* SANREM ME, Auburn University. Cotacachi Cantonal Asamblea.

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
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## **Sustainable Mountain Futures: Linking People and Information for Effective Landscape Decision-Making in the Andes**

**Principal Investigator**  
Robert Rhoades

### **OBJECTIVE 1**

Integrate data from the SANREM-Andes activities (land use/biodiversity, hydrology, ethnoecology, institutions) into a "Futures Scenario" modeling process at two Ecuadorian test sites (Nanegal and Cotacachi).

### **Achievements**

Data integration has been a major theme of SANREM-Andes in year 5. Accomplishments include (see also AND-01):

All three database nodes (Catholic, Cotacachi, and UGA) have advanced in data enrichment and an integrated framework as a result of a concerted effort on the part of all PIs to provide data (processed, analyzed, and raw) to the datanodes. Two workshops were held specifically for data integration purposes. ARCGIS (an ESRI Geo-referencing software) and Toolbook software were provided to Catholic University to upgrade their database capability. Database is now approximately 90% complete with all activities providing up-to-date information. Requests for database information from Ecuadorian NGOs, international development projects, and academic institutions have increased as evidenced by written requests for materials.

Three database workshops were held in Cotacachi under guidance of Monsarrat Mejia (Catholic) and Hernan Velasquez (MAG) to gain input from UNORCAC and the cantonal government on needs and outputs. Given boundary disputes between Imbabura Province and Pichincha Province, Catholic has invested considerable energy in reviewing existing maps and discussing with appropriate authorities issues of political boundaries. Monsarrat Mejia has also visited the planning office of the municipality to receive input on the proposed cantonal Atlas.

UNORCAC requested in November, 2002, and received from the SANREM coordinator, a full report of all data on Cotacachi collected by SANREM. SANREM-Andes was moved within UNORCAC to the Natural Resources unit for better integration with other UNORCAC projects. In May, 2003, SANREM provided a CD to UNORCAC with all available UNORCAC data to be used in planning other NRM projects.

In March, 2003, a four day intensive data integration coordination meeting was held in Quito and Cotacachi in preparation for the final year of Phase II. All activity projects and all but one PI were represented in the workshop also attended by Carlos Perez (SANREM Director) and Robert Hedlund (USAID). Through collaboration with the Communities and

**Co-Principal Investigator**  
Marcia Penafiel Cevallos

Monsarrat Mejia

Hernan Velasquez

Communities of  
Nanegal and  
Cotacachi

Jose Iquicio Sanz

Juan Hidalgo

Watersheds Program of CIAT (Jose Ignacio Sanz, Program Director) a decision was made to shift to "Toolbook" presentation of SANREM-Andes data (Cotacachi Andean Landscape) and the Atlas format (Canton, Cotacachi) led by Laboratory of Geomatics, Department of Geography, Catholic University-Quito. On April 24, 2003, a SANREM-Andes/CIAT workshop and training session on Toolbook was held in Quito and attended by 18 individuals representing 7 Ecuadorian organizations. The basic SANREM-Andes Toolbook format was designed in this workshop which was followed by 3 additional design days with the SANREM and CIAT team.

The multi-temporal LUC analysis originally led by Ing. Hernan Velasquez of MAG was re-oriented upon Dr. Rhoades' arrival in Ecuador. Although considerable information had been collected, the "ground truthing" portion of the work had lagged behind due to field difficulties. In January, 2003, Ing. Xavier Zapata was hired temporarily to help with the analysis. Amplified aerial photographs for the Andean study area were developed by Instituto Geografico Militar for 1963 and 2000. Using more modern techniques than available to MAG, Ing. Zapata has completed entering all units for analysis and is now finishing ground truthing with a botanist, Maria Claudia Jegovia-Salcedo (Ecuadorian national, Ph.D. candidate, Ohio University). Simultaneously, Dr. Rhoades started an analysis of land tenure to complement the LUC analysis since it is clear that tenure is a major determining force in how the land is used. Three representative communities (and former haciendas) in the high agroecological zone and three in the lower agroecological zone were selected for in-depth analysis. Archival research was started in the municipal office of Cotacachi and in Ibarra with the Catholic Church to determine how land tenure has changed during the same period of the aerial photographs (1962-2000). The multi-temporal LUC study of the Cotacachi Andean zone will be completed by July, 2003, and scenario building will take place immediately afterward. Xavier Zapata will intern at CIAT to learn appropriate models of scenario building.

During Year 5, Fabian Rodriguez, a doctoral candidate in Ohio State University's School of Natural Resources, analyzed socioeconomic data that had been collected in September and December 2001 in a survey of 80 rural households in Cotacachi, Ecuador. These data were used in a linear programming (LP) model of a representative farm; the model provides information about the value of irrigation water in the study area. Survey data were also used in a contingent valuation (CV) study of household's willingness-to-pay (WTP) for potable water; this analysis reveals a positive and statistically significant relationship between WTP, on the one hand, and household income and educational attainment, on the other.

The results of LP modeling and CV analysis are contained in the dissertation that Rodriguez has written under the direction of Douglas Southgate, a professor of natural resource economics at Ohio State University. The dissertation, which will be defended at the end of June 2003, addresses the benefits and costs of watershed management in Cotacachi. Research findings are also contained in papers that Rodriguez and Southgate will present in July 2003 at the Congress of the Latin American Association of Environmental and Resource Economists (ALEAR) in Cartagena, Colombia, as well as the research workshop in Cotacachi organized by SANREM-Andes. Finally, Rodriguez's dissertation research represents a point of departure for more detailed study in Cotacachi as well as field research in Quito watershed that he proposed for year 6.

In conjunction with AND-02 (and the Cotacachi Commission on the 3-D model of Cotacachi), a 1-10:000 scale 3-D model ("maqueta") was completed under the direction of Robert Rhoades and Shiloh Moates with assistance from Hernan Velasquez, Virginia Nazarea, and UNORCAC's natural resource unit. In a ceremony in March, 2003, the maqueta was dedicated to UNORCAC and transferred to Jambi Mascari's training seminar room where it is used in all of UNORCAC's and related workshops (approximately 12 per month) as a way to visually ground discussions. In cases of natural resource management projects, such as the

Pitzimbitze Watershed Project or the Cuichoca Project, the maqueta helps orient discussions and in resolving conflicts over water uses or boundaries. The 3-D model is the highest quality 3-D physical model ever developed in the Ambi Watershed region and will have many years of use as a decision support tool.

## **OBJECTIVE 2**

Test and refine the participatory future scenarios modeling exercise with a hierarchy of decision-makers (internal and external) connected with the landscapes around Cotacachi and Nanegal.

### **Achievements**

All future visioning testing in Nanegal is complete and two articles written and published. Results have been presented to conservation projects working in the Nanegal area, especially those connected with the Choco-Andean biological Corridor and the Cantonal Assembly NRM committee for Cotacachi. The Nanegal case study was also presented as an invited paper at the International Soil Science Congress in Thailand (August, 2002) and published in the proceedings.

The TC recommendation that future vision is too narrow a focus has led to a re-orientation of SANREM-Andes work toward support policy and planning at a cantonal and regional level. The multi-temporal landuse change analysis was transferred back to AND-07 (its original home) from AND-05 due to Dr. Rhoades' full-time presence in the field. Several operation problems were identified and a fresh start was initiated. Xavier Zapata (Ing. hydrology; now the assistant in charge) will receive training and backstopping at CIAT for the generation of future plausible scenarios related to LUC. In addition, an analysis of land tenure change is being undertaken to complement work of the LUC team (Rhoades and Zapata). Oral histories, archival work, and photo analysis is being undertaken in select communities and haciendas in the area. Jointly with the Participatory 3-D modeling exercise, stakeholders from the ecological reserve, indigenous communities, mayor's office, private

sector, and other government offices will join in a landscape planning meeting over the next few months in preparation for the future visioning workshop.

## **OBJECTIVE 3**

Extrapolate the Future Scenarios methodology to other global mountainous landscape/watershed projects as a contribution to Agenda 21, Chapter 13.

### **Achievements**

The envisioning methodology was presented to audiences in Huaraz, Peru (IYM meeting), North Carolina State University, University of Georgia, and before the International Congress of Soil Science in Bangkok, Thailand. In addition, a distinguished lecture was given before the Fulbright Commission in Quito on "Place, Identity and the Politics in Cotacachi, Ecuador" which included elements of SANREM research.

Robert Rhoades received for his research in mountain areas and on sustainable agriculture the "William A. Owens Creative Research Award" from the University of Georgia. This award is the top social science research award at the university. A 10 minute video on Rhoades' work was created for the UGA Research Awards banquet and contained footage of SANREM research in Cotacachi.

## **OBJECTIVE 4**

Evaluate the impact of land use and land management on biodiversity of flora and fauna in the study area.

### **Achievements**

Two reports on biodiversity in the Cotacachi Cayapas Reserve and its buffer zone have been completed by Dr. Marcia Penafiel. The study, *Flora and Vegetacion de Cuicocha*, which is a longitudinal study of biodiversity around the lake Cuicocha has been published by Abya Yala Press in Quito. Dr. Penafiel and her students have already delivered a final report entitled *Diversidad Ecologica del*

*Canton Cotacachi*. Three graduate degrees have resulted from this effort (2 M.S. and 1 Ph.D.). One U.S. Masters (Shiloh Moates) completed and partial fieldwork toward Ph.D. has been started.

The biodiversity component of the multitemporal study of landuse change has also been completed by Dr. Penafiel and her students. This work is being integrated into the GIS effort of Xavier Zapata/Ing. Velasquez and the Atlas research of Monsarrat Mejia at Catholic University.

## Advances

**In Research:** Integrated SANREM-Andes Database incorporating all Phase I and II results in multi-layered, systematic formats in three computer labs (Catholic-Quito, UGA, UNORCAC). A CD Atlas of the Canton Cotacachi is 80% complete (hard copy version dropped due to prohibitive cost).

Multi-temporal landuse change study (1962-2000) 80% completed with the possibility for thematic overlays based on researcher and planning demand. Initial research on land tenure started.

Ph.D. dissertation completed in June, 2003, on economics of efficient water allocation and rights for Cotacachi.

Papers solicited for monograph in English and Spanish on *Natural Resources Management in the Canton Cotacachi, Ecuador: Results and Lessons Learned* (final research document of Phase II work in Cotacachi).

Published monograph on *Flora and Vegetation of Cuicocha* by Marcia Penafiel, Central University, and CDC/Jatun Sacha.

Spanish version of *La Conservacion y el desarrollo integrado* of 1998 conference with CARE/AID published (English version released in 2002).

**In Capacity Building:** One U.S. SANREM Ph.D. graduated in May, 2002 (Eric Jones on colonization and natural resources); two Ecuadorian M.S. and one Ecuadorian Ph.D. completed (Marco Tipan,

Karla Vasquez, and Lincoln Nolivos) at Central University; four undergraduate research projects supported and one indigenous researcher (Carlos Guitarra) completed one year of technical agriculture college.

Training of above students and native collaborators in Quito and Cotacachi in research design, execution, and methods involving computers.

Provided training and backup to UNORCAC and the Municipality of Cotacachi in their ability to identify and solve sustainable agriculture and natural resource projects, primarily through the SANREM database and methods.

One conference and training session on database management provided by Catholic University to UNORCAC and Municipality of Cotacachi as part of the Atlas building process.

**In Scaling Up:** Sponsorship and participation in three International Year of the Mountain conferences in which SANREM's work will be presented (2 in Andes, 1 in Nepal).

SANREM-Andes co-sponsored an international conference with the Mountain Forum (Andes-Condesan) on "Local Communities and Natural Resource Planning" and an international year of the mountain conference in Huaraz, Peru, with the foreign ministry of Peru, and in September, 2002, a special "showcase" field trip to Cotacachi within the IYM conference "Second Gathering of World Mountain Peoples" Quito, Ecuador.

**In Policy Impact:** The biodiversity project (Marcia Penafiel) provides scientific information to Dr. Galo Rosales, Director of Protected Areas, in his management of the Cotacachi Cayapas Ecological reserve regarding permits and policies of tourism and access.

The economics project researched policy matters on water allocation, pricing, access, and rights of value to various agencies in the Cotacachi Canton (communities, municipality, canton, province, and nation).

**In Improved Environment In Natural Resource Management:** Innovative methods for helping communities define and plan for natural resource management over the long-term (e.g., invisioning methods).

Data on and publication about two case studies (Nanegal and Cotacachi) which will be useful to organizations and agencies developing programs and policies in Ecuador (e.g., GEF plans for a Choco-Andean biological corridor or environmental impacts of the trans-Andean pipeline near Nanegal) and the new Ambi Watershed project to start in 2005.

Planning for a management plan for watersheds (e.g., Pitzimbizi) in the Cotacachi area which can serve as a model for other mountain areas is underway..

## **Publications**

### **Books**

Penafiel, M. 2003. *Flora y Vegetacion de Cuicocha*. Quito, Ecuador: Abya Yala Press.

Rhoades, R. and J. Stallings. 2003. *La Conservacion y el desarrollo integrado: Lecciones aprendidos al vincular pueblos, proyectos y politicas en america tropical*. Quito, Ecuador: Abya Yala Press.

## **Other Major Outputs in This Period**

### **Conference Presentations - Papers**

Rodriquez, F. and D. Southgate. 2003. Local resolution of watershed management trade-offs: The case of Cotacachi, Ecuador. Paper presented at the Congress of the Latin American Association of Environmental and Resource Economists (ALEAR). Cartagena, Columbia. July.

### **Proceedings**

Rhoades, R. and V. Nazarea. 2002. *Indigenous and Scientific Conceptions of Land-use Management: A Case Study from Ecuador*. Pp. 149-241 in Soil

Science: Confronting New Realities in the 21st Century. Proceedings of World Congress of Soil Science. Bangkok, Thailand.

### **Working Papers**

Penafiel, M. 2002. *Estudio Multitemporal de los Cambios de Vegetacion del Canton Cotacachi y sus Alredores*. Preliminary draft. 20 pages.

Penafiel, M., M. Tipan, L. Nolivos and K. Vasquez. 2002. *Diversidad Ecologica del Canton Cotacachi*. Preliminary draft. 18 pages.

### **Degree Training**

Eric Jones, Ph.D., 2000-2002

Lincoln Nolivos, Ph.D., 1999-2002

Karla Vasquez, M.S., 1999-2002

Shiloh Moates, M.A., 2000-2002

Brian Campbell, Ph.D., 2000-2004

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## Effects of Land Use Change on Long-term Soil Fertility, Crop Productivity and Water Quality in Cotacachi

Principal Investigator  
William (Bill) Miller

### OBJECTIVE 1

Select with local community guidance a representative first-order watershed to which the model developed in this activity will be implemented.

in the adjacent valleys. The whole area (including the high elevation paramo (grasslands), which is not inhabited) has about 250 km<sup>2</sup>.

Co-Principal Investigator  
Franz Zehetner

### Achievements

Various first-order watersheds within the Cotacachi area were visited during Summer 2000. The specific topography of the study area - streams deeply carved into the landscape, and the major portion of agricultural lands on the surrounding plateaus draining parallel to the streams towards the toeslopes of the volcano - suggested the selection of the Río Yanayacu watershed, which drains the entire southern slopes of the Cotacachi volcano. It extends from the town of Cotacachi west to Lake Cuicocha, and northward up the slopes of the volcano. The watershed has an area of approximately 50 km<sup>2</sup>, its elevation ranges from 2,500 to 4,000 masl covering a wide range of slope gradients, soil types, and agro-ecological zones.

### OBJECTIVE 2

On a field-scale, assess long-term changes in soil fertility, crop productivity, as well as nutrient export by erosion and runoff using an erosion / nutrient cycling / crop growth model (EPIC = Erosion-Productivity Impact Calculator).

### Achievements

Local involvement included mainly officials of the local peasant organization UNORCAC. Later (in summer 2001) UNORCAC asked us to expand our studies to cover all their 41 communities, which are located on the northeastern and southern slopes of volcano Cotacachi and

Soil characterization was finalized during the first half of Year 5. As reported previously, the crop growth modeling was conducted using the DSSAT crop growth models (Decision Support System for Agrotechnology Transfer) rather than the originally proposed EPIC model. The DSSAT models are more mechanistic and have been used in northern Ecuador by our collaborators from CIP (W. Bowen et al.). They have calibrated the crop specific DSSAT input parameters for local crop varieties, which will be utilized in this activity to improve the quality of model predictions. All soil and climate related model input parameters originally collected for the EPIC model were used, with minor adjustments, as inputs for the DSSAT models.

Unfortunately, the growing season of 2001/2002 was unusually dry in the Andes of northern Ecuador, which resulted in drought induced crop failure in the established field plots. However, the DSSAT model predictions were successfully validated using yield data from the previous year. An extensive soil database and corresponding soil fertility maps were generated covering all 41 Andean communities of UNORCAC. The DSSAT model was used to examine the long-term effects of nitrogen fertilization, residue management, and irrigation on crop yields in two contrasting agro-ecological zones. Using the soil database generated in this activity, these model simulations were extrapolated to a wider area. The soil fertility status of the entire Andean Cotacachi area was analyzed and limiting factors to crop growth were identified in the different zones of the area. A book chapter was prepared that describes the soil fertility status in the area and relates this work to earlier soil fertility studies in the Ecuadorian Andes, and discusses avenues for restoring and maintaining soil fertility as the basis of sustainable agricultural production in the Cotacachi area. During YR5, priority was given to validating and finalizing the crop growth modeling and soil fertility mapping as the basis for these outreach activities.

Since the co-PI of this activity will be in Ecuador most of YR6, the planned training activities and workshops will be held this coming fall. An ongoing training activity on “Soil fertility management: Interpretation of soil testing in the local context” will be held from September to December 2003, and a workshop entitled “Soil fertility status in the Andean communities of Cotacachi: Implication for management” will be held in October 2003.

### **OBJECTIVE 3**

Scale up the field-scale modeling outputs to the watershed level using raster GIS.

### **Achievements**

Rainfall-runoff studies have revealed that the soils in the study area are generally very stable and thus not very susceptible to sheet erosion. However, in the presence of amorphous volcanic minerals, the

soils tend to get supersaturated, and in many parts of the study area, the recent soils are underlain by very compacted paleosols with restricted water infiltration. This favors mass-wasting, the downhill flow (solifluction) or slide of soil material on steep slopes. Evidence of this type of soil erosion is found throughout the study area. In light of these findings, the work under Objective 3 has been adapted to capture the impact of land use change on mass-wasting phenomena rather than on sheet erosion. An attempt was made to quantify mass movements using aerial photographs and to compare the size of erosion gullies between the 1960s and the present. However, it turned out that these landslide-type movements have not been of a magnitude large enough to cause changes visible in aerial photographs.

Based on the rainfall simulation experiments, a journal article entitled *Erodibility and runoff – infiltration characteristics of volcanic ash soils in the Andes of northern Ecuador* was prepared for publication in “Catena”. In this article, the runoff – erosion behavior of the Cotacachi soils was described in relation to landscape, soil properties, and management, and comparisons were made to other soils from the Ecuadorian Andes and different soils from other parts of the world. Due to Rhoades' presence in Ecuador during Spring 2003, he has taken the lead in continuing and refining the land use change analyses in collaboration with Xavier Zapata. Progress on this activity will therefore be reported in AND-07.

### **OBJECTIVE 4**

Route sediment and runoff through the landscape and evaluate nutrient export and water quality changes.

### **Achievements**

Due to a modification in the AND-08 workplan during year 4, activities originally planned for Objective 4 have been incorporated into, and are therefore being reported under Objective 3. Objective 3 illustrates that this activity has been completed.

## OBJECTIVE 5

Incorporate the model into the “Future Visioning Methodology” and case study as well as show local people how to interpret and use the model results as a decision support tool.

### Achievements

The manuscript of a book on the development, erodibility, and fertility status of the Cotacachi soils is completed and will be published by Abya-Yala during year 6.

Due to the on-site presence of the co-PI during most of year 6, the workshop and training activities have been postponed until Fall 2003.

### Advances

**In Research:** The land use change analysis (LUC) has been further refined by R. Rhoades and X. Zapata (achievements pertaining to LUC are therefore reported in AND-07).

A soil fertility database covering all 43 (41 Andean and 2 subtropical) UNORCAC communities has been completed.

Two manuscripts (soil erosion, soil fertility) are completed and ready for submission to peer-review journals.

**In Capacity Building:** Nicolas Gomez, our local activity coordinator, has been trained in the interpretation of soil testing results with respect to land management and fertilizer recommendations.

**In Scaling Up:** A geo-referenced soil database and GIS coverages of individual soil properties are completed.

Using these GIS coverages of key soil properties, the modeling results have been extrapolated from the communities studied in depth to a wider area covering the cultivated slopes around volcano Cotacachi.

**In Policy Impact:** The on-site presence of the co-PI during most of YR6 allows for continued training and dissemination efforts in Fall 2003. Policy impacts of this activity are therefore expected after this phase of more intensive outreach.

**In Improved Environment In Natural Resource Management:** The on-site presence of the co-PI during most of YR6 allows for continued training and dissemination efforts in Fall 2003. Impacts on improved environment and NRM are therefore expected after this phase of more intensive outreach and after the publication of the soils book in YR6.

### Publications

#### Book Chapters

Zehetner, F. and W. Miller. 2003. Soil fertility and Crop Growth in Andean Communities of Northern Ecuador. To be published in Zehetner, F. and W. Miller. (ed.) *Los Suelos Volcanicos de La Sierra Norte, Ecuador: Genesis, Fertilidad y Erodibilidad*.

#### Journal Articles

Zehetner, F. and W. Miller. 2003. Erodibility and runoff – infiltration characteristics of volcanic ash soils in the Andes of northern Ecuador. Manuscript to be submitted to *Catena* in Fall 2003.

### Degree Training

Franz Zehetner, Ph.D., 2000-2003

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
Funded by the U.S. Agency for International Development (USAID)**

**July 2003  
Annual Report  
AND-09**

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## **Regional Node for Training and Upscaling of Community-Based Natural Resource Decision-Making**

**Principal  
Investigator**  
Robert Rhoades

**Co-Principal  
Investigator**  
Magdalena Fueres

### **OBJECTIVE 1**

Establish a training and up-scaling node within Jambi Mascáric (UNORCAC) which will serve as the center of scaling up activities for landscape level work (especially the sustainable futures visioning methodology, memory banking, water quality and quantity, leadership training in NRM) within the Andean region and for other mountainous areas.

and UNORCAC for the repatriation of Andean crops. In this process, 20 varieties of Oca, 20 of Mashua, and 4 varieties of Achira were obtained. In addition, through AND-02 and the youth-led memory banking project, many local crops (habas, quinia, peas, potatoes, chocho, etc.) were collected and planted at the farm. This activity is linked with AND-02 where 12 school children conduct memory banking studies with their elders.

### **Achievements**

Since June, 2002, the Jambi Mascáric office has organized or assisted in more than a dozen meetings, including database meetings with Catholic, biodiversity fairs, traditional food fairs, hosting of IYM visit to SANREM projects, commission on 3-D model, and workshops on using GIS at the local level. During March, 2003, this activity hosted and coordinated visits and field trips of the SANREM team, collaborators, the SANREM Director and SANREM CRSP CTO.

The SANREM office at Jambi has become the center of research data for the site and attracts the interest of NGOs, government offices, and researchers interested in data on Cotacachi. It has also become the center of water coordination for several major water systems in the Andean zone, including the two largest potable water systems (Chumavi and Cambugan). The office is coordinating as well the study of Catholic University on the geography of water systems, including mapping of Cambugan and a water survey of needs and uses.

Planted the garden demonstration/plant dissemination (at Jambi Mascáric) as well as the Ancestral Futures Farm in Ugshipungo and organized weekly "mingas" (community self-help) for cultivation and harvest. Through SANREM coordinator, Mr. Shiloh Moates, a link was made between the INIAP genebank

### **OBJECTIVE 2**

Establish a functional data center at Jambi Mascáric headquarters with dynamic linkages to comparable facilities at UGA (USA) and Catholic University (Quito) to house case studies and summaries of Phase I/II findings for use at Cotacachi and other sites in the Andes.

## Achievements

The activity has coordinated planning meetings between the Ministry of Agriculture (via Hernan Velasquez) and Catholic-Quito (via Monsarrath Mejia), and the Cotacachi site for the preparation of decision support tools, the natural resource atlas, and the water surveys.

Workshop held with Ing. Velasquez on Geographical Information Systems using the program 'ARCVIEW' for UNORCAC technicians.

Complete re-organization of the Jambi SANREM files (both computer and hardcopy) and the initiation with AND-02 of a communities histories project as a way to return information to the communities. SANREM data is being organized by communities and summarized into a booklet on their history. This community history activity has opened new doors for the multitemporal landuse project and the land tenure project.

## OBJECTIVE 3

Conduct training on site in methodologies, technologies, land use and water systems for interested individuals and organizations that have the ability to further scale-up the findings of SANREM.

## Achievements

The IYM meeting (World Meeting of Mountain Populations; Sept. 17-22, 2002) in Cotacachi was successfully organized and 45 visitors from 18 countries around the world witnessed SANREM's work.

"Maqueta" (3-D Model) developed and placed into operation within Jambi. Training for its use by NGOs undertaken.

Council Woman Magdelana Fueres continues as SANREM's main contact and collaborator in Cotacachi. She organizes, often with SANREM help, approximately 8 workshops per month and also directly assists with the community histories project.

Planning advanced for the Phase II SANREM conference in July, 2003.

## Advances

**In Research:** This is an outreach activity mainly centered in UNORCAC (Jambi Mascaric) which provides and supports the personnel who conduct research for SANREM core research activities.

**In Capacity Building:** This project does not conduct research per se. It is a support and outreach project of the local indigenous communities. The project houses and facilitates the efforts of Ecuadorian and U.S.-based SANREM researchers. The field coordinator is headquartered in the Jambi SANREM office. The research assistants, computers, and information files are found here. All training occurs in the Jambi Mascaric compound under this project. The activity supports a number of training workshops, including training of trainers, during the year which are described under the other projects (see AND-02, -03, -05, -07, -08). While the most significant capacity building expected to occur in Cotacachi and Nanegal was through training of individuals in NGOs, government agencies, and international organizations, we expect a spread effect of the efforts. During the year, nine training workshops on biodiversity, water, and women were held. The office supported the research activities of 7 graduate students (3 Ecuadorian, 4 U.S.).

**In Scaling Up:** SANREM-Andes collaborators in UNORCAC, the Mayor's office, NGOs and national indigenous organizations have introduced carrying SANREM's methods and findings to interested parties in Ecuador and other Andean regions. Auki Tituana (Mayor of Cotacachi) is possible Presidential candidate for the Republic of Ecuador, Rafael Guitarra (collaborator in AND-02 and AND-03), is the new President of UNORCAC. Magdalena Fueres, SANREM-Andes main counterpart in Cotacachi, is a Council woman of high prestige. In their national and international speeches, they typically refer to SANREM. In addition, since Cotacachi was a venue for one of the International Year of the Mountains conferences, over 50 international visitors saw SANREM research impacts directly. Cotacachi is an ideal laboratory for scal-

ing-up of SANREM research. It has gained international acclaim for its participatory approaches to natural resource planning. The indigenous leaders who are involved in SANREM are widely respected in the Andes. Mayor Auki Tituana is a possible presidential candidate in Ecuador's upcoming elections. He has adopted several SANREM projects as his own and promoted them throughout the Canton (e.g., memory banking). Finally, with one of the three official International Year of the Mountain Conferences coming to Quito (with an official trip to Nanegal and Cotacachi) SANREM was globally highlighted.

**In Policy Impact:** Since Jambi Mascaric receives and provides data to many visiting technicians, government officials, and foreign consultants who come to the area, this activity is central to influencing new policies and programs related to the Cotacachi Cayapas Ecological Reserve, water planning and policies, landuse and agricultural issues, and tourism. Whenever new projects arrive in the area, they are shown SANREM results and advised of the participatory approach. During March 2003, a cross-section of stakeholders in the Canton Cotacachi participated in a SANREM-led meeting in which policies and planning for the cantonal natural resources plan was discussed. One impact of the International Year of the Mountain has been the integration of mountain perspective into national policies of countries such as Ecuador.

**In Improved Environment In Natural Resource Management:** Phase II results from Cotacachi serve as a model of how to do community-based natural resource management. The Cotacachi landscape is an ideal location to demonstrate how multiple stakeholders working in multiple scales can arrive at a common vision plan. SANREM data is guiding the formation and implementation of the Pitzimbizi watershed plan for Cotacachi. More significantly, however, will be the utilization of both Nanegal and Cotacachi as case studies and inspiration for other communities and project engaged in NRM planning.



# Decision Support Systems

## Project Overview

### **Project Goals**

The SANREM Decision Support System (DSS) project has three main thrusts: (1) the development of the integrated suite of economic, biophysical, and environmental models, (2) the application of these models to studies on specific issues identified by senior decision makers, and (3) development of national capacity to use the DSS through collaboration in research and training. Roughly comparable effort has been undertaken in Mali and Kenya with regional implications for West and East Africa respectively. The models are placed in a GIS framework that allows use of spatially explicit data and analysis that provides for vertical and lateral scaling.

### **Partners**

Senior decision makers at the level of the Office of the President and the Permanent Secretaries in the Ministries of Agriculture, Rural Development, Finance, and Environment actively participated in the planning and evaluation of the methodological development and the specific issue-based studies that were done. Scientists and Extension workers in the national systems were actively involved in planning, conducting research, evaluating outcomes and reporting results from the studies done in Sikasso and the Central Rift Valley. Farmers and village elders were very generous in sharing their knowledge and wisdom.

### **Year Five**

Multi-year field studies and analyses were completed in year 5, permitting the preparation of two major compendia of papers on applications of the DSS to issues and options defined by national partners. These included companion studies conducted on the impact of food security and natural resources management in the Sikasso Region of Mali and in the Central Rift Valley of Kenya. These studies evaluated options for modification of farming systems including new germplasm and resource management for key crops and other technology innovations representing products of previous national research. The consequences of these new systems were evaluated for the year 2015, relative to the goal of the World Food Summit to reduce hunger by 50%.

Methodological developments continued in year five with major emphasis on developing tools to allow use of the DSS models by less experienced analysts. Methods were also extended for the acquisition and application of satellite based information for use in the DSS. The FAO method for estimating risk of hunger was modified and extended by coupling it with the integrated DSS system for analysis. Methods to achieve the WFS goals involved both intensification and extensification of farming systems. Studies were conducted at farm, sub-national, and national levels.

Results were expressed in terms of both consumer and producer benefits, changes in risk of hunger along with evaluation of the impact on natural resources of the various farming systems that were modeled. These studies involved spatially explicit methods to define sampling frames, both rapid appraisal and detailed interviews at village and household levels, a study on factors affecting adoption of new technology, and a preliminary cross site evaluation of the assessment of the projection of outcomes in East and West Africa.

These studies produced quantitative estimates of both the economic and natural resource implications of the options for use of new technology to meet future food security needs. With current population projections (including estimates of the influence of HIV-AIDS), present farming systems are not predicted to produce enough food to sustain even the current level of nutrition for Malians or Kenyans. In the face of increased demand, the price of food for consumers is sharply increased in 2015. Present farming practices result in continuing soil erosion and other degradation of natural resources in 2015. The introduction of new technology on those lands now under cultivation (intensification) can only partially meet future goals of food security and is associated with continuing degradation of natural resources. In both Mali and Kenya, the DSS suggests that annual productivity increases of about 5% per year would be required to meet the objectives of the WFS with regard to risk of hunger. Achieving this rate of growth will be a daunting task.

This suggests that newer technology, perhaps including the use of genetically engineered crops, may be necessary to meet these goals. Conceptually new schemes may be required. At the very least, the results of these studies show decision makers that a concerted and aggressive effort, well planned and executed will be needed to achieve the goals of the WFS while making sustainable use of natural resources. The regions chosen for more intensive studies in Mali and Kenya are the most productive in each country and will continue to contribute to achieving the national goals of the WFS. Extensification, bringing more (often less

productive) land into cultivation, appears to offer temporary relief at the expense of long term sustainability as these lands are more rapidly degraded.

In qualitative terms, these results are not totally surprising to either national decision makers or concerned donors. However, the DSS allows general impressions to be expressed in quantitative terms and allows for more precise evaluation of the relative merits of the policy and technology options that must be considered for future food security needs. The ability to concurrently evaluate the positive and negative natural resource consequences of decisions about economics and hunger will help to ensure that the long-term sustainability of food systems is considered in a holistic way. Results expressed at sub-national and farm levels provide insight into the relative merits of various investments by location within the countries. Lateral and vertical scaling adds important new dimensions of quantitative inputs to decision makers at the national level.

While the major thrust of these studies applies to planning and evaluation at the national level, the application of the DSS at sub-national and farm levels is necessary to fully understand the implications of national policies and decisions at local levels. Similarly, the results of the application of the DSS at local levels, with lateral and vertical scaling, forms the basis for extrapolation of results to other regions and to understand how aggregate performance at the farm level leads to national results.

Studies are partially completed to assess the impact at the national level in Mali of the FAO Special Programme for Food Security as it has been undertaken at the farm level in selected provinces. The ability to scale up the farm level results to the national level is a critical element of assessing the utility of this program. This is a pilot study to evaluate the use of the DSS as an assessment tool.

The impact of climate change in the tropics is estimated to have a substantial impact on food security. Initial studies in Mali and Kenya are being completed and extended in year six of SANREM II to compare and contrast the impact of climate change and

to place this in the context of the overall assessment of options to achieve sustainable food security in the future.

### **Capacity Building**

In year five, a shift in emphasis placed more focus on in-country workshops to evaluate outcomes of research that was being completed and to more effectively engage both research partners and decision makers. In-country training workshops were conducted in Mali and short term training of scientists and civil servants in the Government of Kenya was done at Texas A&M. The involvement of national players throughout all stages of the project helped to ensure that they had the ability to use the methods themselves and that there was confidence in the product of the assessments.

### **Products**

The products of this project include (1) methods for use in making more informed decisions on the sustainable use of natural resources to improve food security and economic activity, (2) related and relevant databases organized for application to future studies using these methods, (3) methods for accessing and using the models and data, (4) a cadre of scientists and analysts in national research and operational organizations trained to use these methods, (5) progress toward establishing an institutional home for the DSS that will be sustained over time, (6) results of a series of issue-based studies addressing issues deemed to be of high relevance and priority by decision makers at various levels of government, and (7) initial progress toward the application of these results to countries adjacent to the host countries where the preponderance of research was done.

### **Users**

The users of the products of the DSS include: (1) the national and regional collaborators that have participated in the research and capacity building, (2) policy makers at senior levels of government including ministries dealing with agriculture, rural development, natural resources, environment and overall integrated planning at the national level, (3) similar actors at sub-national levels of government, (4) extension co-workers that have participated in

field research and capacity building, (5) analysts in the ministries of government that will use the methods to produce results for decision makers, (6) and selected NGOs and para-governmental organizations such as the Malian Cotton Corporation and the Kenya Institute of Policy Analysis.

The products of research in this project are generally equally applicable to use in the U.S. Models and are designed to be generic frameworks that are made specific by the questions asked and the input data. For instance, the development of improved farm and sector level economic models and the linkages between these models and with natural resource management models provide enhanced utility in Texas and other states, bringing to bear such features as the added ability to perform risk assessment on options for policy and technology. Methods to link remotely sensed satellite information with natural resource and weather databases for near-real-time operational decisions are very applicable to farming and ranching operations in the U.S. The methods to assess trade-offs between intensification and extensification of agriculture and the resulting impact on the sustainability of natural resources fit perfectly when transposed from Africa to the U.S. The development of the middleware for linking related models and databases under a "user-friendly" framework has high utility in the U.S. and in other countries. The suite of integrated models is useful to donors for developing countries in assessing their investment options both at the planning and evaluation stages.

### **Overview of the DSS Project Structure**

There are seven activities in this project. The first is primarily for project management – both administrative and scientific. The second activity involves development of methods for application at global levels. The next three activities are primarily directed at development of economic, biophysical, and spatial methodologies that contribute to the DSS. The sixth activity is directed at the application of the methods developed under the preceding sections for application to specific scenarios or issues that support decision makers in Mali and Kenya. The last activity deals with delivery systems and applications of the DSS

While individual disciplinary methodological components of the project are documented under separate activities, the development was done collectively and with interdependent sharing of data and outputs with the output of one model serving as input to another – in an iterative manner. The acquisition and management of spatially explicit satellite imagery was done in large measure under the global activity and both the methods and data shared across the other development activities. Because of the rich interaction between the activities involved with development of methods and their application to products of the multiple analyses, there is considerable commonality in reporting between the various activities.

# SANREM CRSP

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**July 2003  
Annual Report  
DSS-20**

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## Project Management

**Principal  
Investigator**  
Neville Clarke

### OBJECTIVE 1

Provide a central focal point for scientific and administrative functions of the project.

### Achievements

The overall administration, planning and reporting at the project level has been successfully completed for Year Five. The Year Six workplan for the DSS was successfully completed and approved with a substantial restructuring of the activities to better reflect products and outcomes. Restrictions on travel, especially in Kenya, have caused delays in research and related workshops that were planned for late spring. This means that some goals intended for Year Five will be delayed until the beginning of the second quarter of SANREM Year Six activity on the DSS. As a result of the extension of SANREM II to include Year Six, there are some efforts intended to summarize across the full duration of the project that will be done at the end of Year Six rather than at the end of Year Five.

Two major compendia of studies on the DSS were produced in Year Five. Both of these are found at the CNRIT website which is <http://cnrit.tamu.edu>. The first is a major compendium on the results of studies of food security and natural resource management in the Sikasso region of Mali. The second compendium, reporting studies conducted in the

Central Rift Valley and more recently completed, is found at the same website. This paper remains in draft form until there is opportunity to present it and discuss it with national partners and Kenyan decision makers at the workshop, which has been delayed because of travel restrictions. It is the intent in Year Six to draw several formal papers from these compendia.

A preliminary paper has been written on cross-site assessment of general principles for application of the DSS, but will develop a substantially more complete picture when specific engagements with partners occurs on this subject in Year Six. More specific studies comparing the impact of climate change across Africa will also be available.

### Advances

**In Research:** Anticipated results included cross cutting assessment of models and methods that would provide synthesis for broad application by developing country partners and analysts in government on a global scale.

Actual results show that the models comprising the DSS have been brought together and meta-models have been used to facilitate and simplify these linkages. Relevant legacy databases for these studies are being organized for access through the SANREM and CNRIT websites. Progress has been good on developing spreadsheet portals for less experi-

enced users to access and use the DSS. The cross putting “lessons learned” synthesis is provided in preliminary form and will be expanded with results from the year 6 studies. Results provide a contrast between East and West Africa showing the interplay between ecological, social, and economic factors affecting the adoption and use of technology and policy in meeting future needs for sustainable methods to meet food security goals. The comparison of development and application of methods that can be seen from preliminary analysis points toward a final DSS product that will have broad geographic and political applications at multiple levels of scale.

**In Capacity Building:** The compendia on food security and natural resource management in Sikasso and the Central Rift Valley have been completed, as anticipated, and will provide a synthesis of results and models that can be broadly used for capacity building. These two documents are being considered for publication in book form. Taken together with similar compendia on earlier studies, these are central to capacity building efforts that occurred in Year Five.

**In Scaling Up:** A major overall objective of the DSS is to provide tools for scaling up and down, both from the economic and environmental standpoint. Scaling would occur between economic models at farm and political levels and at geographic levels from farm to watershed and to subregional and national levels. Progress in Year Five has provided new methods for linking biophysical and economic models in a highly effective and simplified way through the use of spatially explicit meta-equations that provide easily usable mathematical expressions of biophysical outcomes as input to economic models in a geographically coherent manner that allows direct comparisons between environmental and economic analyses at multiple scales. Using DSS methods, the use of geographic equivalence as a means of evaluating lateral transfer of knowledge and technology to similar areas has been developed and applied. Extending the agricultural sector model down from national and regional levels to agroecological zones in the Central Rift Valley study and coupling sector and farm level models completes the ability to scale

vertically from farm to national levels for both biophysical and economic outcomes.

**In Policy Impact:** It is expected that compendiums and cross cutting assessment will provide policy makers at multiple levels of government the tools and products to make better decisions. The actual application of the compendia and cross-cutting assessments by policy makers awaits their evaluation and use after their completion at the end of Year Five. Through their active participation in planning and evaluation of model development and applications, decision makers in Mali and Kenya have already gained experience in the application of these products as shown DSS- 26. The results of projections of food security and natural resource consequences in the year 2015 shows the importance of a more aggressive approach to meeting World Food Summit goals and demonstrates the utility of the DSS in helping to evaluate options to meet these goals.

**In Improved Environment In Natural Resource Management:** The several synthesis documents provide an overview of the results of case studies that show the impact of policy and technology options on sustainable use of natural resources. The methods summarized in the compendium documents provide national researchers and analysts with tools to assess environmental and natural resource impacts of alternatives to enhance sustainable production of food. Results of the synthesis documents indicate that the natural resource implications of technology and policy options affecting the sustainable use of natural resources for enhancing economic growth and improving food security.

## **Other Major Outputs in this Period**

### **Research Reports**

Clarke, N., J. Stuth, T. Butt, J. Vitale, and J. Angerer. 2003. *Cross-Site Analysis of Methods, Models, and Results from Decision Support System (DSS) Studies in East and West Africa*. Submitted to Center for Natural Resource Information Technology, Texas A&M University.

Clarke, N., J. Stuth, T. Butt, J. Vitale, R. Kaitho, J. Angerer, and P. Dyke. 2003. *Decision Support Systems for West Africa: An Examination Of Issues, Policies, and Alternatives for Food Security and Natural Resource Management in the Sikasso Region of Mali*. Submitted to Center for Natural Resource Information Technology. Texas A&M University.

### **Degree Training**

Kristen Zander, M.S., 2000-2004

# SANREM CRSP

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**July 2003  
Annual Report  
DSS-21**

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## Global Level Analysis

### OBJECTIVE 1

Expand and apply Global Agricultural Sector Model (GASM) to development of national and regional impact assessment methods linking economic and natural resource management goals.

#### Achievements

Link GASM with African Models - The study on the impact of climate change on food security in Mali was completed. GASM was used to project prices of various crops in international markets under climate change scenario. These projected prices were used as an estimate of cost of food imports for Mali under climate change scenario.

Economic Implications of NAO/ENSO - The objective of this activity was to assess the economic implications of exploitation of North Atlantic Oscillations and El Nino Southern Oscillation forecasts on future adverse and beneficial weather events and the benefits of timely NAO and ENSO forecasts on world markets and their implications on costs of food imports for African countries. The results show that information on ENSO/NAO phase allows farmers, in the U.S. and in Europe, to better manage their farming operations. In the value of information context ENSO/NAO information is worth between \$0.6 to \$1.1 billion dollars a year.

Documentation of GASM - The methodological objectives of GASM have been achieved. No further expansion of the model is planned at this time. The results have been applied to studies on climate change as noted above and project international prices of various crops as input to national models.

### OBJECTIVE 2

Use DSS methods to expand the ability to interpret satellite imagery for decision-making at national, regional, and global levels.

#### Achievements

A tool for extracting point weather data from NOAA satellite image products has been developed that allows extraction of daily temperature and rainfall data for the entire continent of Africa for the period of 1998 to present and has been blended with the new EROS CHARM rainfall data back to 1961 for the entire continent of Africa. This tool interpolates missing data, estimates solar radiation, and preformats the data for use in the DSS biophysical models. These tools are accessible and documented at <http://cnrit.tamu.edu/rsg/rainfall/rainfall.cgi> for the daily rainfall, max/minimum temperature, and solar radiation data from 1998 to present. The new CHARM daily rainfall data are available at <http://cnrit.tamu.edu/charm>. The model ready data provides a powerful mecha-

**Principal Investigator**  
Bruce McCarl

**Co-Principal Investigator**  
Jerry Stuth

nism for the laymen unfamiliar with the complexity of NOAA's FTP distribution system to simply input a desired longitude and latitude and specify the time period of interest. Once this is done a comma separated file of the climate data is automatically provided via a simple web browser. A tool for extracting NDVI data for a user defined point(s) has been developed for examining greenness indices and making this data available for use in cokriging of biophysical model output. The tool outputs data in comma delimited or dbase format allowing integration with other software. It is available at <http://cnrit.tamu.edu/cgi-bin/ndvi.py>.

The Common Modeling Environment was completed and all documentation describing the middleware and scripting language is provided on the internet (<http://cnrit.tamu.edu/CME>).

Demonstration of the CME for linking legacy models was completed for PHYGROW. A new online concept of the system has been developed and tested using PHYGROW as the primary platform. The system, available via internet login at <http://cnrit.tamu.edu/phyweb>, allows global collaboration by permitting people to share modeling efforts stored on the same server with verified datasets, using the most recent version of the PHYGROW model. Legacy outputs of the Mali and Kenya PHYGROW runs are being loaded in the system for use by national partners. Permissions for access must be requested through the CNRIT webmaster to avoid unintentional or intentional destruction of the existing datasets.

### **OBJECTIVE 3**

Expand and apply impact assessment methods for improving the capability of international organizations to monitor the status and progress toward achieving the goals of conventions and treaties dealing with food, agriculture, and natural resources.

### **Achievements**

The methodology is completed for extrapolating spatially explicit point-based biophysical model output to large-scale assessments of biophysical

responses to weather using geostatistics. The paper that describes the methodology is provided on the CNRIT website:

(<http://cnrit.tamu.edu/IMPACT/cokriging.pdf>) and was published as part of a book chapter in Oxford Press.

Forage response maps were developed via co-kriging for Kenya. The process was successfully tested for delivery of internet based information to remote areas via Worldspace radios in Kenya. Maps available on the web were successfully transferred via the African Learning Channel on the WorldSpace radio system in collaboration with an array of NGOs and the Ministry of Agriculture and Rural Development. This method allows distribution of analysis to most of Africa where linkages to the internet are poor.

### **Advances**

**In Research:** DSS-21 aims to predict national impacts on agriculture of global climate change, to plan and assess (real time) options for improved NRM at varying levels of scale, including large-scale assessment of climate responses and spatially explicit maps of rangeland forage, and to provide access to and use of multiple models and databases by users with different skill levels. Global change impacts were completed for the Sikasso region reflecting losses in soil carbon and erosion on croplands, and loss in basal area of grasses, increased weed species, and loss of woody species due to fuelwood pressure. The biophysical responses of the models reflected the climatic changes projected by two global change model scenarios for West Africa. The change in climate was also reflected in performance of the indigenous zebu cattle and sheep/goat populations. The methodology for reflecting deterioration in rangelands and reflecting area weighted yields depicted in maps was developed and written up in the Compendia for the Mali Studies.

**In Capacity Building:** As anticipated, scientists in Mali and Kenya are being trained in the use of the SWAN crop model, PHYGROW rangeland model, NUTBAL PRO livestock production model, LANDDEMAND livestock demand on grazing-

lands model along with methodology to translate biophysical responses for use in economic models. Meta-model equations were developed and their effective use demonstrated to the trainees from Mali and Kenya. A complete handling of the training and capacity building issues can be found in DSS-26.

**In Scaling Up:** This project anticipated providing specific ability to link modeling products at varying levels of scale - both in biophysical and economic terms. The concept of multiple scale agro-ecological simulation zones was expanded in the intensification/extensification study in the Sikasso region of Mali using methods developed from the prior studies on Small Holder Dairy Technology and sorghum/peanut technology of the INSORMIL and PEANUT CRSP. This methodology was also used and further expanded in the farming intensification study of the Central Rift Valley in Kenya with the representation of agro-ecological simulation zones and virtual representation of soils within those zones. This allowed the matching of appropriate technologies with the land use capabilities within each agro-ecological simulation zone, thus allowing the modeling of partial to full infusion of technology in a region that is spatially coherent and properly matched with natural resource capability. When linked to administrative boundaries, it is possible to allow proper NRM attribution of technology within political boundaries to better serve the sectoral and farm models, resulting in the greater ability to address attribution of technology impacts, both economic and environmental, at multiple scales.

**In Policy Impact:** DSS-21 focuses on long-term planning for food security based on forecasted changes in global climate, improved decision making for NRM at varying levels of scale, and improved information for farmers on weather, global markets, real time operational decision making. Actual results demonstrated that impact of emerging agricultural technologies relative to climate change was completed for the Sikasso region of Mali. The Climate Change Study in Kenya is underway and will be completed in Year Six. The technology impacts in both the Mali and Kenya studies were viewed from the national scale to agroecolog-

ical zones down to the farm level by farm type. The ability of the METEOSAT based satellite weather coupled with the new CHARM rainfall data of Africa on an 11 x 11 grid system has provided an exciting new mechanism to acquire spatially coherent, historical data on a denser grid, thus allowing the linking of biophysical responses with economic response at multiple scales using historical precedence. The ability to link local weather with an array of carefully selected farms allows the combined effects of crop and forage response and subsequent economic response on the farm level be aggregated to the sectoral level in future studies. These data are provided in both historical and near-real time, allowing for the creation of future impact assessment tools that are responsive at the logistical level of decision making by farmers and pastoralists.

**In Improved Environment In Natural Resource Management:** The development of biophysical and economic models and databases for use at global levels provides tools that can be used to assess progress toward achieving the goals of international agreements such as the CCD and WFS. These specifically include methods to assess the impact of policy and technology changes on sustainable use of natural resources - showing such things as soil erosion and water runoff as a function of technology and farming practices. As anticipated, the SWAN crop and PHYGROW rangeland models were enhanced to better accommodate carbon movements in the case of SWAN and rangeland deterioration in the case of PHYGROW. The output was successfully integrated with the economic sector model of Mali and Kenya to allow assessment of global change impacts on food security issues.

## Publications

### Book Chapters

Stuth, J., J. Angerer, R. Kaitho, A. Jama and R. Marambii. 2003. Livestock Early Warning System for Africa Rangelands. In Boken, V. (ed.) *Agricultural Drought Monitoring Strategies in the World*. Oxford: Oxford University Press.

## **Journal Articles**

Butt, T. and B. McCarl. 2003. An Analytical Framework For Making Long-Term Interlinked Economic and Food Security Projections: A Case Study For Mali. Under review by *Food Policy*.

## **Other Major Outputs in This Period**

### **Workshops**

Vitale, J., T. Butt, and B. McCarl. 2003. *Training Manual on DSS Economic Models: Farm and Sector Models*. Paper presented at West Africa Workshop. August.

### **Degree Training**

Tanveer Butt, Ph.D., 2000-2003

Jay Angerer, Ph.D., 2000-2004

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
Funded by the U.S. Agency for International Development (USAID)**

**July 2003  
Annual Report  
DSS-22**

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## Development of Economic Models

### OBJECTIVE 1

Adapt, extend, or create economic models to be linked with biophysical and environmental models in the DSS to provide quantitative estimates of the impact of alternative policy options or technology introductions in the agriculture of developing countries

### Achievements

Consolidate methods and case studies - The agriculture sector models for Mali and Kenya have been expanded to include Risk of Hunger measure of food insecurity that is used by FAO for monitoring the overall national level food insecurity in countries around the world. This expansion of the sector model provides a new dimension to the Risk of Hunger measure, as it has previously been used in an accounting framework by FAO. In contrast, now the measure is part of a behavioral model that shows the impact of various policies on Risk of Hunger in ex-post and ex-ante fashion. Also ASM results provide estimates of Risk of Hunger measure at sub-national level, whereas earlier they were available only at national level. This development has important implications for national and international policy makers who are involved in planning for food security. For example, those involved in promotion of technological development can compare the effectiveness of alternative technology packages on food security by measuring the impact on Risk of Hunger

in an ex-ante fashion. The primary FLAM modules have been consolidated into a spreadsheet package. These modules relate to technology adoption, risk, food security, and economic valuation of non-marketed goods and resources. The spreadsheet version of FLAM has been presented to Mali scientists in an October 2002 training workshop to extension, research station, and ministry level personnel. The development of documentation of methods and models for FLAM is now complete. Documentation consists of a training manual on farm modeling, including how to use FLAM's spreadsheet modules and training exercises. The training materials will be posted on the CNRIT website.

Applications of models in the Sikasso and Rift Valley case studies have been completed and documented in the Mali and Rift Valley compendia. The economic models have been applied in settings that include the economic impacts of new technology, food insecurity, drought management, environmental consequences of alternative land use policies, and the integration of crop and livestock activities. The results of the Rift Valley study will be presented at the upcoming workshop in Nairobi and policy implications will be shared with policy makers in Kenya. The Mali and Rift Valley compendia are posted on the CNRIT website.

Link existing economic models to a spatially referenced environmental model - Work on linking FLAM to the hydrologi-

**Principal Investigator**  
Bobby Eddleman

**Co-Principal Investigator**  
Bruce McCarl

cal component of PHYGROW has been completed and documented in the Mali compendium. The product of this model has been a study of the environmental consequences of land expansion onto marginal lands. A key finding was the subtle nature of the associated degradation from land expansion in the Sikasso region. The discounting rate of future events by farmers occurs at a faster rate than degradation, confirming the observed propensity that farmers in this region have for land expansion. Organization of databases and legacy outputs of all models, in a web-based format, is nearly complete. The databases include crop and forage yields, soil degradation rates, rainfall, and groundwater runoff rates. In addition, training materials to document the models and associated databases are being placed on the CNRIT website.

The Kenyan Agriculture Sector Model (KASM) has been disaggregated from its previous regional level to agro-ecological zone level. As a result, the model now captures crop production and the natural resource environment in 363 zones in Kenya whereas in previous studies in Kenya only eight were considered. This provides a great deal of flexibility in terms of data exchange between biophysical and economic models. The disaggregation allows economic impact to be assessed in a greater detail as well. For example, impact can now be measured as changes in land rent, production, area, etc., at varying levels of scale including agro-ecological, district, regional, and national levels. The farm-level component of the DSS (FLAM) has incorporated meta-equations from SWAN that quantify the forward time progression of crop yields and several key environmental factors. Included are environmental variables that describe changes in soil profile, hydrological conditions, and stock of soil nutrients. The meta-equations are geo-referenced according to agro-ecological position and prevailing soil characteristics, allowing the meta-equations to be applicable at the field level.

## **OBJECTIVE 2**

Develop linkages between economic models at varying levels of scale to improve the ability to forecast impact of technology introductions in the agriculture of developing countries.

## **Achievements**

Link national level outcomes and decisions to farm level outcomes through embedding farm models in ASM - The Mali ASM and Kenya ASM have been modified to include embedded farm models and the work has been completed. Products of this model include estimating how impacts are distributed among the farm stratification that was developed in the Sikasso and Rift Valley spatial sampling framework and corresponding rapid/intensive surveys. Findings of this model have been applied to the impacts of new sorghum technology in Mali and have been published. In Kenya, a scaling up approach has been taken to resolve consistency between farm and national level analysis. Recent additions to FLAM have incorporated the production and price outcomes from KASM at the sub-regional level (as delineated by 363 zones modeled). Using the cross-section of farming systems derived from the Kenya surveys, FLAM solves for the supply response across the farm cross-section consistent with the KASM results. This provides insight into how the various farm types compete among each other for market share, develop specialties and niches, and when necessary, move out of agriculture.

Linkage of outcomes and decisions at the multi-village level to outcomes and decisions at the farm level has been completed. The FLAM farm model was extended to include the decision making aspects of both crop and livestock activities as they pertain to encroaching crop production onto communal rangeland areas. The model developed for this activity was exercised to illustrate the impacts of communal grazing on forage yield degradation, as well as the increased competition for resources between crops and livestock activities. The results of this activity are documented in the Mali compendium. Documentation of this model is now complete and is being placed in the CNRIT website. (<http://cnrit.tamu.edu>)

## **OBJECTIVE 3**

Continue to add the risk dimension to economic models at varying levels of scale to assist decision-

makers in the evaluation of policy and technology options.

## **Achievements**

Complete the development and documentation of methods that add the dimension of risk at varying levels of scale - The development and documentation of methods for farm level risk is included in the FLAM documentation and training materials are complete for both Mali and Kenya (see Objective 1 above) - The incorporation of risk at the multi-village scale through inclusion of weather induced forage variability into the methodology and analytical framework has also already been completed (see Objective 2 above). This multi-village scale model is applicable only in the Malian case where foraging on communal rangelands is the norm. In the Rift Valley, foraging is conducted on private property rendering such a model irrelevant. The task of incorporating the risk aversion tendencies of small holder farmers will be completed following an upcoming Mali training workshop scheduled for August, 2003. Consultation with Malian colleagues and further refinements of the model is required to complete this task. The primary task remaining is to incorporate the risk aversion tendencies of small-holder farmers in the crop-livestock setting. At national scales, the documentation of methods of risk modeling has been completed for Mali. The document provides a detailed description of the type of risk that farmers face in developing countries, with specific reference to Mali, and how such risk considerations can be included in a sector model. The model embeds firm level risk behavior through an additional set of equations. Ramifications of varying levels of farmers' attitudes toward risk aversion on market outcomes can be assessed at the regional and national levels.

Incorporate both national level risk effects and farmers' risk behavior into the holistic model - The methodology and analytical framework to complete this task has been completed (see Objective 2 above). Results have been documented in a working paper that will ultimately be published.

National risk effects and farmer's risk behavior - The ASM incorporates the effects of risk behavior

on adoption. Farmer's risk behavior has been incorporated into the FLAM model. A study on factors of adoption is still in progress and is expected to be completed in early July 2003. The study will add further information to the integrated product through testing hypotheses related to the significance of risk on the adoption of new technology.

Organize databases and legacy outputs of all models into a web-based presentation - This task was initiated in January 2003 in concert with similar porting of IAG methodologies from the PC to the web and will be continued through Year Six.

## **OBJECTIVE 4**

Evaluate trade-offs between sophistication and quality of output versus simplicity and ease of use of economic models in the developing world.

## **Achievements**

Complete evaluation of trade-offs between sophistication and quality of output versus simplicity and ease of use - This evaluation has been completed given experiences in the June and October (2002) Mali training workshops, and prior experiences with Malian and Kenyan collaborators. In each case, the level of information gained from the user friendly versions of the models was more than adequate for scientists to utilize in their research. As developing countries begin to take on more aggressive agendas, the types of questions demanded of scientists are likely to become more complex. Under these conditions, the more sophisticated models would be expected to be more appropriate as the simpler models may be overwhelmed. The comparison of utility of simplified vs. complex approaches will be documented in a working paper format following the upcoming Mali and Kenyan workshops.

Provide simplified user-friendly spreadsheet interfaces to economic models (ASM and FLAM) - These tasks have been completed. ASM uses a GAMS solver-engine to obtain optimal solutions; FLAM uses LINDO based software to find optimal solutions. Both FLAM and ASM have been documented (for FLAM see Objective 1 above). The

basic analytical formats for this activity have been completed and the interface is based upon the spreadsheet versions of ASM and FLAM.

Provide user interface for specific case studies using economic models - The basic analytical formats for this activity have been completed since the interface will be based upon the spreadsheet versions of ASM and FLAM. Additional modules have been developed that include the specific data used in the Sikasso Case studies. These modules will be presented and delivered to Malian counterparts in the upcoming training workshop. The Rift Valley modules will be complete by the time of the upcoming Rift Valley workshop. Users will then be able to vary parameters away from those established in the case studies.

Embed models with crop yield meta-functions to permit extrapolation to geographically similar regions - This task has been completed for all relevant applications. Both FLAM and ASM have been embedded with yield meta-functions in the East and West African model settings for the major food and cash crops included in the Sikasso and Rift Valley case studies (maize, sorghum, millet, cotton, potatoes, and peanuts). Expanding user base requires complementary information on rainfall, soils, and fertilizer usage.

Distribute spreadsheet models at regional workshops - For FLAM, this task was completed in Mali during the October 2002 Bamako training workshop. FLAM was distributed to sixteen (16) Malian scientists from various disciplines following 2 days of hands-on training (see DSS-26), while the Mali ASM will be distributed as part of the upcoming Bamako workshop. The distribution of spreadsheet models for Kenya will be completed for ASM and FLAM as part of the upcoming Nairobi workshop. This work involved two Kenyan economists who were part of a training course (November 2002). Spreadsheet models for ASM and FLAM will be distributed on CD-ROM to workshop participants and for the broader web based community via the CNRIT web page (<http://cnrit.tamu.edu>).

## OBJECTIVE 5

Use economic models as part of the GDSS suite in implementing the Mali and Kenya Pilot FIVIMS - GTOS Studies by evaluating scenarios deemed relevant by national decision-makers.

### Achievements

Complete and document the Sikasso and Rift Valley case studies using the GDSS - This task has been completed.

Incorporate economic models into the watershed studies in East Africa (see DSS-23) - The Kenyan FLAM was linked to the Sondu River Basin study to assess the economic impacts of reduced crop yields.

### Advances

**In Research:** DSS-22 anticipated results that would link economic, biophysical, and environmental models for integrated DSS, advance development of farm level economic models, and incorporate risk assessment into economic and biophysical models. In each of these three areas the actual results have reached or surpassed the anticipated level of results. The FLAM farm level modeling component of the DSS has been linked with biophysical and environmental models to include crop, forage, and environmental meta- equations to assess the environmental consequences of soil erosion from land clearing. These linkages have advanced the development of farm models by introducing a more accurate reflection of the trade-offs that farmers encounter in their land use decision making: opting for short term gains from land expansion must be measured against future losses in agricultural productivity from induced degradation. The newly introduced environmental equations provide information on the future consequences of farming alternatives on hydrology, soil nutrient management, soil erosion, and watershed. These support and explain the changes in long-run productivity that are contained in the crop and forage biophysi-

cal simulations. At the village and multi-village scale settings, impacts of communal land use patterns on both crop and livestock production can be quantified. Production risk from variable rainfall has always been a fundamental aspect of the economic models within the DSS, both at the farm and sector levels. Recently, the role of risk has been expanded to include the effect of rainfall on forage yields (Kenya and Mali). This has allowed for the development of a model at the multi-village scale, and when combined with the linkages to animal nutrition (NUTBAL) model, production risk in both the crop and livestock sectors at an intermediate scale level has been accomplished. A risk-of-hunger measure at the farm level has been developed to complement the existing production risk structure of the Kenya and Malian versions of FLAM. This measure predicts the conditions under which farm households' food consumption could fall below the subsistence level when one considers the stochastic nature of food production, food prices, and household income. At the national level, the Kenyan Agriculture Sector Model has been disaggregated from its previous regional level to agro-ecological zone level. As a result, the model now captures crop production and natural resource environment in 363 zones in Kenya whereas, in the past, only eight zones were considered. This provides a great deal of flexibility in terms of data exchange between biophysical and economic models. The disaggregating allows economic impact to be assessed in greater detail as well.

**In Capacity Building:** The workplan aims to develop user-friendly spreadsheet access to complex models and to complete documentation on case studies in Sikasso and Rift Valley. For both FLAM and ASM, spreadsheet models have been developed for both Malian and Kenyan applications. Interactions at three recent Malian workshops, and domestic-based training of four Kenyan scientists, have demonstrated the utility of user-friendly versions of the more complex models. Scientists have been able to quickly grasp the essential features of the models without being bogged down with learning computer languages or cumbersome execution routines. Experience has shown that since frustration levels have been reduced that scientists have had more time to

devote to how the models can be applied to their particular research agenda. With the simpler versions put in place, there is cautious optimism that in the longer run, as scientists gain more familiarity with the models, their research interests and curiosity will motivate them to advance to the more complicated models. As these scientists outgrow the simpler models and require more analytical sophistication, the demand for longer term training increases (see DSS 26 and the CILSS initiative). The Mali compendium on model development and subsequent results has been completed (see above, DSS 23, and DSS 24), and a similar compendium on studies done on method development and application in the Rift Valley of Kenya had been completed in draft form. These compendia are being considered for publication in book form, either separately or jointly. These materials have been the cornerstones of the capacity building efforts (see DSS 26) since they demonstrate the utility of applying the TAMU DSS to relevant agricultural policies in developing countries (i.e. food security, risk, new technology introduction). Moreover, their value will continue in legacy during capacity building projects that are proposed to follow Year Five.

**In Scaling Up:** Anticipated results were to provide specific ability to link modeling products at varying levels of scale - both in biophysical and economic terms. The research has yielded two products that provide such scale linkages. One is an already developed model that embeds FLAM's farm level models directly into the ASM. This provides more complete information on how the diversity of farming households affects market outcomes at provincial and national levels. While market outcomes are still derived at mean production values, the multi-scale linked model contains information about market outcomes under perturbed conditions such as unexpected weather events. Such a model, hence, will have legacy utility in research on catastrophic events that could take place such as drought. Another product links farm level decision making to outcomes at the multi-village level. This model was constructed using FLAM, the LANDDEMAND spreadsheet model, crop and yield production models (SWAN and PHYGROW), and an animal nutrition model (NUTBAL). This aggregated model provides the economic trade-offs from vari-

ous environmental consequences of alternative land uses and new crop technology introduction. These trade-offs were made possible as a result of this scale linkage and the economic-environmental integration, since land use in these regions of the world (West Africa) are by nature at the multi-village level and involve the interaction between economic decisions and subsequent environmental consequences. To complement the recent disaggregation of the Kenyan ASM (KASM) into 363 zones, the structure of FLAM has been expanded to include both price and quantity information from KASM. This new structure resolves how various types of farmers within a simulation unit would compete with one another for market share based on diverse production costs, and provides a distribution of impacts across the various farm types.

**In Policy Impact:** Economic models, linked with biophysical and environmental models allow decision makers at varying levels of scale to evaluate technology and policy options related to sustainable use of natural resources and to enhance food security. The models and methodology, at various levels of scale and across economic and environmental dimensions, have been developed and exercised in the Sikasso and the Rift Valley. What remains to be done is to place the information from these models in more strategic locations in the agricultural planning process. To achieve this, it will be necessary to continue the training program beyond Year Five to equip. (see DSS 26). Host country scientists adapt the model to contemporary settings within the research agenda.

**In Improved Environment In Natural Resource Management:** Incorporating economic models into overall watershed analysis in Kenya provides an integrated approach to work at a significant level of biophysical scale. The recent work in Kenya has developed a set of hydrological meta- equations for the farm models that estimate future hydrological conditions on a per unit basis. Additional modeling is required to route and channel water runoff from particular farmers' fields into local watersheds.

## Other Major Outputs in This Period

### Proceedings

Kaitho, R., J. Stuth, J. Angerer, A. Jama and R. Marambii. 2002. Potential use of climate information and prediction products in addressing challenges of livestock development. In: *Proceedings 9th Greater Horn of Africa Climate Outlook Forum*, Kenya. May.

Stuth, J. 2002. Determinants of Livestock Distribution and Their Linkage to Climate. In: *Proceedings 9th Greater Horn of Africa Climate Outlook Forum*, Kenya. May.

# SANREM CRSP

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## **Development of Biophysical and Environmental Models**

**Principal Investigator**  
Jerry Stuth

### **OBJECTIVE 1**

Develop and demonstrate the utility of biophysical models to estimate performance of crop and livestock species under developing country conditions.

### **Achievements**

The rangeland and cropland biophysical analysis for the case studies in the Sikasso Region of Mali has been completed along with comprehensive compendia on the effects of agricultural intensification in the Central Rift Valley on meeting Kenya's food security needs. Both compendia are available for viewing and download on CNRIT website at <http://cnrit.tamu.edu>.

Two comprehensive documents were prepared on the methods of integrating forage and crop models using geospatial weather data for use in spatially-coupled economic models. A paper describing how both geo-corrected generated weather data and METEOSAT derived weather data can be use for both crop and forage modeling is provided on the CNRIT website. (<http://cnrit.tamu.edu>) A book chapter was completed on the use of weather satellite data for near real time modeling of forage response. This was done in collaboration with the Global Livestock CRSP.

Meta-equations of biophysical and environmental responses have been completed for all crops used in the Mali Sikasso study and for all rangeland types by degradation state. These meta-equations have been integrated into the GAMS software for both the sector and farm models. An Excel interface was also developed to allow partners in Mali to change inputs to the meta-models and observe sectoral responses for Sikasso and Mali as a whole. A similar set of meta-equations was developed for the Central Rift Valley in Kenya to represent an array of maize, wheat, bean and potato varieties adapted to the wide array of agro-ecological zones in this region. The meta-equations were tightly coupled with the farm level model (FLAM) for all 13 representative farms to allow for more rapid study of the interactions between economics and the environment. For the rangeland component in the Sikasso region of Mali, approximately 50 meta-equations were developed for the ASM components representing the aggregated response of cattle, sheep, and goat forage in the region along with runoff environmental effects. For the farm level analysis, approximately 30 meta-equations were developed for the soils and landscape positions of the representative farms. For the rangeland component in the Central Rift Valley of Kenya, approximately 476 meta-equations were derived for the ASM aggregat-

**Co-Principal Investigator**  
Jay Angerer

ed response of cow, sheep, and goat forage along with runoff under base and future technology scenarios. For individual farm analysis, approximately 50 meta-equations were developed for the soils occurring at each representative farm.

The protocol has been developed to link FAO WAI-CENT to the CNRIT website and allow linkages to access to models and databases where appropriate. FAO has agreed to provide a brief page for the SANREM DSS on their homepage and a hyperlink to the CNRIT Website so that potential users may get a full description of the system and directions for accessing the models and databases.

Data and models have been packaged for web delivery and will be completed by July 2003. All data are in hand but the best mechanism for web delivery is still being investigated.

## **OBJECTIVE 2**

Further develop and apply watershed models to assessment of environmental and economic impact of alternative policies and technologies.

### **Achievements**

The original Sondu watershed analysis was completed reflecting the projected 2015 change in population and infusion of new agricultural technologies.

A proposed study of the Ngoro watershed will not be conducted. Extra funding that was proposed for collaboration between SANREM, the GL, PD, and Soils CRSPs and Egerton University was not forthcoming. Given limited resources available in year 5, this effort was redirected to other studies in the Central Rift Valley effort. In year 6, there will be a user directed study of the Tana River Basin that accomplishes the original intent of this part of the overall DSS effort as identified by government institutions to address the urgent need to explore impacts of various reforestation options in the Upper Tana River basin.

Kenyan partners working with their government institutions identified the need to study impacts of

new reforestation policy and improved farming systems technology in the Upper Tana River Basin that would reduce downstream environmental effects and improve upstream small holder livelihoods. This study helps to address the need for greater integration of the crop (SWAN) and grazingland (PHY-GROW) models with the SWAT hydrology model to allow capture of both economic and basin-scale environmental effects. Recent floods in Kenya have greatly heightened the need for this study. This participatory research program will be conducted in year 6 of SANREM.

## **OBJECTIVE 3**

Develop and use improved indicators of land and water degradation as a function of agricultural practices involving intensification and extensification of production

### **Achievements**

The assessment of agricultural intensification and extensification case study for Sikasso region of Mali and intensification study of the Central Rift Valley of Kenya was completed, documented and made available on the CNRIT website.

Methods for use of Crop Use Intensity indices to assist in area weighting of yield responses for crop technology and rangeland vegetation were completed within the context of the Sikasso study and provided within the documentation posted on CNRIT website.

### **Advances**

**In Research:** This workplan focuses on using watershed level integrated modeling in the Ewaso Ngiro basin to provide an objective basis for evaluating management, technology and policy options at a critical level of biophysical scale. During year 5, the focus was on generating hydrological effects at the landscape level through application of robust spatial sampling frames that allowed a future framework for integrated modeling with the SWAT basin hydrology model. The need for improved middleware to manage SWAN and PHYGROW runoff output to SWAT input was identified. As

indicated in progress report of DSS 23 Objective 2, Item 3, the Kenya collaborating institutions have made a major commitment in pursuing this concept in the Upper Tana River Basin as part of Year six activities. Data sourcing and staging has begun with appropriate institutions in preparation for initiating this study.

**In Capacity Building:** Completion of ongoing studies and the development of simplified spreadsheet approaches to access more complex models allow decision makers at varying levels of scale to make use of modern information technology in decision making. Both the Sikasso and Rift Valley studies have been completed and simple spreadsheet interface to the economic analysis have been finished with biophysical meta-equations imbedded in the system to ease the use of both the biophysical component and the economic component of the analysis in both studies.. The approach used was to embed meta-equations in simple spreadsheets linked with legacy models. This will accelerate the process of capacity building and institutionalization in the partner institutions.

**In Scaling Up:** DSS-23 aims to provide an integrated approach to providing for scaling up and for lateral and vertical transfer of knowledge and experience. The concept of multiple scale simulation zones was successfully tested for both the Sikasso and Central Rift Valley case studies. The methodology forms the foundation for linking biophysical and economic responses in a synchronized manner using spatial characterization and a common geospatial link. The Kenya ASM was restructured to reflect agro-ecological simulation zones and associated biophysical meta-equations. When the spatial sampling is used to select representative farms, the resulting integrated ecological-economic framework allows scaling of impacts from the district to the national level accounting for more real world application of technologies that are spatially explicit. The methodology answers not only the level of impact but also the issue of where the differential impacts occur in a spatially explicit manner. This question has eluded many researchers in the past.

**In Policy Impact:** Policy makers at varying levels of scale are provided with better methods for

assessing the longer term environmental and natural resource impacts of decisions aimed at enhancing food security, more quantitative tools for assessing the impact of alternative technology applications and research investments, and a basis for making quantitative investment decisions for research and development. The completed methodology allows analysts working with policy makers to provide impact analysis on a wide array policy and technology options dealing with crop technologies and rangeland degradation stages in both the Sikasso region of Mali and the Central Rift Valley of Kenya. The complete suite of biophysical support analytical tools is fully parameterized, synchronized spatially with the sectoral and farm levels making them ready for use in future analyses by or collaborating institutions in both countries. The integrated suite of biophysical tools was used to evaluate several relevant issues identified by government institutions as part of these studies.

**In Improved Environment In Natural Resource Management:** Anticipated results included indicators of rangeland deterioration that offer methods to enhance long term and near real time management of fragile ecosystems; quantitative estimates of environmental impacts of extensification and intensification of production to meet future food security needs provides a basis for more balanced decision making; and policy makers in different parts of government to have an improved basis for inter-ministerial communication about overall impacts of alternative policies on food and agriculture - natural resources and environment. A methodology for representing rangeland deterioration as defined by changes in grass basal area, replacement of higher order species with lower order species, and changes in woody plant populations was completed and offers the ability to assess how ecological deterioration affected vegetation supporting livestock operations. The modeling approach used confirmed the assumption that lower ecological condition of rangeland leads to greater variance in production and higher risk. The use of spatial sampling frames and geographic continuity of data for both biophysical models and economic models insured that environmental and NRM issues are reflective of economic processes. Decision making was greatly enhanced for appraisal of strategic infusion of agri-

cultural technology to meet target yields required for food security needs. Involvement of inter-disciplinary teams from key ministries improved the understanding and need for impact assessment tools. The assessment methodology provided an opportunity to contrast the Sikasso region of Mali with the Central Rift Valley of Kenya. In the Sikasso Region of Mali, the analysis indicated that benefits to society came at the expense of expanded land cropped with greater runoff and soil nutrient loss with introduction of new technologies. In the case of the Central Rift Valley study in Kenya, new technologies significantly benefited society but also had a positive environmental consequence with reduced erosion loss, reduced runoff, improved deep percolation and greater nitrogen use efficiency.

## **Publications**

### **Book Chapters**

Roberts, C, J. Stuth and P. Flinn. 2003. Chapter 10: Analysis of Forage and Feedstuff In: *Agricultural Applications of Near Infrared Reflectance Spectroscopy*. New York, NY: CAB International.

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
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**July 2003  
Annual Report  
DSS-24**

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## Spatially Explicit Analysis

### OBJECTIVE 1

Develop and demonstrate the utility of a geo-referenced framework for models, information systems, and analytic procedures. These tools will be expanded to a multi-regional and (ultimately) global scale to make projections of the utility of research products to other geographically similar areas.

### Achievements

A geostatistical methodology of using defined agro-ecological zones (AEZ) with embedded virtual landscapes of soils was tested in Central Rift Valley of Kenya impact assessment. Using defined boundaries of agro-ecological zones for the country, dominant soils within agro-ecological zones were identified by intersecting the agro-ecological zone map with the Kenya Soil and Terrain (SOTER) map. This allowed creation of a new data layer for Kenya that is more reflective of soil conditions but maintains the AEZ terminology that is compliant with existing government documents. Using this methodology in the Central Rift Valley of Kenya also provided a means of extrapolation to the various agro-ecological zones for the remainder of the country and to determine where the selected technologies could best be adapted. A similar methodology was employed in the Sikasso region of Mali where NDVI-derived crop use intensity coupled with spatial buffering techniques were used to

define village locations relative to roads, markets, and inherent productivity of the land using the bas-fons, reflecting areas of high and low food security in Sikasso.

All training points for the LANDSAT imagery of Sikasso reflecting known locations of the bas-fons of Sikasso have been obtained and first generation classification completed.

All shapefiles of analysis and supporting data have been compiled for both the Kenya and Mali studies and are currently being transferred to the CNRIT MAPSERVER and to the Mali and Kenya Almanac Characterization Tool for viewing by partners and donor agencies.

### Advances

**In Research:** The workplan focuses on a method for organization and presentation of complex data and statistics on natural resources, climate, populations and national infrastructure for use in planning and monitoring of agriculture and natural resource strategies and research. A comprehensive method for establishing agro-ecological zones and extrapolating technology to zones outside of areas of analysis has been developed to allow applying complex suites of technology in a coherent manner considering variation in climate, human populations and soil resources. The use of geographically synchronized weather, soils, crop varieties, rangeland communities and farm budgets

**Principal Investigator**  
Jerry Stuth

**Co-Principal Investigator**  
Raghaven Srinivasan

overlaid by secondary data by administrative district allowed for a coupled system of economic and environmental impact assessment.

**In Capacity Building:** This activity provides ready access to complex data in an easily retrievable form for users with varying backgrounds in computer managed NRM methods. Meta-equations of all major crops and rangeland types in Sikasso and Central Rift Valley of Kenya have been completed in a spatially explicit manner. This allows less experienced users the ability to access to legacy analysis without intensive training. These data are being staged for access via the CNRIT website using MAPSERVER software on the internet. It is also being included in the Almanac Characterization Tool (ACT) that will be distributed as a CD ROM to partner organizations.

**In Scaling Up:** Provision of an ability to store and retrieve natural resource and other geospatial data with levels of scale from local to national contributes to decision making and planning at multiple levels of scale. The ACT tool has been updated with the major shapefiles emerging out of the Sikasso and Central Rift Valley impact analysis. Collaborators in Mali and Kenya have been provided with the models and map files to work with the legacy analysis. The method for using agro-ecological zones described above also provides the ability to scale vertically and laterally from farm to national levels and beyond.

**In Policy Impact:** Anticipated results included a relatively easily used tool to present and evaluate natural resource information in the context of NRM planning and implementation.

Actual results demonstrated that the ACT tool was updated and the MAPSERVER tool will accommodate all spatial biophysical data generated in the Sikasso and Central Rift Valley analysis. The MAPSERVER tool has been set up and is ready to accept all the necessary spatial data. This, coupled with the overall DSS, provides an easily accessible and usable tool. All meta-equations that reflect the complexity of the SWAN and PHYGROW model runs by simulation zone have been embedded into

the ASM sector models for Mali and Kenya as well as the representative farms selected in Sikasso and the Central Rift Valley, easing the use of complex biophysical models in an integrated manner with the economic models. This will allow policy makers the ability to assemble various data layers or themes of interest to explore the spatial interactions or distribution of the effects of various policy or technology options.

**In Improved Environment In Natural Resource Management:** Anticipated results included providing the multiple spatially related data bases that can be used for NRM planning and management of natural resources and serving as an integral part of the DSS system for managing spatially explicit information and setting geospatial sampling frames for NRM research.

Actual results demonstrated that comprehensive natural resource data were assembled on major crop species, major rangeland ecosites by degradation state, soils, weather, grazing practices, crop management practices for the entire regions of Sikasso, Mali and the Central Rift Valley of Kenya. The integrated AEZ/Kenya soils database was derived for the entire country of Kenya, providing planners in that country with a large, integrated database of natural resources data in a form ready for use in biophysical models that will allow integration and scaling with economic models. The data is organized to deal with national, regional, watershed, agro-ecological zone and soil series scale. The databases are integral to the overall DSS capacity for assessing NRM consequences of policy and technology options in both countries. The output of these various environmental databases and maps provides a perspective or assessment of the nature and distribution of environmental consequences that help shape policy formation or technology solutions in a more informed manner. The approach developed for spatial integration of biophysical models and economic models has lead representatives for the Government of Kenya to move forward on a collaborative assessment of reforestation and farming technology issues for the Upper Tana River Basin in Year Six of SANREM.

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
Funded by the U.S. Agency for International Development (USAID)**

**June 2003  
Annual Report  
DSS-25**

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## **National and Regional Applications of Decision Support Systems**

**Principal  
Investigator**  
Neville Clarke

### **OBJECTIVE 1**

Extend and expand the integrated package of decision support tools through cooperation with partners by using specific case studies at varying levels of government as platforms or real-world scenarios for development of methods

### **Achievements**

Sikasso and Rift Valley case studies - The Sikasso and Rift Valley studies have been completed. An evaluative workshop planned for Nairobi has been delayed until August 2003. The Rift Valley study will be in draft form until the workshop is completed and national feedback obtained. The impact of regionally specific technology packages on food security and natural resource management are reported in these studies which are located on the CNRIT website. Results of these impact studies indicate that without substantial agricultural technology intervention and expanded adoption, food security goals of the WFS will not be achieved in 2015 as population increases and natural resources continue to degrade. Combinations of new approaches appear to be needed to sustain the present level of nutrition and the goal of reducing hunger by 50% in 2015 probably will not be achieved.

Impact global climate change - Mali studies have been completed using five of the

DSS models. The climate change study for East Africa was initiated in February 2002 and will be completed by approximately August 2003. As indicated by the Mali studies and expected in the Kenya studies, predicted climate change will threaten food security in the years ahead due to changes in both the variability and quantity of moisture available.

**Co-Principal  
Investigator**  
Jerry Stuth

Compare results of case studies in Mali and Kenya - – The cross-cutting comparison, found on the CNRIT website, provides very useful general principles for sustainable enhancement of food security across the continent. A more detailed assessment will be made when the year 6 studies are completed. In both instances, the impact studies indicated that society in general would benefit by investments in new agricultural technologies. However, the environmental consequences observed between the two regions were quite different. The economic benefits came at the expense of expansion of cropping in Sikasso on less productive lands resulting in greater erosion (+11 to +16%), somewhat higher runoff and greater loss of soil nitrogen. The technologies proposed for use in the Central Rift Valley had a beneficial environmental effect not requiring increased extensification onto marginal lands, thus resulting in decreased erosion of approximately 38% while deep percolation was increased 10% and nitrogen was used more efficiently. Neither Mali or Kenya could meet their food security goals by

2015 with the technology suite selected for the target land areas, requiring greater investments in improved adoption rates and more aggressive advances in crop productivity that is sustainable. Rangelands in both countries would be expected to degrade with greater impact in Mali due to overgrazing of grazingland in village commons and accelerated fuelwood harvesting for sales in other regions. Where adapted, improved grasses would replace rangelands in the Central Rift Valley due to a reduction of basal area of more desirable grass species and expansion of woody species.

Applications by National Partners - Malian trainees will initiate case studies using data and models from the Sikasso effort near the end of their training in July-August 2003. Kenyan trainees are working on the Upper Tana River basin study which they initiated as part of their 30-day training on the campus of Texas A&M University.

SPFS studies - A study is in progress that considers evaluating economic and food security implications of improved technologies of maize and rice introduced by FAO's Special Program on Food Security (SPFS) in Mali. As part of the research results, the study will compute Risk of Hunger measure of food insecurity in Mali. The results of this study will be shared with FAO to set a course of future collaborations.

## **OBJECTIVE 2**

Participate with SANREM and other partners in developing deliverables, conducting or participating in workshops and providing training in using the SANREM GDSS methodologies.

We will continue to implement the plan for collaboration with the West Africa Project. This involves linking commune level activities of the WAF project with the model outputs and databases of the DSS. The elements of the plan, which were reviewed in February 2001 by the EEP, are shown below in the 2001-02 plan.

In addition, we will continue to participate with SANREM and other partners in developing deliverables, conducting or participating in workshops and

providing training in using the SANREM DSS methodologies.

## **Achievements**

Economic models - The DSS agricultural sector model for Mopti has been completed and will be delivered to the WAF team. Discussions between WAF and DSS economists compared and contrasted the two methods of modeling.

Fecal profiling – NIRS protocols for data collection were provided the WAP project along with the French version of NUTBAL PRO – no substantial investment of DSS resources was made.

EPIC- CROPSYS comparison - EPIC data and runs are available to the WAP.

## **Advances**

**In Research:** Anticipated results included completion of user- defined case studies on intensification/extensification, drought management; impact of new technology, and the interaction of livestock and the environment in mixed crop-livestock systems, comparison of results from East and West Africa in cross cutting analysis; and collaboration with SANREM West Africa Project to link farm-village with regional-national levels of scale in modeling impact of alternative NRM strategies.

The Sikasso and Rift Valley studies are complete. Based on the results of the impact analysis, no single strategy for the current suite of advanced agricultural technologies appears to be able to meet the food demand of 2015; however, a combination of intensification and extensification, along with the introduction of new technology and revised policies on food self sufficiency appear to make an attractive combination. Extensification, with the use of marginal lands, would have the expected negative environmental consequences. Addition of the impact of risk aversion introduces an important variable in the integrated model output. The substantial extension of the agricultural sector models for Mali and Kenya – with the ability to extend the quantitative estimates of the risk of hunger resulting from such variables as population growth, technol-

ogy adoption, and climate change add important new dimensions to the DSS product. The more explicit modeling of livestock and rangelands into the integrated suite of the DSS provides a clearer picture of the interaction between crops and livestock at the village and commune level. The comparison of East and West Africa results in the cross-cutting analysis provides an interesting contrast between the ecological and social settings in these two regions with evaluation of similar case studies using comparable methodologies in the DSS. The completion of the analysis in this effort during Year 6 will make a substantial methodological and case study contribution to the modeling of crop-livestock systems.

**In Capacity Building:** Participation by national partners for experience and future use of methods, participation by national research partners in developing and applying models helps ensure full ownership of products. Capacity building within governmental ministries for use in analysis and in national research institutes ensures commitment to provide institutional homes for the DSS as well as continue its development and application.

Hands-on involvement of national and regional collaborators from the concept formation, research planning, data acquisition, and analysis has contributed substantially to the capacity of both decision makers and their analysts and the national research establishment (see DSS 26). As the current trainees take on specific practice projects, using the Sikasso and Rift Valley data and models, they will not only gain proficiency in using the methods, but will produce useful case studies and build national and regional confidence in the DSS. Ongoing experience and training after SANREM II will add proficiency and confidence in both the analysts and decision makers.

**In Scaling Up:** Farm/village/commune level modeling can be linked to watershed and landscape models and finally to broader sector models that operate at subnational and national levels. The DSS links economic, environmental, and biophysical models in an integrated suite. In the Sikasso and Rift Valley studies, methods were developed to link the FLAM and ASM (See DSS-22) and to link eco-

nomic and environmental/biophysical models (see DSS-23). The use of spatially explicit analysis provides the ability to scale both vertically and laterally using the concept of geographic equivalence and simulation zones with spatially defined sampling frames to extrapolate upward from household to national levels. The Rift Valley studies provide further methodology, through the extension of the use of spatially explicit agro-ecological simulation zones to link farm, region, and national results. In contrast to West Africa, the land holdings in Kenya tend to be smaller and land tenure more secure. The highly variable ecology in Kenya is in sharp contrast to the more homogeneous West Africa study area of Sikasso scenario. The utility of the DSS in addressing the scaling up issue is quite evident in the ASM and FLAM farm models. In this approach, farm level impacts are scaled up to provincial and national levels and clearly demonstrate the effect that scale has on returns to new technology. As more farm technology is introduced, market supply increases and prices fall. Results show that failing to consider the scale issue would result in a significant overestimation of the returns to technology. Similar significance in results is anticipated as other case studies employing the DSS models at multiple scales are exercised in the mini user-defined case studies.

**In Policy Impact:** This workplan provides improved methods to evaluate policy and technology options at various levels of scale from local to national and to regional analysis. National policy analysts and researchers are using the DSS in practice applications as part of their training (see below). Policy makers at the ministerial level of government and in the office of the President in both Kenya and Mali express ongoing interest and commitment to the use of the methods when they are delivered. Developing the capacity to fully use the methods remains a pivotal issue (see DSS 26). With a wide spectrum of uses and livelihoods derived from it, and the complex biophysical processes that alter its condition, a systematic approach to manage the natural resource base is required. The DSS delivers to decision makers, at local, national, and international levels of government, access to methods and products that enhance the quality of decision making on the sustainable

use of natural resources in enhancing future food security. The DSS considers a multitude of factors that can be used to characterize and track various physical indicators of the natural resource base as it responds to an array of production alternatives by its user base.

### **In Improved Environment In Natural Resource**

**Management:** This workplan intends to provide decision makers at levels of government from local to national and international with access to methods and products that enhance the quality of decision making on the sustainable use of natural resources in enhancing future food security. The Rift Valley study shows that the ongoing land degradation using current farming practices continues to degrade the ability of Kenya to achieve the WFS goals for food security in future years. Use of the DSS in the assessment of options for reforestation in the Upper Tana River basin of Kenya will provide options for achieving these goals in a sustainable manner, allowing options to be explored for returning this basin to more a more sustainable stable ecosystem for supporting small holder livelihoods and needs of Kenya society in general.

## **Publications**

### **Journal Articles**

Butt, T., B. McCarl, J. Angerer, P. Dyke and J. Stuth. 2003. The economic and food security implications of climate change in Mali. Submitted to *Climatic Change*.

## **Other Major Outputs in This Period**

### **Proceedings**

Butt, T. and B. McCarl. 2003. Climate Change Impact in the Developing Countries: A Case Study from Mali. Forthcoming in the Proceedings the conference *Climate Change, Carbon Dynamics and World Food Security*. June 10-11. Ohio State University, Columbus, OH.

## **Tools**

Ranching Systems Group. 2003. *WEBGLA Users Guide*. Center for Natural Resource Information Technology. Texas A&M University. College Station, TX. 92 pp.

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
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**July 2003  
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DSS-26**

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## **Delivery Systems and Capacity Building**

### **OBJECTIVE 1**

Prepare and deliver products from the DSS that are in usable form and format for national and regional partners.

### **Achievements**

CME - The common modeling environment middleware has been developed and delivered to FAO and is being organized and extended for use in the DSS website, the fundamental elements of which are in place on the CNRIT website at <http://cnrit.tamu.edu/CME>. This will provide streamlined access to the databases and models used in the DSS and facilitate its use by other operators.

Development and application of meta-functions - The activity of developing crop and forage meta-functions from SWAN and PHYGROW has been completed. Crop meta-functions have been developed for the Sikasso region of Mali and the Central Rift Valley (CRV) of Kenya for the major food crops (sorghum, millet, maize, and peanuts) and cotton. The crop meta-functions are defined in general terms according to soil type, rainfall, and fertilizer application. Rangeland meta-functions have been created for all major rangeland types in Sikasso and the CRV including multiple levels of degradations on each ecosite in the region as reflected in the changes in basal area of grasses in different preference categories and woody plant cover by species. These functions are now ready

for use in extrapolation of existing DSS models to areas with similar geographic features (i.e. AEZ/soil combinations).

Engagement and feedback to enhance adoption of methods - In Mali this activity is about 50 percent completed with remaining work to be completed following the upcoming Mali Training workshop. The three Mali workshops conducted this year have provided significant feedback on the application of the DSS in the Sikasso Case studies from the 16 scientists included in the IER/TAMU training program. The response has for the most part been positive, with some concerns over model validation. Such validation activities will be conducted during the Mali training workshop. The Mali trainees will write case study reports on one of the topics included in the Mali Compendium. One objective of these reports is for Malian counterparts to take ownership of the databases and legacy model outputs to provide feedback on the accuracy of the contents and to eventually rectify any gaps and misspecifications in the data and model output as warranted. As a result of the workshops and DSS software distribution, the DSS suite of models have been installed on approximately 25 computers in various locations including: the Malian Ministry of Rural Development and Water (MDRE), Statistics and Environment (STQ/CIGQE), two research stations within the Institute de l'Economie Rurale (IER) (Sotouba and ECOFIL), and DNAMR. Staff training in these institu-

**Principal Investigator**  
Neville Clarke

**Co-Principal Investigator**  
Jeffrey Vitale

tions will continue in the second half of Year Five. Capacity will be increased even further with longer term training in year 6. Kenyan trainees have worked with the DSS methods at an earlier stage of development of the Central Rift Valley study and will provide similar feed-back from their perspective to that received from Malian colleagues when the Nairobi workshop is conducted in the first quarter of year 6.

Document the structure and operation of the several models in the DSS, along with the related databases - This activity has been completed for West and East Africa. Training materials have been developed and provided to collaborators in each country. These materials document the theoretical underpinnings, model structure, and computer operation for the overall DSS and the integral components.

Feedback on final design of DSS - During Year Five, workshops in Senegal for CILSS, Mali for IER collaborators and (planned) for Kenya are providing feed-back from collaborators and users on the final design of the DSS. Completion of these engagements, including those with trainees who are analysts and researchers in the two countries, will contribute to making the DSS more usable, practical, and relevant.

## **OBJECTIVE 2**

Participate with national and regional partners in information, training and evaluation workshops on the products of the DSS.

### **Achievements**

Workshop of collaborators in Kenya - This workshop has been delayed as a result of travel restrictions for U.S. citizens in Kenya. It is tentatively scheduled for August 2003.

Support CILSS commitment to employ the DSS methods - The CILSS has stated the intent to acquire capacity to and then use the DSS as a planning tool in the implementation of their new strategy. They are seeking funding to implement a capac-

ity building effort at the regional level. This is to be backstopped by TAMU after the end of Year Five of SANREM II. A workshop was held for CILSS operators in June 2002 in Dakar. There the DSS was presented to various CILSS decision makers using the Sikasso case studies as an example of the DSS utility in developing countries. Following this meeting a proposal was sent to CILSS in Ouagadougou that outlined a training program consisting initially of three CILSS countries. The Dakar workshop exposed approximately 25 analysts and decision makers to the DSS and created substantial awareness and interest in its application.

WAICENT-FAO - A definitive linkage on the CNRIT/SANREM website is anticipated; therefore, the DSS models and databases will be available and the FAO Worldwide Agricultural Information Center (WAICENT). This will provide access to the DSS through WAICENT for both FAO and national users in both developing and developed countries.

## **OBJECTIVE 3**

Provide long-term training of national analysts in both research and operational parts of the government.

### **Achievements**

The plans for providing long-term training of national analysts in both research and operational parts of the government - Long term training for Malian and Kenyan nationals has been completed in the scope of SANREM II.

## **OBJECTIVE 4**

Engage with national and regional partners in ongoing training and mentoring on the use of the DSS and its component parts in impact assessment.

### **Achievements**

Ongoing training with national and regional partners - In Mali, workshops have been conducted by

joint IER/TAMU scientists in June and October. A third workshop is planned for July 2003 to be conducted jointly by IER/TAMU scientists. To date a total of 16 Malian scientists are enrolled in this workshop oriented training course. Since returning from intensive short term training last year, Kenyan collaborators are proceeding with practice in the use of the DSS in preparation for year 6 studies.

Case studies conducted by Malian scientists - This group is conducting a series of small case studies as part of their training program, using the models and data developed for the Sikasso study. Potential case studies were discussed during the October 2002 workshop. The topics include crop-livestock integration, impacts of crop intensification, and drought management. Studies will be conducted during latter parts of the workshop. The case studies will be completed following the upcoming Mali workshop in July, 2003.

Upper Tana River Basin study by Kenyans - After completing the intensive residence training at Texas A&M, Kenya trainees in communication with leaders in their government developed a definitive proposal to address the key national issue of reforestation and enhanced farming systems in the Upper Tana River Basin. The importance of this study led to its incorporation into the Year 6 DSS plan. Kenyan trainees (collaborators) have initiated the acquisition of the data needed to model the Tana River basin in response to options for reforestation. An in depth workshop will be conducted with Kenyan colleagues in August 2003 to review the Rift Valley study and the results of a number of practical applications of the method to problems identified by Kenyan decision makers. 3. Training Report - the results of intensive training, training workshops, and related case studies is documented in a separate training report on the CNRIT website – <http://cnrit.tamu.edu>.

## **Advances**

**In Research:** Anticipated results included packaging and delivery of models in form and format for users with varying levels of experience, Common Modeling Environment middleware that would pro-

vide access to suites of complex models and databases in a user- friendly format, and final design of tools and databases based on engagement with national partners and decision makers. Progress has been excellent in developing delivery systems and in upgrading capacity of governmental analysts and research scientists in the national research institutions. The actual outcomes have met expectations, as spreadsheet versions of FLAM and ASM have been developed and delivered (in the Mali case). The installed user base is about 25 computers, and the number and capacity of users is expected to increase after the upcoming workshop in July 2003. The smaller number of more intensively trained analysts from Kenya will have the ability to exercise the DSS in practical application and it is anticipated they will be come trainers of other users on return. Kenyans will be active participants in the Upper Tana River basin study in year 6 of the DSS effort. Packaging of the DSS suite of models into formats that are more usable by those not highly trained in modeling and GIS has been very well received and is substantially increasing its sustainability. Further development of the system interfaces and the additional opportunity for capacity building in year 6 will add to the utility of the final product.

**In Capacity Building:** The seminars in Year Five in West Africa and its hands-on training have increased the capacity of the 16 Malian scientists included in the training. The DSS and its modules introduce a more systematic approach to the research methods currently employed. This has the potential to shift the research agenda to more meaningful questions, particularly those regarding future agricultural conditions in Mali. The information that this corps of scientists will be able to produce is intended to be passed onto decision makers at various levels of scale in order to provide more relevant information and to produce an enhanced decision making environment. Four trainees from Kenya's Ministry of Finance and Planning and Ministry of Agriculture and Rural Development were trained at Texas A&M University and have put their skills to practice in planning and conducting a major segment of the year 6 DSS work on the Upper Tana River basin project.

**In Scaling Up:** Workshops involved participation by analysts and users from countries surrounding Mali and Kenya. Support by regional organizations and incorporation of models and databases into the FAO-WAICENT library also ensured regional and global scaling up.

Vertical and lateral scaling is inherent in the DSS which uses powerful spatial analytic tools combined with models for economic, biophysical, and environmental factors. Delivery systems have been substantially simplified, making these tools and capacities much more accessible to developing country partners and customers. The workshop conducted for CILSS representatives in Dakar in June 2002 provided broad exposure to the DSS in West African countries and led to the planning of separately conducted regional training on the DSS. Workshops intended for year 5 will be completed in the early part of year 6 to provide additional practical experience on scaling.

**In Policy Impact:** Explicit linkages with policy makers in the governments of Mali and Kenya throughout the development process have ensured that the models and case studies conducted in SANREM II are relevant and contemporary. Appropriate delivery systems and capacity building are critical requirements for successful application of the DSS to policy issues and options at varying levels of scale. Explicit linkages with policy makers in the governments of Mali and Kenya have been established throughout the development process, and have ensured that the models and case studies conducted in SANREM II are relevant and contemporary. The three Malian workshops in 2002 have further strengthened this, and the case studies to be conducted by the Malian workshop trainees add an additional level of policy relevance. The workshop in Kenya on the Rift Valley study will be a capstone for decision makers' awareness of the methods and their use. Once completed, the potential for DSS to be institutionalized is increased as is the likelihood that decision makers would continue to use the methods beyond year 5. There continues to be a recognition of the need for appropriate delivery systems and the critical role that capacity building plays in successfully applying the DSS to policy issues and options at varying levels of scale.

**In Improved Environment In Natural Resource Management:** Capacity building and effective delivery systems are critical requirements for the use of the DSS in planning and policy decisions affecting the sustainable use of natural resources in meeting future food security needs. For this reason, the training programs in Mali and Kenya are being developed in a unique manner that teams up scientists from various disciplines including those with strong environmental backgrounds. Environmentally trained scientists and analysts are key members of the two teams and currently work at institutions specifically devoted to NRM. In planning their training, their respective national sponsors have agreed that they will train together and then work together to apply the DSS in integrated analysis that has a major natural resource management component. The emphasis placed on range land and analysis aimed at mixed farming systems helps to ensure that NRM considerations are prominent in application of the DSS methods. The increased capacity of these scientists increases the potential for an improved environment as a result of stronger research and development staffing that can provide decision makers at various levels of scale with better information regarding NRM.

## **Publications**

### **Journal Articles**

Bessler, D. and A. Kernga. 2002. Price discovery: The case of millet in Bamako, Mali. *Journal of African Economies*. 11(4): 472-502.

Vitale, J. and J. Sanders. 2003. New markets and technological change for the traditional cereals in Sub-Saharan Africa: The Malian case. In press for publication in *Agricultural Economics*.

## **Other Major Outputs in This Period**

### **Tools**

TAMU, 2003. *Training on 2003 Impact Assessment Report: East and West Africa*. TAMU.



# SANREM Global Impacts and Information Exchange

## Project Overview

### **Introduction**

Global Impact and Information Exchange (GIIE) consists of two separate initiatives that blend to mutually support the SANREM program and regional project themes. Coordinated and administered by the Management Entity (ME) of SANREM, the major thrusts of the GIIE project are information dissemination and identification of decision support opportunities.

The GIIE Project has two key activities; these are categorized under the headings of:

1. Communication and Information Exchange
2. Development of Decision-Maker Priorities and Decision Support Opportunities

The two projects under the Global Impacts and Information Exchange complement each other by integrating demand and supply sides of knowledge related to sustainable agriculture and natural resource management decisions. On the one hand, the Communication and Information Exchange (GLO-11) initiative aims to increase availability of information and access to information and tools produced by SANREM and by other research. On the other hand, the Decision Maker Priorities and Support Opportunities (GLO-31) initiative aims to

ensure that SANREM's decision support activities are responsive to real demands of decision-makers. This activity emphasizes the understanding of the process of decision making at various levels and the identification of the specific needs of different groups of decision-makers and of appropriate types of decision support (e.g., data and information, tools and methods, and capacity building).

### **Accomplishments**

#### *Communication and Information Exchange*

This activity centers on the on the production of a wide gamut of communication products that document and synthesize SANREM's research findings for a diversity of audiences. In addition, efforts have been directed to increase access to resources, networks, and information related to sustainable agriculture and natural resource management. Outputs include:

Website: The ME manages the SANREM website, but the regional program (Andes, South East Asia and West Africa) have also set up their own websites to highlight the own activities. The SANREM website is user-friendly and interactive and has been improved to enable frequent updates with new information on SANREM activities and outputs and access to time-sensitive opportunities.

The SANREM website and the tools and links it provides access to enhance the capacity of scientists, development professionals, and policy makers, particularly in developing countries where access to information and resources is limited. The website received about 30,000 visits during 2002-2003, with the average visitor engaging in 15 accesses of different pages and documents.

Highlights for Year 5 are:

- a) An updated comprehensive list of over 500 SANREM publications and other outputs, about 40% of which are downloadable (some publications are copyrighted and therefore not available electronically except as abstracts);
- b) An expanded repertoire of downloadable tools for NRM decision support, including tools for environmental and economic modeling, sustainability monitoring, social and NRM assessments, Holistic Management planning, multistakeholder decision making, institutional analysis, etc.;
- c) A frequently updated "Announcements" section with information on international conferences, calls for papers, requests for proposals, job opportunities, and newly released resource materials;
- d) An enhanced "Related Links" page, including linkages to other resources and organizations and organized by key themes, innovative approaches and methodologies, and bibliographic engines;
- e) A new "What We Are Reading" (under Resources) series to disseminate new resource materials in different languages relevant for policy makers and practitioners;
- f) A new, continually-updated, photographs database, including information about the subject, location, and author of each photograph, and accessible via the Team Room;
- g) A streamlined system for online reporting which greatly reduces the amount of time required to make information available to both SANREM and external audiences.

Research Briefs: A key objective of this activity is to make research results available to the public in

an accessible format. The SANREM Research Brief series, started in 2001, was expanded with two additional briefs (two on methodology, two on policy). The briefs enable a diverse non-specialized audience, including practitioners, educators, and decision makers to access relevant information and methodologies generated by SANREM. The briefs are available online for downloading and distribution:

<http://www.sanrem.uga.edu/index.cfm?pageID=20>

PI Profiles: A PI profiles series was launched, showcasing the scientific accomplishments of SANREM's PIs and how their involvement in SANREM contributed to their intellectual and professional development. Two profiles (of former Deputy Director Constance Neely and of SANREM SEA PI Agnes Rola) have been produced and posted on the website so far.

#### *Development of Decision-Maker Priorities and Decision Support Opportunities*

A concerted effort was directed towards facilitation of understanding and prioritizing of watershed management issues among a diversity of stakeholders. Various tools were produced to enable researchers to identify and respond to decision-makers' needs, and therefore ensure the relevance and feasibility of technologies and approaches developed by research. Other tools are directed to decision makers, to enhance their capacity to prioritize between interventions in ways that enable optimization of scarce resource use and enhancement of project performance.

Multistakeholder consultations: Seconded to the Food and Agriculture Organization (FAO) for five months, SANREM's Deputy Director Dr. Constance Neely worked with civil society groups and governments in the development of a Sustainable Agriculture and Rural Development (SARD) Initiative to serve as a planned output of the 2002 World Summit on Sustainable Development. Dr. Neely also played a key role in the design, implementation and moderation of an electronic forum, with over 720 participants from 55 countries on Good Practices for SARD, Fair Employment for Agricultural Workers, Access to Genetic Resources and Access to Land. Dr.

Neely's involvement in the SARD Initiative enabled better communication and partnership building between policy makers and government officials on the one hand and civil society on the other, including less powerful groups such as women, youth, indigenous people, and agricultural laborers.

E-conferencing guidelines: A set of guidelines for implementing electronic conferences has been produced. This tool, designed to serve users who do not have ready access to web based platforms, provide step-by-step directions for planning, implementing, and moderating electronic discussions. It enables the realization of the potential of e-conferencing for the elicitation of decision-makers' priorities for tools, information, and capacity building support for improved decision-making on natural resources management. The manuscript is ready for publication. A draft can be requested from Dr. Constance Neely ([constance.neely@fao.org](mailto:constance.neely@fao.org)).

Watershed management framework: Based on an assessment of experiences by government and non-governmental organizations in Latin America, Africa, and Asia and on a synthesis of international literature on watershed management a framework was developed for prioritizing among watershed interventions, sharpen the intervention focus on critical locations and activities that can yield good and long term pay off for resource users. The framework is showcased in two articles in professional journals directed to development practitioners and to policy-makers.

Directed reading module: A directed reading module on watershed management has been compiled, including a general overview as well as targeted readings on key concepts and approaches, planning tools, citizen participation, watershed quality assessments, and identification and implementation of corrective actions. The module addresses the needs of development practitioners, environmental activists, government officials, and educators. The module is being finalized and will be reviewed by a small interdisciplinary committee of SANREM researchers before being posted on the website.

Watershed modeling manual: Support was provided to produce a manual that synthesizes the watershed modeling experience of SANREM SEA research in the Philippines for a wider readership than that targeted by technical publications. The 100-page manuscript, entitled "Conducting Economic Policy Analysis at a Landscape Scale: An optimization-simulation approach with examples from the agricultural economy of a Philippine watershed," includes an updated literature review and highlights how economic and environmental modeling tools can be used for supporting and prioritizing resource management decisions. The draft document can be downloaded from <http://www.agecon.purdue.edu/staff/shively/manuali> (embedded in file containing software) but is to be published separately in 2003. Part of this document will also be included in a volume on "Land Use Changes in Tropical Watersheds: Causes, Consequences and Policy Options" and edited by G. Shively and I. Coxhead to be published by CABI in 2004.

Training materials: Materials in English and Spanish were developed to train social and biophysical scientists and practitioners throughout Latin America to identify key stakeholders and to design and carry out demand-driven watershed research. Materials can be requested from Dr. Cornelia Flora ([cflora@iastate.edu](mailto:cflora@iastate.edu)).

### **Impacts**

The enhanced website has greatly increased the flow of communication among SANREM researchers and collaborators and will enable greater comparability of methods and integration of findings. Innovative communication tools have also substantially improved access by specialized and non-specialized audiences to relevant information and methodologies generated by SANREM. The various tools, manuals, guidelines, and frameworks produced enhance the capacity of US-based and host-country researchers and practitioners to conduct demand-driven research or development interventions, ensuring the relevance and feasibility of technologies and approaches being produced and promoted. By providing a gateway to relevant resources and linkages, the SANREM website and online communication products provide a con-

stantly expanding and updating opportunities for continuing education and on-the-job training.

Several outputs of this GIIE project directly respond to the needs of policy makers-makers. The Research Briefs outline policy recommendations that emerge from SANREM's research, relative to agricultural development, land use planning, buffer zone management, biodiversity conservation, water quality, trade and price policies, non-farm employment, and carbon sequestration. Separate versions of Perez and Tschinkel's framework for prioritizing watershed interventions were designed to appeal to development planners and policy-makers. The wide repertoire of tools accessible through the website also enhances policy makers' capacity to analyze and to predict outcomes of decisions and to prioritize between interventions in ways that enable optimization of scarce resource use and enhancement of project performance.

Through Dr. Neely's work with FAO and, in particular, her participation in multistakeholder consultation and preparation of documents for the 2002 WSSD, SANREM contributed to greater prominence of sustainable agriculture and natural resource management principles in international commitments and deliberations. It also enabled better communication and partnership building between policy makers and government officials on the one hand and civil society on the other, including less powerful groups such as women, youth, indigenous people, and agricultural laborers. The e-conferencing manual offers a tool for stimulating and structuring interaction between stakeholders in ways that facilitate consensus building and inclusion of diverse agendas into research practice and development policies.

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
Funded by the U.S. Agency for International Development (USAID)**

**July 2003  
Annual Report  
GLO-11**

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## **Communications and Information Exchange**

### **OBJECTIVE 1**

Collect and facilitate access to knowledge generated by SANREM regional and global projects.

### **Achievements**

A number of communication products and tools have been produced to document and synthesize SANREM's research findings to various audiences and to enhance their availability:

Two Briefs have been created, bringing the total number of SANREM Research Briefs series to 14. They are both relevant to policy analysis and draw from SANREM's experience in the Philippines, respectively tools for measuring costs of carbon storage for various land use systems and on mechanisms to better integrate natural resource management research into policy design and implementation. In addition, four Policy Briefs and eleven additional Policy and Economics Based documents including Policy Notes, Economic Issues of the Day, and Development Research News, generated by regional projects, have also been made available. A readership survey, eliciting readers' feedback, has been completed.

A PI profiles series was launched, showcasing the scientific accomplishments of SANREM's PIs and how their involvement in SANREM contributed to their

intellectual and professional development. The series features US-based and host-country PIs. Two profiles (of former Deputy Director Constance Neely and of SANREM SEA PI Agnes Rola) have been produced and posted on the website so far.

We have successfully increased the accessibility of SANREM materials on our website, namely through the provision of downloadable copies of SANREM publications. Additionally, as of November 2002, the lists of SANREM publications and other accomplishments are up to date. Phase II has boasted 500 publications, including 10 books, 61 book chapters, 70 journal articles, 33 proceedings, and over 100 conference presentations. Prior to Year 5, however, a small percentage of these publications were available for downloading. Efforts to make them accessible electronically, via SANREM's web site, were a major thrust during Year 5. Many publications were copyrighted and therefore not available electronically except as abstracts. Currently, approximately all SANREM Phase II downloadable publications (i.e. 40% of all publications) can be downloaded. The percentage of downloadable publications will continue to steadily increase as many scholarly journals are making full articles available on-line, and an increasing number of authors are choosing to make their work available to a broader audience (via the internet). For documents cov-

**Principal Investigator**  
Carla Roncoli

**Co-Principal Investigator**  
Robert Phares

Kristen Miller

ered by copyrights, namely journal articles, abstracts have been posted.

A photographs database has been created, and organized according to region. The database includes information about the subject, location, and author of each photograph. The database is accessible via the website's Team Room by all SANREM PIs and is continually being updated as new materials come in from the field.

Printed copies of SANREM materials and brochures have been distributed at appropriate venues.

## **OBJECTIVE 2**

Generate awareness of SANREM research and activities and promote understanding of sustainable agriculture and natural resources management issues, in particular as undertaken by SANREM.

### **Achievements**

SANREM played an active role in international multistakeholder consultations relative to the future implementation of Chapter 14 of Agenda 21 (Sustainable Agriculture and Rural Development). Seconded to the Food and Agriculture Organization (FAO) for five months, SANREM's Deputy Director Dr. Constance Neely worked with civil society groups and governments in the development of a Sustainable Agriculture and Rural Development (SARD) Initiative to serve as a planned output of the 2002 World Summit on Sustainable Development. She facilitated communication and consensus building on SARD issues leading to the development of partnerships and commitments among the Agenda 21 Major Stakeholder Groups (Scientists, Farmers, Business and Industry, NGOs, Local Authorities, Youth, Women, Indigenous People, and Agriculture and Trade Workers) and other key actors, including international organizations and governments. Accomplishments include the design, implementation and moderation of an electronic forum, with over 720 participants from 55 countries. The e-forum focused on key aspects of the SARD Initiative, including Good Practices for SARD, Fair

Employment for Agricultural Workers, Access to Genetic Resources and Access to Land. Dr. Neely also served on the FAO delegation for the Commission on Sustainable Development Preparatory Committee Meeting held in May in Indonesia and during the WSSD she continue to catalyze dialogue among FAO, civil society, and governments to promote the SARD Initiative.

## **OBJECTIVE 3**

Facilitate exchange of information and data generated by SANREM research among and between SANREM partners and others interested in sustainable agriculture and natural resource management.

### **Achievements**

The SANREM website is the main vehicle for facilitating exchange of information among diverse audiences interested in sustainable agriculture and natural resource management. The website is user-friendly and interactive.

The SANREM website is continually being updated with information on relevant events and developments on sustainable agriculture and natural resource management, including international conferences and workshops, calls for papers, requests for proposals, job announcements, etc. The website received about 30,000 visits during 2002-2003, with the average visitor engaging in 15 accesses of different pages and documents.

The repertoire of downloadable tools continues to be expanded and updated. Resources include tools for environmental and economic modeling, sustainability monitoring, social and NRM assessments, Holistic Management planning, multistakeholder decision making, institutional analysis, etc.

The number of linkages to other resources and organizations has been greatly expanded. They include information on key themes (i.e. Agriculture, Biodiversity, Climate Change, Gender), on innovative approaches (i.e. Ecoagriculture, Landscape Planning) and on decision support and assessment tools (i.e. Conflict Mediation, Impact Indicators, Participatory Research, Visioning, GIS and

Mapping) as well as access to Bibliographic engines. A "What We are Reading" series has also been initiated, to highlight and disseminate new resource materials relevant for policy makers and practitioners.

## **Advances**

**In Research:** The availability of SANREM research results have been greatly increased through an expanded, updated publication and photographs database. The SANREM Research briefs have enabled a diverse non-specialized audience, including practitioners, educators, and decision makers to access relevant information and methodologies generated by SANREM. The PI Profile series stimulates commitment and collaboration.

**In Capacity Building:** The SANREM website and the tools and links it provides access to (including access to downloadable materials and to information on opportunities for networking, publication, research funding, and employment in the field of sustainable agriculture and natural resource management) enhances the research capacity of scientists and development professionals, particularly in developing countries where access to such resources is limited.

**In Scaling Up:** Through Dr. Neely's work with FAO and, in particular, her participation in multi-stakeholder consultation and preparation of documents for the 2002 WSSD, SANREM contributed to greater prominence of sustainable agriculture and natural resource management principles in international commitments and deliberations.

**In Policy Impact:** Several SANREM Research Briefs address the needs of policy makers, by outlining policy recommendations relative to agricultural development, land use planning, buffer zone management, biodiversity conservation, water quality, trade and price policies, non farm employment, and carbon sequestration. One brief spells out principles for a better integration of science and policy. The Related Links and Tools pages facilitates access to key decision support, planning, and evaluation tools by policy makers and the "What Are We Reading" series enables access to resource

material on natural resource management policy (including French translations for Francophone Africa). Dr. Neely's involvement in the SARD Initiative enabled better communication and partnership building between policy makers and government officials on the one hand and civil society on the other, including less powerful groups such as women, youth, indigenous people, and agricultural laborers.

## **Other Major Outputs in This Period**

### **Research Briefs**

Buenavista, G. 2003. Integrating Research and Policy for Natural Resource Management: Lessons Learned in the Philippines. SANREM CRSP Research Brief. No. 13.

Shively, G. 2003. Assessing the Prospects for Carbon Sequestration in the Manupali Watershed, Philippines. SANREM CRSP Research Brief. No. 14.

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
Funded by the U.S. Agency for International Development (USAID)**

**July 2003  
Annual Report  
GLO-31**

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## **Development of Decision-Maker Priorities and Decision Support Opportunities**

**Principal  
Investigator**  
Carla Roncoli

### **OBJECTIVE 1**

To fine tune the methodology for identification and understanding of natural resource decision – making priorities and constraints.

### **Achievements**

The objective has been accomplished through a concerted effort to facilitate better understanding and prioritizing of watershed management issues among a diversity of stakeholders, including practitioners, educators, activists, and decision makers.

1. Based on assessments of experiences by government and non-governmental organizations in Latin America, Africa, and Asia and on a synthesis of international literature on watershed management a framework was developed for prioritizing among watershed interventions, sharpen the intervention focus on critical locations and activities that can yield good and long term pay off for resource users, their communities, and their environments. The framework is showcased in two articles in professional publications directed. The first paper, authored by Carlos Perez and Henry Tschinkel and entitled "Improving watershed management in developing countries: a framework for prioritising sites and practices", is being published in

July 2003 in Overseas Development Institute's Agricultural Research and Extension Network (Paper n.129). This is a longer version that targets specialists and practitioners in the field. The second paper is a different, shorter version, addressed to policy-makers, and is under review by Society and Natural Resources. It is titled "Watershed Management and Poverty Alleviation: Are they Compatible?"

2. A directed reading module on watershed management has been compiled, with input from SANREM and non-SANREM scientists and educators. The module intends to provide a condensed reader of important resources on the topic. The reading list includes a general overview as well as targeted readings on key concepts and approaches, planning tools, citizen participation, watershed quality assessments, and identification and implementation of corrective actions. The module addresses the needs of development practitioners, environmental activists, government officials, educators (especially at college level), and other interested individuals, particularly in developing countries where access to libraries or opportunities for continuing education are limited. Emphasis is on downloadable resources and references to commercially available materials and manuals. A CD containing all accessible materials will be produced

**Co-Principal  
Investigator**  
Carlos Perez

and sent to interested individuals in developing countries who may not be able to download them directly. The module will be posted on the SANREM website and disseminated through sustainable agriculture and natural resource management listservs and environmental education websites. The module is being finalized and will be reviewed by a small interdisciplinary committee of SANREM researchers before being posted on the website.

## **OBJECTIVE 2**

To synthesize and prioritize decision-maker concerns to help focus decision support research activities of SANREM, its collaborating partners, and other interested parties.

### **Achievements**

Support was provided to produce a manual that synthesizes the watershed modeling experience of SANREM SEA research in the Philippines for a wider readership than that targeted by technical publications. The 100-page manuscript, entitled "Conducting Economic Policy Analysis at a Landscape Scale: An optimization-simulation approach with examples from the agricultural economy of a Philippine watershed," includes an updated literature review and highlights how economic and environmental modeling tools can be used for supporting and prioritizing resource management decisions. The draft document can be downloaded from <http://www.agecon.purdue.edu/staff/shively/manupali> (embedded in file containing software) but is to be published separately in 2003. Part of this document will also be included in a volume on "Land Use Changes in Tropical Watersheds: Causes, Consequences and Policy Options" and edited by G. Shively and I. Coxhead to be published by CABI in 2004.

## **OBJECTIVE 3**

To compare and validate the demand for tools, information, and capacity building support to improve natural resource management decisions in the regions and globally.

### **Achievements**

The vast experience of SANREM's former Director Dr. Robert Hart and Deputy Director Dr. Constance Neely's in facilitating multistakeholder dialogue has been consolidated into a set of guidelines for implementing electronic conferences. The guidelines draw upon experiences in creating international fora for dialogues and debates at national, regional and international levels surrounding issues relevant to international research and development that have taken place over the course of the last decade. This tool, designed to serve users who do not have ready access to web based platforms, provides step-by-step directions for planning, implementing, and moderating electronic discussions. It enables the realization of the potential of e-conferencing for the elicitation of decision-makers' priorities for tools, information, and capacity building support for improved decision making on natural resources management. The manual will be posted on the SANREM website and widely distributed throughout the regions.

## **OBJECTIVE 4**

To integrate findings into a participatory monitoring and evaluation framework to assess how research activities are progressing towards addressing decision-maker priorities.

### **Achievements**

Support was provided for participatory production of training materials in English and Spanish. The materials will be used to train social and biophysical scientists and practitioners throughout Latin America to identify stakeholders whose decisions influence the watershed, to assess appropriate roles and mechanisms of participation in watershed research, and to integrate watershed research with local decision makers' priorities, such as household prosperity, community well-being and environmental health.

### **Advances**

**In Research:** The various tools, manuals, guidelines, and frameworks produced enable researchers

to identify and integrate decision-makers' needs and concerns and therefore ensure the relevance and feasibility of natural resource management technologies and approaches that are being developed. SANREM's research agenda for year 6 will be built on a better fit between scientific questions and decision makers' priorities.

**In Capacity Building:** Several accomplishments of this workplan directly address the decision-support and institutional capacity needs of resource managers and development practitioners. They enhance capacity to analyze and to predict outcomes of decisions and to prioritize between interventions in ways that enable optimization of scarce resource use and enhancement of project performance. The directed reading list expands understanding by practitioners, educators, activists, and other interested stakeholders of key watershed management concepts and approaches and access to useful resources and materials. The training manuals and e-conferencing guidelines also increase capacity of host-country researchers to design demand-driven research and network with colleagues around the world.

**In Scaling Up:** The production of decision-support tools has been guided by the clear intention of making them applicable in a variety of agroecological and socioinstitutional contexts. Wide dissemination in a variety of formats (web-based, CDs, hardcopies, etc.), particularly through key training and research nodes which SANREM PIs are affiliated with, enables them to impact watersheds and regions where SANREM does not currently operate.

**In Policy Impact:** SANREM policy analysis research in the Philippines has identified that the major obstacle to a better integration of research and policy is the lack of understanding of policy-makers' decision environment and information needs (in terms of both content and format). The e-conferencing manual offers a tool for stimulating greater interaction between scientists and policy makers and ensures that research agendas address priority questions for policy making. A version of Perez and Tschinkel's framework for prioritizing watershed interventions, specifically designed to

appeal to and be accessible to policy-makers, will lead to more sustainable interventions and cost effective resource allocation among various watershed management options.

## Publications

### Journal Articles

Perez, C. and H. Tschinkel. 2003. *Improving watershed management in developing countries: a framework for prioritizing sites and practices*. Overseas Development Institute's Agricultural Research and Extension Network (Paper n.129).

Perez, C. and H. Tschinkel. 2003. *Watershed management and poverty alleviation: Are they compatible?* Submitted to Society and Natural Resources.

### Tools

Flora, C. 2003. *Training Modules for Interdisciplinary Participatory Research*. Iowa State University. Ames, Iowa.

Neely, C. and R. Hart. 2003. *Managing electronic fora for participatory decision making*. SANREM CRSP. Athens, Georgia.

Shively, G. 2003. *Conducting Policy Analysis at a Landscape Scale: An Optimization-Simulation Approach with Examples from the Agricultural Economy at a Philippines Watershed*. Draft version downloadable at <http://www.agecon.purdue.edu/staff/shively/manupali> (embedded in file containing software). Purdue University. West Lafayette, Indiana.



# SANREM Southeast Asia

## Project Overview

The Southeast Asia regional program of SANREM continues to produce excellent and innovative research and to convert it into scholarly publications, higher and continuing education training, and useful and high-impact outreach at various levels from community to national government. Evidence of the value of our work is clear in continued strong growth of demand for community-level outreach (now in all areas of the Philippines); in requests from provincial and regional administrations for data and technical support; and in the comments of peer reviewers in the international scholarly community on articles and book manuscripts submitted by SANREM researchers. SANREM researchers have won recognition in the form of grants from highly competitive Federal agencies including the NSF. In the Philippines, national legislators and government officials now regard SANREM as an authoritative source on watershed-based natural resource management, water resource management, and related policy advising. This national reputation has been greatly enhanced through our long-term partnerships with leading university researchers in agricultural and resource economics and with the national government's primary economic and policy think-tank.

The prospects for further research discoveries, outreach and policy impact, and institutional development resulting from SANREM activities are very strong, both in the Philippines and also in Vietnam, where our research initiatives are now beginning to pay off in the form of institutional commitments from universities and government departments. These are rewards won by a combination of longevity (our work now stands out internationally for its depth of time perspective), the continuous participation of high-quality, dedicated researchers, and an institutional commitment to meaningful collaboration across disciplines and national boundaries.

### **Research highlights**

Highlights of research accomplishments include continued innovation in on-site research into agricultural and natural resource management strategies, based on interdisciplinary collaboration in agronomic and economic research; continued expansion and deepening of water quality monitoring and analysis activities, and further outreach of this activity to communities around the Philippines; and continued innovation in policy-related work at community, local and provincial government, and national government levels, with notable results at provincial and national levels.

Additionally, a GIS database has been constructed and used to track land cover changes. This data set is now in demand for planning purposes by the Government of Bukidnon. It is available to other researchers through SANREM web site.

### **Degrees and training**

SEA-32 and -42 produced three graduates (two M.S. and one Ph.D., University of Philippines at Los Baos) during Year 5. SEA-24 produced one Ph.D. graduate (Purdue University.)

### **Leveraged funding and activities**

Jerry Shively and Dang Ha (SEA-24 and ERGP) won a U.S. federal grant (from ALO) for parallel work on curriculum development to be based in Ho Chi Minh City.

Jerry Shively (SEA-24) won an NSF grant for research on environment and development in Palawan, Philippines, using the upland-lowland analytical approach refined in SANREM work.

Our ERGP program attracted a strong field of candidates and the selected projects all brought in expertise and counterpart funds to augment SANREM activities.

### **Outreach and ‘scaling’**

Site-based water quality monitoring activities have been conducted, along with training and other institution-building activities, in Bohol Province, Sarangani Province, and in western Bukidnon province (four watersheds). New members have been inducted and trained in Lantapan-based water watch NGO.

Numerous site-based workshops were held on a range of topics, including those by Dr. Ella, an ERGP grantee, on use of erosion prediction models.

In-depth discussions with the Governor of Bukidnon and advisors on the use of SANREM methods and data for resource management planning province-wide have taken place.

### **Highlights of dissemination and policy impact**

Water policy researchers at UPLB and PIDS (SEA-53) hosted a Policy Forum on Water Resources Management in August, 2002 for a national audience including congressmen and representatives from national government, local administrations, business and NGO groups, and the media. The four papers commissioned for the forum were presented and discussed; following the forum, five more papers were commissioned, the whole to be issued as a monograph in late 2003. The forum led to the involvement of SANREM researchers in the drafting and discussion of a number of provisions proposed as amendments to the National Clean Water Act (1999); these relate to the need for a watershed-scale approach to water management and the adoption of economic principles in the valuation and allocation of surface water resources. A longer report containing more detail is available; send requests to: [sanrem2001@madmail.aae.wisc.edu](mailto:sanrem2001@madmail.aae.wisc.edu).

ICRAF-SANREM workshop on "Locally Led Natural Resource Management" was held in Bukidnon December, 2002, with attendance by 82 local government officials from four provinces; presentations, reactions and discussions were led by SANREM & ICRAF resource persons, local government officials, senior UPLB researchers, Bukidnon provincial governor's office, and members of the Bukidnon Congressional delegation.

### **Highlights of publications**

A special issue of "Philippine Journal of Development," the leading outlet for development research in the Philippines, was devoted to SANREM research and appeared in print in early 2003.

Two "Policy Notes" were released (PN 2002-09 entitled *Why Watershed-based Water Management Makes Sense* and PN 2002-10 entitled *Using Community-Generated Data for Water Management Policy*) while three research briefs appeared in various issues of the *Development Research News* of the PIDS.

SEA-23 and -24 produced several articles in refereed journals and one book, published by Edward Elgar Company (UK and USA).

SEA-32 produced six publishable research briefs relating to the extension of lessons from Lantapan to Vietnam.

An ERGP grant to Dr. Ella produced two technical bulletins.

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
Funded by the U.S. Agency for International Development (USAID)**

**July 2003  
Annual Report  
SEA-01**

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## **Administration and Research Management for SANREM-Southeast Asia**

**Principal  
Investigator**  
Ian Coxhead

### **OBJECTIVE 1**

To manage and coordinate research and related activities conducted by PIs and work plan holders of the Southeast Asia project.

#### **Achievements**

A synthesis paper was submitted and published in Philippine Journal of Development; several other summaries of achievements and impacts were prepared and presented at USAID & internally.

Documents were archived in libraries, the website and on the SANREM SEA multi-media CD-ROM.

### **OBJECTIVE 2**

To provide administrative guidance for the research programs of the Southeast Asia project.

#### **Achievements**

Financial administration was conducted efficiently and effectively throughout Year 5. Early in the year modifications to all subcontracts were completed. Plans for closing out the project's financial processes, that had been discussed at the May 2002 Baguio meeting, were suspended when it was decided that there would be an interim Year 6.

### **OBJECTIVE 3**

To coordinate documentation and communication of SANREM-SEA procedures and results.

#### **Achievements**

Details of dissemination are listed in individual work plan reports. Details of communications with policy makers are listed in the reports for SEA-23 and SEA-53. Ground work for continuation in Year 6 was laid through the design of ongoing policy work with PIDS, PCAR-RD, Prov. of Bukidnon and local government.

### **OBJECTIVE 4**

To facilitate project monitoring and evaluation.

#### **Achievements**

The impact evaluation survey was completed. Data cleaning and analysis are in progress and a draft report of findings is in an internal review.

Phase II synthesis is dependent upon submission of final reports by PIs. This will be an activity in year 6.

**Co-Principal  
Investigator**  
John Rowe

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
Funded by the U.S. Agency for International Development (USAID)**

**July 2003  
Annual Report  
SEA-02**

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## **Administration and Coordination of the SANREM CRSP Southeast Asian Program (PCARRD)**

**Principal  
Investigator**  
Rogelio Serrano

**Co-Principal  
Investigator**  
Vel Suminguit

### **OBJECTIVE 1**

To provide timely administrative and coordination support to regional principal investigators and work plan holders.

### **Achievements**

This activity coordinated the Inter-project site visit and monitoring/evaluation of the Lantapan-based R&D Projects Technical Working Group last June 5-6, 2002.

SEA-02 also facilitated Mr. Gregg Clark's presentation on the Spatial Information Management Systems in July 2002.

This activity assisted other workplans conduct workshops such as the Participatory Impact Assessment (SEA-42) and policy workshop and field evaluation (SEA-23).

The coordination/facilitation of the 7th Technical Working Group meeting of all Lantapan-based R&D Programs on November 11, 2002 in Cagayan de Oro City was achieved.

The SCO co-directed the conduct of natural resources management impact assessment survey in 15 Bukidnon municipalities from November 11-27, 2002.

The coordination/facilitation of the 6th Steering Committee and 9th Technical Working Group meetings held at Malaybalay City, Bukidnon on January 10

and February 13, 2003, respectively, was achieved. New SC members include MKAVI representing the Private sector and Mr. Adolino Saway representing the indigenous peoples group and new TWG members coming from private companies like DOLE Skyland for banana, Medvil Farms Inc. for poultry, and Diel Joy Piggery Farm for swine.

The SANREM-PCARRD and SCO assisted the ERGP work plan on "Production of Instructional/Informational Materials on Sustainable Agriculture and Natural Resource Management in Comics Format for the SANREM CRSP/SEA Program" by reviewing and providing technical inputs to improve the content and presentation of the following four comics written in Cebuano: a. "Sa Lunhaw nga Bukid Mosidlak ang Paglaum!" (In the Mountains of Green, Hope Shall Rise); b. "May Kahayag pa Ang Ugma" (There is a Clear Future); c. "Gitugon ni Lolo Indo: Buhion Nato ang mga Buntod ug Higugmaon Nato ang Atong Kalikupan" (Advice of Grandfather Indo: Let us revive our mountains and take care of our environment); d. "Mga Bidlisiw sa Kalambuan" (The Rays of Progress).

The SCO coordinated and facilitated the presentation of Dr. Vic Ella on the result of his WEPP modeling activity to the members of Tigbantay Wahig.

The SCO partnered with ICRAF in the implementation of a survey entitled

“ATSAL Contribution to Reforestation Effort in Lantapan and Other Provinces Through Small-Scale Tree Domestication on Farm and Sale of Seeds and Seedlings,” which is currently being processed.

SANREM-PCARRD facilitated and organized the Annual Strategic Planning Workshop held on January 20-21, 2003 at Traders Hotel, Manila.

The SCO implemented and processed the TWG-initiated Technology, Information, and Communication Need Assessment Survey.

The SCO coordinated and presented to the farmers the results of SEA 23 “Agricultural productivity and sustainability trends and prospect in Lantapan, Bukidnon.”

The SCO assisted graduate students from the U.S. (Bayou Demeke and Rodd Dyer) during their reconnaissance visit to Lantapan on Jan. 28-Feb. 3, 2003.

The PCARRD-based communication specialists gathered data and conducted interviews for the SANREM Testimonial Book with the assistance of the SCO in January and February 2003.

The SCO assisted graduate students, Ms. Athena Custodio and Ms. Laarni Lacandula from UPLB during reconnaissance and data gathering visit in Lantapan.

The SCO assisted Mr. Rodd Dyer determine the spatial distribution of livestock and locate the sampling sites of water quality monitoring.

SEA-02 assisted Mr. Adolf Torres in the creation of his poster presentation entitled “Natural Resources Management and Development Plan: The Experience of Municipality of Lantapan, Bukidnon, Philippines” to the National Landcare Conference at the Northern Territory, Australia on April 28 to May 1, 2003.

## **OBJECTIVE 2**

To build linkages with other agencies and institutions that are implementing similar programs.

## **Achievements**

This activity co-sponsored, with PCARRD, the conference on Rewarding the Upland Poor for their Environmental Services (RUPES) last September 2002.

SEA-02 also assisted Kitanglad Integrated NGOs (KIN) in drafting the Implementing Rules and Regulations (IRR) of Mt. Kitanglad Act.

SANREM-PCARRD co-organized the "6th Multi-Sectoral Forum on Watershed Management: Unlocking the Keys to Sustainable Watershed Management" held at the Banaue Hotel, Banaue, Ifugao on November 14-15, 2002. During the forum, the SANREM Regional Program Co-Director served as discussant to the paper presented entitled “Indigenous Watershed Management Practices and Ancestral Domains/Property Rights Appropriate to Watershed”. Also on November 14-15, 2002, the SANREM-PCARRD Program Administrator participated to the "Conservation Farming Movements' Annual Conference and Symposium on Conservation Farming in Agricultural Modernization" in Cagayan de Oro City.

On October 7-10, 2002, the Regional Program Co-Director and Site Coordinator attended the "Kapihan sa Malaybalay" featuring Natural Resource Management Policy Initiatives of SANREM Program. They also attended to some problems in the operation of Alanib SANREM Automatic Weather Station (AWS) and visited other two SANREM weather stations.

SANREM-PCARRD conducted data gathering for SANREM impact write up for Research Briefs in Lantapan, Bukidnon and interviewed workplan holders/PIs on updates of their respective ongoing projects for the ERGP of Mr. L. Reyes last September 18-21, 2002.

The Regional Program Co-Director completed his monitoring and evaluation duties in Ho Chi Minh City, Vietnam as required for SANREM workplan SEA-32: Adapting and Transferring Lessons from Manupali to Other Critical Watersheds in Southeast

Asia: Focus on Vietnam on October 16-20, 2002. 7. The Site Coordinator attended the Impact Assessment Workshop held in Washington D.C., USA on September 10-24, 2002.

PCARRD-based staff attended the first mobile Wood Production Forest Commodity Team meeting and field visit among mangrove and agroforestry sites in Cagayan Valley on April 11-16, 2003 and conferred with Dr. Rogelio C. Serrano, Team Leader, Northern Luzon EcoGov Program regarding collaboration.

The SCO has established strong linkage with the Western Mindanao Community Initiatives Project (WMCIP), an IFAD-funded, DAR-implemented project in Zamboanga Peninsula. Farmers in the area rapidly adopted soil conservation measures after visiting ICRAF's site in Claveria and SANREM-ICRAF sites in Lantapan. In an effort to establish a learning site in the region for sustainable agriculture and natural resource management, ICRAF and IFAD tapped the Site Coordinator as the study leader in their collaborative study on documenting local agroforestry practices and ethnobotanical knowledge.

### **OBJECTIVE 3**

To support scaling and outreach activities at the community, provincial, national and regional levels.

#### **Achievements**

Provided the Bukidnon Watershed Planning and Development Council Technical Advisory Committee an orientation on GIS/GPS/Remote Sensing. As a result of this presentation, the provincial government has now set aside close to P1M for the purchase of some GIS-related software and hardware.

The Site Coordinator was appointed by the BWPDC/TAC as the consultant in the development of the province's GIS system.

As a panel member of the BWPDC/TAC, the Site Coordinator conducted technical reviews of the watershed management plans of the 22 municipalities of the Province of Bukidnon. The Site Coordinator's inputs will be integrated with other panel members' inputs to serve as a new guideline in the development of watershed management plans.

Facilitated the submission and consolidation of Program-wide Phase 2 cumulative accomplishment report including indicative impacts.

The Site Coordinator was appointed by the Provincial Governor as member of the Oversight Committee responsible for monitoring the implementation of Watershed Management Plans of the 20 municipalities and two cities.

### **OBJECTIVE 4**

To support program capacity building activities, especially for community-based partners.

#### **Achievements**

Using Cebuano dialect that is commonly used in Lantapan, the Site Coordinator presented to the farmers the results of the 9-year socio-economic survey conducted under the SEA-23 workplan (see accomplishment under objective 1 above). The socio-economic survey was conducted to the farmers in Lantapan, Bukidnon.

### **OBJECTIVE 5**

To organize and coordinate the annual conference of SANREM CRSP-Southeast Asia partners.

#### **Achievements**

The SANREM CRSP/SEA annual conference is being planned and has been postponed and scheduled on Year 6.

## **OBJECTIVE 6**

To improve public dissemination of research outputs.

### **Achievements**

PCARRD-based SANREM staff was interviewed over the local radio stations (DRZB, DZRM, DWAN and DWSS) providing overview of the SANREM CRSP/SEA program on January 15, 2003.

Published the SANREM CRSP SEA newsletter (Vol. 3, Nos. 2 and 3).

A survey on information, technology and communication need (see accomplishment under objective 1) was carried out to develop an effective communication strategy for Year 6.

Edited and proofread the Sustaining Upland Development in Southeast Asia (SUDSEA) Conference proceedings and in its layout stage. It will be completed on December 2003.

## **OBJECTIVE 7**

To facilitate access and sharing of primary data.

### **Achievements**

Continued regular downloading and archiving of AWS data. Created databases for the ATSAL Survey and Technology, Information Needs Assessment Survey. Acquired 9 years worth of data from the Policy Analysis work plan. Secured complete technical descriptions of the barangay boundary markers (BBMs) of Lantapan. The technical data is now being encoded and converted into polygons for use of the GIS work plan and watershed integrity work plan for year 6. Collected GPS points for the creation of Lantapan road networks.

### **Other Major Outputs in This Period**

SANREM CRSP SEA. 2003. SANREM CRSP SEA newsletter (Vol. 3, Nos. 2 and 3).

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
Funded by the U.S. Agency for International Development (USAID)**

**July 2003  
Annual Report  
SEA-23**

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## **Policy Analysis for Environmental Management Planning**

**Principal  
Investigator**  
Ian Coxhead

### **OBJECTIVE 1**

To develop a monitoring and evaluation system for NRMDP impacts and other national policy impacts on farm households and the community's natural resource endowments.

ers, mentioned that the data will be a good input into their development planning. He wanted a copy of the presentation materials. The SCO also has a copy of the data base and the presentation materials for dissemination to other stakeholders, i.e. the provincial level officials.

**Co-Principal  
Investigator**  
Agnes Rola

### **Achievements**

Through the end of phase survey in Oct. 2002, we have collected land, labor and soil conservation data.

### **OBJECTIVE 2**

To strengthen policy analysis and policy advocacy skills at the municipal and the provincial levels.

Trends analysis of yield, area, prices and farm incomes by various categories for major crops in the watershed from the period 1994 to 2002 are available. Trends in household incomes are also available for the period 1998 to 2002. These results were presented to the farmers-partners who worked with us for the past 9 years. Results also show that economic growth in the uplands has differential impacts on different groups of farmers. Our results were fully concurred by the farmer partners. More analyses of data are found in the several working papers prepared by the ISPPS, UPLB staff.

### **Achievements**

We have so far completed data collection needed to evaluate the implementation of the Lantapan NRMDP (Natural Resource Management Development Plan) and the MKMP by the ten barangays in the buffer zone.

We also have conducted one kapihan (an informal meeting such as a brown-bag discussion) with the NGOs.

Our database is now with the Lantapan municipal planning and development office and the municipal agriculture office. The president of the Association of Barangay Councils (ABC, Lantapan) who attended the presentation to farm-

### **OBJECTIVE 3**

To distill lessons learned from Lantapan at the national level.

### **Achievements**

The water policy forum was conducted in Aug. 2002.

Further meetings with the NWRB, and the DILG Water Resources Division were pursued and have now formalized our links between UPLB and these two offices of national government. These offices will advise us as well as invite us in any activities related to water and watershed management policies; in turn, we also give them any results of studies done along their areas of interest.

Policy briefs (with the PIDS) are now available for national policy makers consumption.

A meeting between SANREM researchers (Jim Oprecio, Agnes Rola, Dulce Elazegui and Jenny Liguton) and the officials of the Water Quality Division of the EMB was held last Jan. 2003. More follow-up activities were defined to facilitate policy relevant research activities.

## Advances

**In Research:** Eight discussion papers plus a synthesis paper are now collated into a volume for publication. This volume is in the review process and scheduled for publication by the end of 2003. Six of these papers were presented in the water policy forum in August, 2002. Two policy briefs were translated in the local dialect. An article on benefits and risks of banana production was submitted for publication to the agribusiness magazine. Eight ISPPS (UPLB) 2003 working papers contain analysis of data from the SEA-23 data base. These working papers are circulated to the academe and other sectors to generate discussions on the topics being presented. The wp abstracts will be available at the ispps website by the end of June, 2003.

**In Capacity Building:** As of Feb. 2003, we have trained 15 selected faculty and staff of the College of Public Affairs, UPLB and 2 staff of the PCAR-RD on "Communicating Research to Policymakers." The training output resulted in three policy briefs written by the trainees. Due to this increased capacity, the Dean of the College provided funds for the publication of at least six policy related materials. We do this in close collaboration with the PIDS.

**In Scaling Up:** Please refer to Act. 3

## Publications

### Books

Coxhead, I. and S. Jayasuriya. 2003. *The Open Economy and the Environment: Development, Trade and Resources in Asia*. Cheltenham, UK: Edward Elgar Co.

## Other Major Outputs in this Period

Calderon, R. and A. Rola. 2003. *Assessing the Benefits and Costs of Commercial Banana Production in the Philippines*. ISPPS Working Paper No. 03-03.

Chupungco, A. 2003. *Impacts of Trade Policies on Vegetable Prices in the Philippines*. ISPPS Working Paper No. 03-02.

Chupungco, A. 2003. *Impact of Trade Policies on Corn Prices in the Philippines*. ISPPS Working Paper No. 03-01.

Paunlagui, M., M. Nguyen and A. Rola. 2003. *Social Capital, Eco-governance and Natural Resource Management: A Case Study in Bukidnon, Philippines*. ISPPS Working Paper No. 03-04.

Rola, A. I. Coxhead, I. Bagares and E. Villavelez. 2003. *Economic Development in the Philippines' Uplands: Who wins? Who loses?* ISPPS Working Paper No. 03-05.

## Degree Training

Gregg Clark, M.S., 2001-2003  
Brian Wiley, Ph.D., 2001-2006

## Non-Degree Training

### On the job training

*Communicating Results to Policy Makers* was attended by 15 person(s) and lasted 3 day(s).

# SANREM CRSP

Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
Funded by the U.S. Agency for International Development (USAID)

July 2003  
Annual Report  
SEA-24

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## Integrated Watershed Modeling for Decision Support and Policy Planning

Principal  
Investigator  
Gerald Shively

### OBJECTIVE 1

To disseminate a computer-based tool for policy research and planning at the watershed scale to serve researchers, government agencies, and NGOs for whom natural resources management is a programming priority.

#### Achievements

Model construction, testing, revision and documentation has been completed. A technical manual regarding the model, its uses, and research results has been available via the web and CD (<http://www.agecon.purdue.edu/staff/shively>). This is now being copyedited and readied for publication as a technical monograph. Model dissemination continues through research channels.

### OBJECTIVE 2

Relate rate of eroded soil and decline in soil fertility to loss of yield potential in annual crops.

#### Achievements

The plan for this objective was to have Dr. Antonio Dano spend one month with Prof. Midmore in order to bring all data gathered since 1995 together, into a multivariate model, so as to predict yield changes associated with various changes in soil parameters. Dr. Dano

did spend two weeks with Dr. Midmore in Australia, and much data were compiled in a format ready for the combined analysis.

The hand-over of research plots to other agencies has not been completed, for we are still involved in the collection of data. A proposed trip to the Philippines in October/November was postponed due to travel restrictions imposed by the Australian Govt and CQU. More data have been collected from the erosion plots, especially in relation to erosion, the growth of trees, and C-sequestration. The multivariate analysis will be undertaken in the next six months, to bring all of the data together, for the final season's field data on yields and erosion have just been completed.

### OBJECTIVE 3

To evaluate and measure the potential economic and environmental impacts of changes in economic policy variables and corresponding changes in land use in a prototype watershed economy.

#### Achievements

A number of research discoveries have been published. As noted above, the model and documentation has been disseminated via CD and the web (at <http://www.agecon.purdue.edu/staff/shively>). A published paper by Nissen and Midmore also explores the economic

Co-Principal  
Investigator

implications of farmers introducing trees via forestry and agroforestry, and the policy implications of the latter as a means of re-afforestation. A Ph.D. dissertation (Zelek) was completed at Purdue and led to published research results. Dissemination in non-academic circles is in progress, both through SANREM (see the research brief at [www.sanrem.uga](http://www.sanrem.uga)) and in conjunction with partners at PIDS and PCARRD. A major research workshop will be held in Manila in early 2004. An edited volume of research findings is being reviewed by a publisher, with expected completion in 2004.

#### **OBJECTIVE 4**

Provide evidence for or against the thesis that full and/or partial conversion of vegetable farms to agroforestry will lead to sustainable use of soil and water resources, and satisfy the income demand by upland farming families.

#### **Achievements**

Some data were collected in June 2002 and in January 2003, and are being followed up on. Simple modeling with currently available data would suggest that partial conversion of vegetable farms to agroforestry is economically viable. Preliminary research indicates there are no significant market linkages to Manila, but we are verifying this information.

#### **OBJECTIVE 5**

Further incorporate biophysical parameters into the watershed model.

#### **Achievements**

Forestry and agroforestry data have been incorporated into the economic simulation model. Shively's visit to Midmore (in Australia) has been postponed to the third quarter of 2003 to coincide with Shively's sabbatical at the University of Melbourne.

#### **OBJECTIVE 6**

Quantify pesticide loading on eroded soil, runoff and stream flow.

#### **Achievements**

Various visits to the site were made by Dr. Dano, and some pesticide data were collected.

Runoff events were limited to twice in June and once in September in 2002, and none in 2003 to date.

Data has not yet been incorporated into the simulation model due to lack of available time.

Relationships between erosion events on plots and TSS in stream flow are not complete. To address these deficiencies, arrangements for this to take place in year 6, following amalgamation of modeling and data collection activities, and to include cooperation with a number of other agencies/industries are underway (e.g. EPA, Xavier University, Dole).

#### **OBJECTIVE 7**

To assess the potential transferability of the computer modeling strategy to other sites in the Philippines and elsewhere in Southeast Asia.

#### **Achievements**

Work on farm level model for Vietnam continues, and in July 2003 (in conjunction with a visit by Dr. Ha to Purdue University) will incorporate field data from a survey of upland farmers in the Central Highlands of Vietnam. Dissemination of research in non-academic/policy community is taking place (see above), with additional progress expected in coming months. It is also worth noting that SANREM efforts are now enjoying considerable synergy and cross-fertilization via an ALO-funded project with Purdue and Nong Lam University (Vietnam) entitled Curriculum

Development for Improved Environmental Management in Vietnam.

## **OBJECTIVE 8**

Provide model parameters for inclusion of such evidence into a watershed model.

### **Achievements**

Modeling work is mostly complete. Some additional data from experiments are being incorporated into the model as necessary and appropriate.

## **OBJECTIVE 9**

Understand harvest and associated costs of tree production, and effects of trees and sunflower on soil properties and subsequent annual crop performance.

### **Achievements**

Positive impacts of re-cultivated plots on yield of vegetables after 3 years of rotation with sunflower have been shown. Soil samples have been removed and sent for analysis to determine the effects of rotation with sunflower on soil properties. Some quantification of the costs associated with the harvest of trees is being undertaken. However, logging of plantation forests is not taking place at a fast rate. Rather farmers are being conservative and using trees as a buffer against future economic hardship.

## **OBJECTIVE 10**

To monitor the changes in the practice of vegetable production, and the adoption of participatory-led research-substantiated innovations.

### **Achievements**

Data from a previous survey, targeting about 50 vegetable farmer, were analyzed. A visual analysis of the current spread of agroforestry, grassy strips and contour plantings (with or without high value

species), has not been completed but will be undertaken in early 2003.

The analysis indicates that few farmers practice biological methods against pest and diseases and most of them are not aware of natural parasites. Most farmers were using more insecticides than previous years due to increased pest attack. Farmers generally believed that vegetables could not be grown anymore in the area without applying pesticides. Bacterial wilt is a common problem but farmers are not using control method to minimize losses.

Farmers in the area are not practicing mulching for various reasons, including labor and material requirements and associated diseases. They are not practicing either compost making and green manuring, and only a few practice intercropping. About two thirds of the farmers apply lime as a way of improving the soil. Farmers plant trees mainly for house construction and repair, mostly on field edges. About half of those who do, plant Eucalyptus. Farmers learn about tree planting from the Department of Agriculture, neighbors and friends, as well as ICRAF.

The main farming problem is the lack of capital, mentioned by about half of the farmers interviewed. Pests and diseases, low, fluctuating vegetable prices, and availability of labor, land, and fertilizers were also mentioned. Most farmers believe that soil erosion in Manupali is still moderate, and that soil quality and crop yields are still satisfactory. To minimize erosion, about two thirds of them suggest trees planting as a way to minimize erosion.

## **OBJECTIVE 11**

Interpret relationships between off-plot and in-stream sediment loadings.

### **Achievements**

Data sharing was agreed upon for year 6, with emphasis in bringing a number of data generating and modelling activities together.

## OBJECTIVE 12

To provide a robust model for prediction of impacts due to changes in upland vegetable production practices on farm scale income generation and resource management (In year 3/4).

### Achievements

The work plans of activities relating to resource management in the watershed have been brought together for integration in the final year, when we anticipate that the outcomes for objective 12 will be achieved.

### Advances

**In Research:** Please refer to achievements noted above.

**In Improved Environment In Natural Resource Management:** To be determined through involvement of all projects' staff in final meeting in 2004.

### Publications

Nissen, T. and D. Midmore. 2002. A bioeconomic rationale for the expansion of tree planting by upland farmers in the Philippines. *Philippine Journal of Development, a special joint issue of the SANREM CRSP/SEA and PIDS*. 29(1): 85-100. First semester 2002.

Shively, G. and I. Coxhead. 2003. Conducting economic policy analysis at a landscape level: examples from a dynamic model of a Philippine watershed. In press. *Agriculture, Ecosystems, and the Environment*.

Shively, G. and C. Zelek. 2002. Linking economic policies and environmental outcomes at a watershed scale. *Philippine Journal of Development, a special joint issue of the SANREM CRSP/SEA and PIDS*. 29(1): 101-125. First semester 2002.

Zelek, C. and G. Shively. 2003. Measuring the opportunity cost of carbon sequestration in tropical agriculture. *Land Economics*. 79(3): 342-354.

## Other Major Outputs in This Period

### Theses/Dissertations

Zelek, C., 2002. *Measuring the Opportunity Cost of Carbon Sequestration in Tropical Agriculture*. Ph.D. Dissertation. Department of Agricultural Economics. Purdue University.

### Degree Training

Charles Zelek, Ph.D. 1997- 2003

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
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**July 2003  
Annual Report  
SEA-25**

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## **Water Resource Management and Education Work Plan**

**Principal  
Investigator**  
William Deutsch

**Co-Principal  
Investigator**  
Jim Orprecio

### **OBJECTIVE 1**

To support the growth and capability of the Tigbantay Wahig as a viable and sustainable people's organization in Lantapan, and extend community-based monitoring to other parts of Mindanao (Sarangani Province).

### **Achievements**

All aspects of Objective 1 were completed in full:

Organizational Development: An organizational development workshop was conducted by Heifer International (HI) staff in Lantapan for the Tigbantay Wahig (TW) on August 5, 2002. A similar workshop was conducted for the Let's Help Bohol group in Bohol on November 27, 2002.

On October 3, 2002, members of the "Magbalantay sa Tubig Bol-anon" or MagTubo group (the water watch group in Bohol) elected their first set of officers for better organization and coordination of field activities.

On February 27-29, 2003, the HI staff from the Mindanao and Visayas regions conducted a three-day training on Structural and Organizational Management for the MagTubo in Tagbilaran City, Bohol.

Technical Workshops: A water monitoring data summary and interpretation session was conducted in Lantapan for the TW from September 30 to October 2, 2002 by Dr. Bill Deutsch and Wendi Hartup (AU).

On March 8, 2003, Wendell (Mogie) Talampas (HI staff and Water Quality Monitoring Project Coordinator) attended a half-day presentation by Dr. Vic Ella of the University of the Philippines-Los Baños on the use of the Water Erosion Prediction Project (WEPP) model. Dr. Vel Summinguit of SANREM SCO office, Ms. Evy Elago of BANGON and representatives of the TW also attended the presentation.

On April 22-24, 2003, HI staff conducted a three-day level 2, water monitoring training for the newly organized group in the western part of Bukidnon. Twelve people from two barangays attended the training and are the new water monitoring volunteers in the municipality of Baungon. Many residents of Baungon are of the Higonon tribe, so the monitoring group decided to adapt the official name, Taglantaw Tubig, which means Water Watch in the Higaonon dialect. They will monitor the Lipatunan, Malubog, Tumalaong and Napulon Rivers. A Structural and Organizational Management training for the group is scheduled on the first week of July 2003 to further strengthen the group.

On May 19-20, 2003, HI staff conducted

a level 2 water monitoring training for 10 new members of the TW at the HI/Philippines Training Center. Training was given in water chemistry, TSS and stream discharge measurement.

Trainer Internships: As a follow-up to the Training of Trainer workshop conducted in February 2002 for experienced water monitors of Lantapan, Sarangani and Bohol, some citizen trainers practiced their training skills in workshops conducted in Bohol under the supervision of HI staff.

Study Tours and Site Visits: The Tigbantay Wahig group in Lantapan has hosted several groups interested in learning more about community-based water monitoring projects.

On August 5, 2002, the Heifer International/Mindanao Program and members of the TW hosted Mr. Mario Limocon of PROCESS-Bohol for a tour at the four main sites of the water monitoring activities. Techniques of water chemistry and stream discharge measurements were demonstrated by the TW.

## **OBJECTIVE 2**

To collect water quality and quantity data for addition to a six-year database. This information will be useful for local water management and as a model for other communities.

### **Achievements**

All aspects of Objective 2 were completed in full:

At the primary SANREM research site in Lantapan, monthly monitoring of Total Suspended Solids (TSS), Stream Discharge and Soil Export, Water Chemistry continued as scheduled at the four main river sites. In addition, water quality/quantity data were collected by community groups at Bohol, Sarangani and Baungon.

Data collected for the period June 2002 to May 2003:

1. Tigbantay Wahig – Lantapan, Bukidnon Province: 465 Total Suspended Solids samples; 69 Water Chemistry samples; 80 Stream Discharge/Soil Export samples.

2. MagTubo – Bohol Province: 643 Total Suspended Solids samples; 102 Water Chemistry samples.

3. Munong El – Maitum, Sarangani Province: 164 Total Suspended Solids samples; 77 Water Chemistry samples; 42 Stream Discharge/Soil Export samples; 81 Bacteriological samples.

4. Taglantaw Tubig – Baungon, Bukidnon: 24 Total Suspended Solids samples; 14 Water Chemistry samples.

## **OBJECTIVE 3**

To organize the water database for use in watershed model to be developed by the SANREM Southeast Asia Program.

### **Achievements**

Several aspects of Objective 3 were completed:

A coding system for all monitoring sites in the Philippines (based on island, province, water body and site) in Thailand was developed in June 2002.

A prototype of the Philippine Water Watch database and online data entry feature was developed at Auburn University and demonstrated to the TW and HI staff by Bill Deutsch and Wendi Hartup in Malaybalay, Mindanao in June 2002.

A copy of the Philippine Water Watch database was transferred to the HPI computer so that all data could be entered in a standardized way.

The Philippine Water Watch database was improved with additional programming for eventual internet data entry.

## Advances

**In Research:** Eight consecutive years of water quality and quantity data have been collected on four contiguous subwatersheds of Lantapan. These data document the effects of seasonal changes, drought cycles, and human settlement patterns on streams. In year 5, about 1,200 water quality/quantity samples were collected by citizen volunteers in the Philippines (160 chemistry; 81 bacterial; 831 total suspended solids; 122 stream discharge/soil export).

On October 23-24, 2002, a bacteriological survey was conducted in Maitum (Sarangani Province, Mindanao) headed by the Munong El group (water watchers). Representatives of the TW from Lantapan, Mr. Jo Duba and Ms. Mira Veloso, also participated in the survey. The sampling was conducted on selected sites with history of outbreaks of water-borne diseases and to newly constructed water system in the municipality. Results indicated water systems contaminated with *E. coli* bacteria and these were reported to the local government for evaluation and appropriate action. In October 2002, Jim Orprecio, Janeth Labis and Mogie Talampas of HI met with Bill Deutsch, Wendi Hartup, Rosemary Fernholz, representatives of the TW and Estela Cequiña (CMU) in Mindanao to plan future research and continue writing chapters for the Water Synthesis Document (10- year summary of CBWM work in several countries). The document is in its third draft, with projected completion in year 6 of SANREM.

From September 30 to October 2, 2002 Rosemary Fernholz continued her research on the SANREM work plan entitled "Innovation for Long Term Institutional Support for Sustainable Community-Based Water Monitoring in Lantapan, Bukidnon." Her findings are incorporated in a chapter of the Water Synthesis Document of the AU/HI work plan. The SANREM SEA-25 work plan results and data gathered from the water monitoring activities in Lantapan are now being used by other researchers:

1. Dr. Victor B. Ella – Working on a SANREM ERDP Project on Soil Erosion Modelling of the Manupali River Subwatersheds.

2. Maureen M. Cuevas – working on her thesis entitled "Assessment of the Impacts of Extreme Climate Events on Soil Erosion at Lantapan, Bukidnon using Modified Watershed Model".

3. Mr. Gaudencio Ramos, Sr. Superintendent, National Irrigation Administration - NIA is using the water monitoring data for NIA project proposals.

**In Capacity Building:** The four water monitoring groups in the Philippines received a variety of capacity-building workshops including organizational development (3), water quality monitoring (2), data interpretation (1), database training (1), computer modeling of water data (1) and training internships (1). The mechanism for continued, local support of monitoring groups from local governments and businesses was strengthened with memoranda and other partnerships. Such agreements increase the probability that CBWM groups will continue if SANREM support is discontinued. Bill Deutsch and Jim Orprecio met with Dr. Jonathan Roth, President of Micrology Labs, in Goshen, IN on November 14, 2002. They discussed the continued use of bacteriological monitoring supplies of Micrology Labs at SANREM sites, including how local groups could better acquire the needed materials for future monitoring.

On February 11, 2003, HI/Philippines, Mt. Kitanglad Agri Ventures, Inc. (MKAVI), Tigbantay Wahig and the Local Government of Lantapan formalized a Memorandum of Understanding at Cinchona, Kaatuan, Lantapan that will make the TW a more sustainable group, less dependent upon SANREM. With the partnership, MKAVI will be providing financial support to the TW for the water monitoring activities for a period of three years. Part of the collaboration will be the monthly monitoring of six water sites within the MKAVI plantation area beginning June 2003. HI/Philippines agreed to continue the capacity building of the TW and provision of livelihood projects for the group.

Such agreements can form a model of locally-supported natural resources management.

**In Scaling Up: Philippines:** The community-based water monitoring program continued spreading from Lantapan to new areas of the Philippines including Sarangani, Bohol and Baungon. The approach and lessons learned in Lantapan have been used for similar work of Auburn University and HI in Ecuador, Brazil, Thailand and Alabama. Following an August 2002 study tour in Lantapan conducted by the TW and HPI, the NGO called PROCESS (Participatory Research Organization of Communities and Education towards Struggle for Self Reliance) will be developing a proposal for collaborative efforts in community-based water monitoring. This NGO is based in Tagbilaran City, Bohol with funding from the World Neighbors and has been engaged in organization and empowerment of fishing and farming communities in the upland and coastal areas of Northern Luzon, Western Visayas and Bohol.

A new water monitoring group was established in northern Mindanao (Baungon, Bukidnon) called the Taglantaw Tubig. The training workshops for these community members were conducted by HPI staff, following a site visit and plan by Bill Deutsch and Jim Orprecio in October 2002. The water quality training workshop conducted by HPI and the TW on May 19-20, 2003 in Lantapan was the first time that the water monitoring group has begun to work with high school and college student volunteers. The ten new volunteers who participated in the training, included a second year Veterinary Medicine student of Central Mindanao University, two incoming college freshmen, two incoming fourth year students, and five out of school youth and farmers. The TW president Vincent Molina believes that the membership of school volunteers will help students shape and plan their careers and will develop their leadership skills by immersing them into research and rural development work.

From April 23 to May 26, 2003, MagTubo members and HPI staff made a series of presentations about their water monitoring activities to 12 municipalities of Bohol Province. These municipalities were within the expansion area of the "Let's Help Bohol

Program-LHB." Local government officials from the municipalities have provided support to the water monitoring activities in their respective areas. Municipal Agrarian Officers have been mobilized to assist HPI and LHB staff in conducting site surveys and recommending new volunteers. It was planned that volunteers be selected from already organized groups within each municipality.

On May 25, 2003, HI staff met with the Bohol Alliance of Non-Government Organization (BANGON), an NGO interested in training workshops about water monitoring. BANGON is finalizing its structural framework for their Watershed Health Monitoring Project for the Municipality of Bilar, Bohol. Project Coordinator, Ms. Evy Elago will be conducting an exploratory visit to Lantapan to observe the water monitoring activities of the TW. Bill Deutsch, Wendi Hartup, Jim Orprecio, Janeth Labis and Mogie Talampas began writing a 20-page report on the work plan in Lantapan, for distribution to the general public and policy makers. The report is modeled after the successful Water Body Reports of the Alabama Water Watch Program.

**Thailand:** On February 19-23, 2003, Jim L. Orprecio traveled to Chiang Mai, Thailand and met with staff of HI/Thailand and HI/Mekong River Program, for the implementation of the water monitoring initiative. He was also able to meet with a new group from Chiang Mai University which has an existing water monitoring project, for a possible collaboration with the SANREM work plan and HI projects. Jim and HI/Thailand members were also able to visit the monitors of Sansuk Village in Chiang Rai Province.

On October 7-14, 2002, Bill Deutsch, Jim Orprecio, Janeth Labis and Mogie Talampas visited Thailand for a series of meetings and visits related to the ongoing water monitoring activities in the northern part of Thailand. The visit was hosted by staff of HI/Thailand. The first two days of the trip were utilized to meet with HPI/Thailand staffs and Professors of the Chiang Mai University to discuss updates of the water monitoring activities in Thailand and to foster partnership and collaboration with Chiang Mai University. The team met with the water watch group in Mae Chan district of Chiang

Rai province, who started monitoring four rivers last July 2002 at San Suk Village. The one-day meeting was also used to give refresher course to the water monitors based as part of the “quality assurance/quality control” of the data they are collecting. Also during the visit, village leader of Mae Chan shared about his plan to expand the water monitoring activity to 50 other Akha villages in Chiang Rai. The last three days of the visit were spent in the Mae Hong Son Province. This trip was made to explore possible expansion of water monitoring in the area. A reconnaissance survey was conducted and the team identified nine possible water monitoring sites in Pang Mapha district.

Other Southeast Asian Countries: From February 23 –30, 2003, Jim Orprecio met with the HIP/China team in Chengdu. The meeting related to HI/China’s plans to expand their water monitoring initiative. The team conducted a reconnaissance for determining possible sampling sites in Anhui Province. Also being discussed during the visit was the development of training schedules and proposal writing for a community-based water project. HI/Philippines coordinated with other Asia/South Pacific (A/SP) programs of HI in Indonesia, Vietnam and Cambodia for a possible second-level water monitoring training. Among the project proposals being worked-out by HI/Philippines with the A/SP program countries was the implementation of a bio-regional water monitoring project. This project would build on the three-year Water Monitoring in Southeast Asia initiative of HI and involve the Philippines, China, Thailand and the Mekong Region, in partnership with the International Center for Aquaculture and Aquatic Environment of Auburn University.

International: Bill Deutsch attended the HELP (Hydrology for Environment, Life and People) Conference in Kalmar, Sweden, August 18-24, 2002. He worked there with the writing team of the UNESCO- sponsored book, Forests-Water-People that has a chapter regarding SANREM research with the TW in Lantapan.

Bill Deutsch met with the Agro-Ecology Council of HI in Mobile, AL, January 20-22, 2003 and gave a

presentation related to SANREM’s Landscape/Lifescape approach to natural resource management.

Bill Deutsch met with the Ends Committee of the Heifer International Board of Directors in Little Rock, AR, January 28-29 and gave a presentation on Agro-Ecology and the community- based water monitoring project of SANREM.

Bill Deutsch gave a presentation on Global Water Watch, based in part on SANREM research, at the Annual Meeting and Conference of Texas Watch in Denton, TX, March 6-8, 2003.

Bill Deutsch conducted Agro-Ecology and bacteriological monitoring training for the project leaders of the North American Programs of Heifer International in Guadalajara, Mexico, from 29 March to 6 April, 2003.

SANREM Program Activities: January 19-21, 2003, HI/Philippines attended a three-day strategic planning of the SANREM/CRSP in Manila. Three groups were organized to focus on: (1) Watershed Integrity, (2) Outreach and (3) Policy and Governance. Group 1 will focus on watershed monitoring research that involves water quality/quantity monitoring including pesticides, soil erosion, and socio- economic impacts not inferring any cost and effect. Group 1 integrates SEA-25 with the works of David Midmore and Tony Daño on pesticides, Gerry Shively, Vic Ella, Dan Thanh Ha from Vietnam, Ann de los Angeles of ICRAF on their RUPES program and Bayou Demeke, graduate student from the University of Wisconsin-Madison on economics and taxes.

Bill Deutsch attended the Annual Meetings of the American Agronomy Society in Indianapolis, November 10-14, 2002. He gave two presentations: “Impacts of Community-Level Water Monitoring on Natural Resource Management in Asia,” in the Tropical Steeplands Symposia; and “Alabama Water Watch: A Ten-year Summary of Citizen Monitoring and Action,” in the Watershed Solutions: Uniting Science and Community Action Symposium.

Bill Deutsch joined a team from SANREM to meet with staff of USAID in Washington, D.C. on November 24-25, 2002. He made a brief presentation about community-based water projects.

**In Policy Impact:** There was continued involvement of the TW in natural resource planning at the Municipal level, including membership in the Natural Resource Council of Lantapan. Community water data was used in establishing local ordinances and refining the NRM plan of Lantapan. Potential for Provincial and National Policy impact as the community-based model gains the attention of and increasing number of Governors, the Philippine Congress and other leaders. A Memorandum Order was issued to all Barangay Captains to initiate a streambank restoration project under the Lantapan Watershed Management Council. A leader of the TW and associate of HPI was designated to oversee the planting of 2,100 bamboo seedlings to protect the riparian zone and reduce erosion. Based in part on water quality data of the TW, the Municipal Council of Lantapan is considering the expansion of the riparian zone from 20 to 40 meters as a Municipal ordinance. Such a riparian zone would be larger than most that are created by ordinance in the U.S. and would probably provide significantly more protection for streams.

On October 2, 2002, presentation of TW water quality data was made by Bill Deutsch and Tigbantay Wahig officers at the municipal hall in Lantapan. The meeting was requested by the Municipality and was attended by Mayor Narciso Rubio, several councilors and representatives from private and non-government organizations in Lantapan. The presentation further strengthened commitment of the Local Government and private sectors to help in the rehabilitation and protection of the Lantapan rivers.

A Policy Brief was written by Dr. Agnes Rola, Ian Coxhead, Bill Deutsch and Jim Orprecio, based on the SEA25 water monitoring data, for use by the Philippine Institute for Development Studies. The Brief was distributed to a congressional delegation of the Philippine Congress who are developing a Clean Water Act.

**In Improved Environment In Natural Resource Management:** Simple and practical techniques for detecting E. coli bacteria in drinking water have continued to identify stream sites that need protection or restoration. Bacteriological monitoring has also improved water supply systems and home storage of water to reduce the probability of human illness. Quantification of erosion and sedimentation by the TW measurements of total suspended solids has continued to be used to prioritize and measure the success of restoration efforts. Establishment of correlations among land use patterns and water quality and quantity that have informed community groups, educators and policy makers to take action to minimize further degradation.

During the October 23-24, 2002 bacteriological survey conducted in Maitum by the Munong El group sampling was conducted on selected sites with a history of outbreaks of waterborne diseases and at newly constructed water system in the municipality. Results indicated water systems contaminated with E. coli bacteria and these were reported to the local government for evaluation and appropriate action.

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
Funded by the U.S. Agency for International Development (USAID)**

**July 2003  
Annual Report  
SEA-32**

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## **Adapting and Transferring Lessons Learned from Manupali Watershed to Other Critical Watersheds in Southeast Asia**

**Principal  
Investigator**  
Victoria Espaldon

**Co-Principal  
Investigator**  
Annielyn Magsino

Dang Thanh Ha

### **OBJECTIVE 1**

Determine suitability of the SANREM Phase 1 tools and processes in a different socioeconomic and political context.

#### **Achievements**

Training module for SA/NRM completed by Mr. Cai and team and finished with the translation and revision. This consists of discussions on the concepts and approaches to sustainable agriculture and natural resources management, participatory technology development (PTD), and sustainable agriculture for the uplands options. This training module aims to promote sustainable agriculture among farmers in Vietnam, not only in the study site but in other upland areas in Vietnam. It also aims to promote the existing sustainable agriculture technologies found locally to other upland farmers in other localities.

### **OBJECTIVE 2**

Examine the dynamics of resources management in the uplands of South Vietnam using a case study approach.

### **Achievements**

Through case study approach, the dynamics of resources management in the uplands of South Vietnam were determined using Participatory Landscape Lifescape Appraisal (PLLA) as a tool. All research findings out of this research study were consolidated, analyzed, and inputted in the development of a monograph. It also includes some methodological insights. The manuscript of the monograph is now ready for final editing and publication. The bidding for the printing of the publication is now ongoing. SANREM CRSP SEA, PCARRD, SEARCA will be the publishers of the monograph.

### **OBJECTIVE 3**

Examine the interlocking influences of economic, cultural, and biophysical factors as they influence upland agriculture and its environment.

#### **Achievements**

This objective was taken into consideration when the monograph was being prepared; hence, the publication of the

monograph entitled, "Challenges for Sustainable Agriculture and Natural Resources Management for Vietnam Uplands: A Case Study" will address this item.

#### **OBJECTIVE 4**

Determine policy implications of the changing agricultural practices among farmers in Southern Vietnam.

#### **Achievements**

Six research briefs were developed from out of the research findings. These are all ready for publication. These briefs will be published in the Philippines (SANREM/CRSP/SEA; PCARRD; NLU) and will be distributed in Vietnam by NLU team. These are listed in the reference section at the end of this report. Bidding for printing of these research notes is on-going.

#### **OBJECTIVE 5**

Promote a community-based and research-based natural resource planning and management at the farm and community level.

#### **Achievements**

The team has completed the training module for sustainable agriculture and natural resources management. The module consists of discussions on concepts and approaches on participatory natural resources management, participatory technology development (PTD), and sustainable agriculture practices and options appropriate for the uplands of Vietnam. The training did not take place due to limited time. It will be conducted by the NLU team because extension is part of their mandate.

#### **OBJECTIVE 6**

Determine a range of sustainable land management options locally found in the area as models for farmers, resource managers and concerned policy makers.

#### **Achievements**

Additional data were collected from identified sustainable agricultural systems adopted by farmers as responses to the changing market conditions. Reports describing these farming options were completed and provide the basis for the video clip documentation activities. These video clips are real examples that can be used by other farmers as models in their efforts to maintain the economic feasibility and sustainability of upland farms productivity.

The video documentation however was not undertaken due to the travel advisory in the Philippines arising from the recent SARS problem in some SEA countries including Vietnam.

#### **Advances**

**In Research:** This workplan provided opportunity for the synthesis of the various researches conducted by SANREM and other research groups on SA/NRM. In order to strongly influence agriculture and environment policy directions. Several research notes were developed from the past and current research activities of the collaborating institution, including SANREM.

**In Capacity Building:** The activities of this workplan enabled the development of a core of trainers for SA/NRM, including promotion of tools such as PLLA. A core of trainers now can be found in different departments of the university, from economics, agronomy, soil sciences, rural development and social forestry. Year 5 activities initiated a university wide effort to examine the policy relevance of the agricultural research program of the university. This was done with the goal of exploring the opportunity to develop a core of academics that will be committed to link research with policy making activities at various levels. It can also potentially serve as a foundation of a SA/NRM policy group at the university. Also, it can continue what SANREM has started, even if financial support from SANREM ends. A team of academic staff from NLU was engaged in various aspects of the research which provided opportunities to enhance appreciation on the need to synthesize and disseminate research

results to a wider public to include policy making community. They can serve as a core trainers on SA/NRM and a pool of trained academic staff for policy analysis.

**In Scaling Up:** At the heart of this work plan is the attempt to scale up the experience in the Manupali Watershed, Philippines to address similar problem in Vietnam. This included promotion of participatory approaches to SA/NRM planning like PLLA. Parallel to another workplan with UPLB/LGU partnership in Lantapan, Bukidnon, the capacity for policy analysis was conducted. The Philippine Institute for Development Studies and Institute of Strategic Planning and Policy Studies, UPLB assisted in capacity building activities on policy analysis.

**In Policy Impact:** We conducted a policy workshop on Linking Research and Policy for SA/NRM, which provided an avenue for dissemination of research results to a wider public including policy makers at the Ministry of Agriculture and Rural Development. At the level of the collaborating research institutions, there is growing appreciation of the need to link and monitor the ways they are influencing policy direction as a results of research dissemination activities. Six research notes were developed for publication and dissemination to concerned and interested agencies.

**In Improved Environment In Natural Resource Management:** There has been promotion of SA/NRM among community of farmers, decision makers and policy makers at various levels through informal conversation and extension activities of the research institution.

## Publications

### Books

Espaldon, M., D. Ha, P. Phouc, L. Thong, L. Du, N. Tuy, P. Hung and A. Magsino. 2003. *Challenges for Sustainable Agriculture and Natural Resources Management for Vietnam Uplands: A Case Study*. PCARRD, SEARCA, SANREM, Philippines.

## Other Major Outputs in This Period

### Conference Presentations - Papers

Espaldon, V., L. Thong and D. Ha. 2003. *Globalization and Transition to High Input Agricultural Crops in Southeast Asia: Selected Case Studies from Vietnam and Philippines*. Globalization and Land Use International Conference, University of Copenhagen, Denmark.

### Research Briefs

Cai, H., 2003. *Changing Agricultural and Forestry Extension Approach in the Management of Natural Resources to Address the Needs of Diversified Bio-Physical and Socio-Economic Settings in the Uplands of Vietnam*. SANREM, SEARCA, PCARRD, PHILIPPINES.

Du, L., D. Ha, P. Phuoc, L. Thong and V. Espaldon. 2003. *Soil Erosion: Causes or Consequences?*. SANREM, SEARCA, PCARRD, PHILIPPINES.

Giang, P. 2003. *Can Forestland Allocation Policy Succeed Without the Participation of Local People?*. SANREM, SEARCA, PCARRD, PHILIPPINES.

Ha, D., P. Phuoc, H. Cai and V. Espaldon. 2003. *How to assist farmers cope with changes in market prices*. SANREM, SEARCA, PCARRD, PHILIPPINES.

Nhat, T. 2003. *Women and Rural Development*. SANREM, SEARCA, PCARRD, PHILIPPINES.

Ut, T. 2003. *Speed Up Or Go Slow Policy For Water Intervention In Bac Lieu Province, Mekong Delta*. SANREM, SEARCA, PCARRD, PHILIPPINES.

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
Funded by the U.S. Agency for International Development (USAID)**

**July 2003  
Annual Report  
SEA-34**

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## **Replicating Models of Institutional Innovation for Devolved, Participatory Watershed Management**

**Principal  
Investigator**  
Eduardo Queblatin

**Co-Principal  
Investigator**  
Antonio Sumbalan

### **OBJECTIVE 1**

Scale-up the Lantapan model to other municipalities surrounding MKRNP in Bukidnon. This means directly assisting and coaching LGUs in developing their own NRM plans.

### **Achievements**

Five sets of interrelated activities were implemented by the LGUs with the help of SANREM/ICRAF resources. These activities assisted the LGUs to “cope up” with the exigencies of the plans considering recent political exercises. These activities are monitored and well-documented, providing a rich source of information and learning on the realities of localized NRM planning and implementation.

1. Municipal Ordinances have been passed by the Municipal Councils of the 4 LGUs after the formulation and approval of their respective Implementing Rules and Regulations (IRRs). The IRRs, through municipal resolutions, provided the legal framework for the implementation of the adopted NRM plans. As indicated in the IRRs, the LGUs were compelled to create local ENROs, institutionalize the NRMC and appropriate budget to implement the plans. The extent of implementation depended on the availability of resources, including qualified personnel.

2. ICRAF provided periodic technical and institutional assistance to the LGUs in mobilizing available resources to implement agroforestry projects within their NRM plans. This included facilitating dialogues between the LGU of Lantapan and farmer groups towards increased human and financial resource investments for Farmers Field School and Capacity Building activities for Landcare groups. The dialogues considered the current limitations of the LGU in the hope of coming up with complementary activities.

Notwithstanding the delayed creation of clear implementation structures, several priority items in the NRM plans have been implemented with our technical assistance. In Manolo Fortich, Landcare activities were initiated in 18 barangays, or villages. The Municipalities of Libona and Impasugong started Landcare - oriented activities in the buffer zone barangays in support to the Province's irrigation project. Baungon's constituents are already benefiting from its Livestock Project, and have recently availed support from the LGU's fruit and timber tree plant-now-pay-later program. Some barangays have already created their Barangay Natural Resource Management Committees (BNRMC), the barangay counterpart of the NRMC.

3. We have provided varying levels of technical assistance to LGUs in the formulation of their 2003 Annual

Investment Plans that would expand implementation of priority, "on-ground" activities in the NRM agenda. In Impasugong, the NRM Secretariat developed activity proposals for 2003 with our assistance. The earmarked activities include expanded Agroforestry and Soil and Water Conservation training at the barangay level; development and production of IEC materials to support their information-drive activities; and formal creation of an ENRO office.

4. On February 2003, ICRAF, the LGU and other agencies initiated and participated in the presentation of three existing developmental plans in Impasugong, namely: the Municipal Watershed Management Plan, which is a component of the NRMDP and developed by LGU-DENR-BENRO; the Barangay Development Plan by LGU-Barangay, and the Ancestral Domain Sustainable Development and Protection Plan (ADSDPP) by the Higa-onon tribe. These plans directly affect resource management in Sitio Mintapud of Barangay Hagpa, which is a major watershed area in the municipality. One innovation during the event was the creation of the multi-sectoral Kumaden Task Force, which is tasked to identify areas and activities of cooperation, and prepare details of implementation making sure that there are no duplications that would lead to wastage of resources. According to the observers from different participating agencies, it was the first time they observed different management entities converging into the negotiation table with open minds and agreeing to a compromise and complementation to harmonize conflicting issues and problems.

5. The identified mechanisms and strategies in the development of the NRMDPs are being "mainstreamed" in two major physical planning processes to enhance the implementation of the NRMDPs. The LGUs of Lantapan, Baungon, Manolo Fortich, Libona and Impasugong have referred to the plan for the development of their respective Comprehensive Land Use Plans (CLUP), as required by the national government. Likewise, the Provincial Government has proactively assisted these municipalities to begin preparation of their respective inter-LGU and municipal-based

Watershed Management and Development Plans. The 5 LGUs of Lantapan, Baungon, Manolo Fortich, Libona and Impasugong have already finished and presented their respective watershed plans to the Technical Advisory Committee of the Bukidnon Watershed Protection and Development Plan (BWPDC) last November 2002, where ICRAF is a member. The respective Watershed Technical Working Groups (TWGs) were the same local planning teams that developed the NRMDPs.

6. Selected elements of the NRM planning and implementation process have been adapted by another in Bukidnon, which is not originally part of the trajectory for scaling up. Inspired by the upland activities implemented in Lantapan, Malaybalay City through its City Agriculture Office (CAO), has adapted the Landcare approach in their mainstream activities. Two (2) capacity-building programs, fully supported by the City Government, were facilitated for the City's Agriculture Technicians. This has resulted in initial activities on agroforestry and conservation farming in 13 upland barangays. The CAO has come up with an Upland Resource Development Program and identified Landcare as one of the key project initiatives to be implemented and supported.

The case of Malaybalay represents a deviation from the ICRAF-SANREM assisted strategy that is, an NRM process initiated by the Municipality (or City, in this case) but starts with a strong action orientation at the barangay level, and culminating eventually into a formal NRMDP planning process. Part of the facilitation work involved here was provided by the ACIAR - ICRAF Landcare project. Based on the progress at the barangay level, the City is planning to go through a formal NRMDP planning process next year.

## **OBJECTIVE 2**

Analyze, evaluate and compare the performance of the NRM model in these different municipalities, and develop this knowledge into modules/decision-support guidelines to local governments for NRM planning and implementation.

## **Achievements**

A comparative assessment of the NRM planning process and implementation at the municipal level has been conducted and initial findings identified. Combination of Retrospective Process Documentation, round table discussions, and surveys were conducted among stakeholders (NRMC, Local Chief Executives and civil society representatives) of the NRM planning and implementation process of the 4 LGUs.

Initial results of the assessment indicate that LGUs are mobilizing and improvising various strategies to address priorities in their respective NRMDPs, given traditional resource constraints, as well as intervening circumstances such as the recent local elections.

For instance, in order to cope with lack of resources to hire new staff, different schemes are being worked out but the common element is to engage a champion. In Baungon, an active NGO-farmer leader is being tapped to head the MENRO. In Impasugong and Libona, detailed staff (Community Development Assistants) of BENRO will serve as Project Management Officers. In Manolo Fortich, MPDO staff is eyed by the LGU to head their MENRO. In each of the above cases, detailed staff from the different organic line offices such as MPDO, MAO, MARO and others will support the PMO or local ENRO.

The survey results highlight the volunteer local talent that can be tapped to support local NRM plans. NRMC members have mixed feelings about their concern for the natural resources, and the fact that these bring new demands for their time and effort. The effective participation of the NRMC members tends to be correlated to the LGUs hands-on leadership, which is partially manifested by participating personally in the planning process and providing sufficient human and financial support mechanisms. This also encourages local support and action during the implementation phase. During the periods where the LGU activity was diverted to the electoral and post electoral processes, the participation of non-LGU sectors rectify this during these challenging periods.

Participants in the consensus-building and planning workshops considered these events important because they provide the venue for contributions by various stakeholders. In addition, there was an appreciation of the barangay level consultation process either through the Development Council or through Barangay Assemblies.

Overall, the Lantapan approach was adopted by the adjacent municipalities. Notwithstanding the challenges brought about by the electoral and post electoral processes, the vision and priorities of the NRM plans developed continue to be respected as evidenced by continuing reference to them in subsequent LGU plans and activities. LGUs are carrying out their plans in varying pace and through various means. In majority of the LGUs, on-the-ground activities have begun. A common phenomenon in all the participating LGUs is that the participatory and multi-sectoral process is still dependent on the attitude of the Local Chief Executives. More results will be shared by the upcoming special report on this assessment.

## **OBJECTIVE 3**

Communicate significant results of the work plan through the production of popular print media such as the quarterly NRM Notes that we've started to produce, paper presentations in related conferences, and self-sponsored workshops or fora.

## **Achievements**

The NRM Terminal Report was submitted July 2000, which highlights key accomplishments of the work plan, and some impacts after 5 years.

The work plan has produced the Proceedings of the First Bukidnon NRM Policy Forum. It features the plenary presentations on experiences, lessons, insights and methodologies employed by LGUs in collaboration with their constituent communities, as well as the results of recent empirical studies on local NRM. It also included outputs of the policy workshops on policy recommendations, particularly on the institutional aspects of participatory local NRM.

Two NRM Policy Briefs were produced featuring participants' policy recommendations during the NRM Policy Forum in November 2001: (1) Establishing an institutional infrastructure for improved Environment and Natural Resource Management: the Provincial, City and Municipal Environment and Natural Resource Office, and (2) Land literacy improvement: key to sustainable natural resource management.

## Advances

**In Research:** Produced 2 NRM Policy Briefs. Assisted LGUs in reviewing and evaluating implementation of NRMDPs, as well as in planning to strategically implement these in proceeding years, including monitoring systems and feedback mechanisms.

**In Capacity Building:** Municipal Ordinances implementing rules and regulations of NRMDPs were passed at the Legislative Councils of these LGUs that include creation of ENRO, budget allocation, and institutionalization of NRMC. Assisted LGUs in mobilizing resources to implement the Agroforestry component of their respective NRMDPs. Assisted LGUs in developing proposals for funding, to include key NRM activities into the 2003 Annual Investment Plans. Assisted in mainstreaming NRMDPs into at least two major physical planning process (e.g. CLUPs and Municipal Watershed Management Plans) to ensure enforcement and make these plans more relevant.

**In Scaling Up:** The Proceedings of the First Bukidnon Policy Forum on NRM have been produced. Malaybalay City adopted selected aspects of the NRM program (e.g. development of Agroforestry systems) and conducted Landcare-oriented Capacity Building to pilot communities. Several municipalities in Southern Mindanao and Western Mindanao visited the site and are in the process of adapting certain aspects of the NRM planning process.

**In Policy Impact:** Multi-sectoral leaders of the Philippine Watershed Management Coalition visited in Lantapan and interacted on how to pursue needed policy reforms on watershed management.

Discussions with ISPPS-UPLB on elevating Bukidnon experience on NRM in subsequent fora to be undertaken.

**In Improved Environment In Natural Resource Management:** LGUs are on the process of creating their Interim ENRO responsible for the implementation of the NRMDPs, while others are already capacitating their MENROs to operational existing environmental development plans. LGUs identified environment and NRM as one of the basic social services that have to be delivered effectively and efficiently. LGUs are building partnership with private partners to move on with the plan's implementation. LGUs-barangay level has created BNRMCs as part of the plan, and in response to the Covenant they signed after it was developed.

## Other Major Outputs in this Period

### Proceedings

Catacutan, D. and C. Duque. 2002. *Locally-led Natural Resource Management*. Proceedings of a Regional Workshop held at Valencia City, Bukidnon, Philippines in November 8-9, 2001. ICRAF, Bukidnon.

### Research Briefs

Tabbada, A. and C. Duque. 2002. *Establishing an institutional infrastructure for improved Environment and Natural Resource Management: the Provincial, City and Municipal Environment and Natural Resource Office*. (NRM Policy Brief, Issue#1). ICRAF, Bukidnon.

Tabbada, A. and C. Duque. 2003. *Land literacy improvement: key to sustainable natural resource management* (NRM Policy Brief, Issue #2). ICRAF, Bukidnon.

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
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**July 2003  
Annual Report  
SEA-42**

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## **Capacity Building for Natural Resource Management at the Local Level**

**Principal  
Investigator**  
Victoria Espaldon

### **OBJECTIVE 1**

Develop and strengthen the skills of trainers on Participatory Landscape-Lifescape Appraisal (PLLA).

### **Achievements**

Seven staff of the BIDANI Institute, one staff of Radio Station DXMU and fourteen faculty members from six colleges in Central Mindanao University ( a total of 22 for the first batch of trainers) were trained on PLLA using the experiential learning approach.

The core PLLA (at CMU) trainers had conducted Training of Trainers (ToT) on the PLLA for 35 faculty members of the CMU College of Arts and Sciences and twelve faculty members of the CMU Extension Unit. Two staff members served as resource persons/lecturers in Lamalama, Pres. Roxas, North Cotabato on the PLLA upon the invitation of the Mindanao Resource Center for Development. The PLLA modules were revised using the experiential learning approach.

One Ph.D. thesis and two M.S. theses were completed with support from SAN-REM: a. " Community Adaptation to the Changing Landscape of Mt. Pinatubo in Central Luzon, Philippines" by Max Gulliermo of UPLB (Ph.D. in Environmental Science), b. "Impact of

Participatory Landscape Lifescape Appraisal (PLLA) Training on the Communities in Bukidnon by Mr. Fernando V. Magdato, Jr. of Central Mindanao University (M.S. Agricultural Extension); and c. Local Community Responses to the Training on Participatory Landscape-Lifescape Appraisal for Natural Resource Management in Lantapan, Bukidnon, Philippines" by Ms. Athena Custodio of UPLB (M.S. Environmental Studies). Mr. Gulliermo used Landscape Lifescape Analysis as one of his methods used.

Undergraduate students in forestry at CMU used the PLLA as a tool for generating information for their field practicum.

There is increasing demand for natural resource management materials and the increasing collection of NRM materials in the office which has been catalogued and recorded by the University Library.

The team conducted on-site trainings on Farm Planning in six barangays for a total of 185 participants and Business Planning in eight barangays for a total of 294 participants.

The PLLA modules/materials were included in the discussion of the courses at College of Forestry and College of Arts and sciences, specifically Social

**Co-Principal  
Investigator**  
Jose Arances

Annielyn Magsino

Forestry, Extension Education, Agroforestry and Special Problem.

Draft of IEC materials and household monitoring cards on NRM were developed.

## **OBJECTIVE 2**

To develop the ability of the community for participatory planning.

### **Achievements**

The twelve barangays covered by the project presented their plans to the Municipal Technical Working Group as of June 2002.

The BIDANI Institute was requested to give technical backstopping (TB) to the six barangays in Lantapan as they prioritized their projects for funding in the last quarter of CY 2002.

Extended technical backstopping to 65 clients in Lantapan.

The BIDANI Institute continued to conduct trainings on Farm Planning. This is based on the fact that barangay plans may not be implemented at once due to funding constraints. However, a household on its own and at its level can make and implement plans related to natural resource management. Thus, the BIDANI Institute went a step further from the barangay level. It continues to assist households to frame individual plans which they can implement on their own.

MOAs were signed between Central Mindanao University and the Local Government Units of Valencia City and the Municipality of Lantapan which provided for commitment to capacity building in terms of funding and expertise.

The City of Valencia provided a grant of P100,000 for micro-finance. This is administered by the BIDANI Foundation Inc. (BFI), an NGO working with the BIDANI Institute. This amount is for the six barangays - Lourdes, Lilingayon, Lurogan, Guinoyoran, Mt. Nebo and Colonia – covered by the project.

Extended loans to 117 clients in the six barangays of Valencia City worth P335,000 using the grant from the Valencia LGU.

Extended loans to 27 clients in one barangay of Lantapan worth P187,000 from the funds of the BIDANI Foundation Inc.

Two manuals were produced by the team of Dr. Jose B. Arances, Head of BIDANI. The two manuals which are now ready for editing and review are: 1. Farm Planning; and 2. Community-based Enterprise Development Planning. CMU will publish them with SANREM as a collaborating institution.

## **OBJECTIVE 3**

To establish a mechanism for collaboration with other work plans/organizations in the area in the planning and implementation of activities.

### **Achievements**

The BIDANI Institute has been collaborating with the Valencia and Lantapan LGUs. Initial discussions for possible collaborations with Heifer International on livestock and ICRAF on soil conservation for the implementations of farm plans and business plans were already conducted.

## **OBJECTIVE 4**

To publish a manual on Participatory Landscape-Landscape Appraisal (PLLA).

### **Achievements**

The BIDANI Institute prepared a manual on "how to teach" PLLA using experiential learning approach. Each member of the PLLA team contributed a draft of the strategies/methodologies they used, which became part of the teaching manual. This will be submitted to CMU Board of Publications for review and publication.

The final editing of the manuscript of Manual on PLLA and bidding for printing are underway. This is a publication by PCARRD/CMU/SANREM.

## Advances

**In Research:** The experiential learning approach was found to be an effective methodology for capacity building. Some faculty members who were involved in the training activities were requested to write and teach modules on NRM for adult learners and translate the PLLA manual to local dialect. The training on organizing and participatory planning enabled the barangays to incorporate SA/NRM principles and translate these into projects in their respective supplemental plans. Local expertise/s based in university (CMU) are effective extension agents because they can speak the local dialect and trusted by the local communities, including local government officials. PLLA materials were incorporated in some courses of the College of Forestry of Central Mindanao University. PLLA was used as a tool for generating information for student field practicum.

**In Capacity Building:** Process of local level capacity building for SA/NRM developed and is outlined in a paper " Participatory Natural Resources Management: Politics of Empowerment" in Sustaining Natural Resources Management in Southeast Asia.

The development of a core of local expertise/advocates of participatory research process, at the university and community level, has taken place. The development and use of instructional materials for SA/NRM trained expertise/s based at CMU has taken place; these individuals are now capable of conducting the PLLA in their local area. Moreover, they found that the data generated were very timely and important in their activities. The CMU/BIDANI team also produced local instructional materials in the dialect e.g. community maps and transects, network diagrams.

**In Scaling Up:** Integration of community plans in developing municipal development plans. The community plans developed from out the results of the PLLA per barangays were presented to the Municipal Technical Working Groups and some of

these are inputs to the municipal development plans. The time element is a constraint. The barangay development plan formulation should proceed before the formulation of the municipal development plan. Synchronization is needed. Study by Custodio (2003) showed that the plans identified during the PLLA were incorporated in the Barangay Integrated Development Plan, at least for the 3 barangays that she examined for her thesis. However, these planned activities need supplemental logistics and financial support and technical trainings, e.g. integrated pest management, soil and water conservation.

**In Policy Impact:** Integration of community plans in developing municipal development plans. See scaling up section.

**In Improved Environment In Natural Resource Management:** Formulation of community plans that integrate environmental considerations.

The team has completed the "impact assessment of training programs". The final report is now available. One of the components under study is the impact of the capacity building activities on environmental awareness and conservation practices of local communities. The study showed that the training activities on PLLA have indeed improved environmental consciousness among local community members. There is a high rating among the respondents to the relevance of the course to their livelihood/profession. The training was also found to be useful to people with positions like barangay officials, health workers, secretaries and nutrition scholar in preparing barangay profiles, organizing and planning their activities; and for information campaigns. For farmers, housewives and housekeepers, the training was useful in daily decision making. For teachers, trainings molds perception and attitudes of young citizens who would heir the natural resources in whatever the status resources would be able to withstand. For barangay officials, made them realized their duties and responsibilities over the physical environment in relation to the needs and demands of their community members.

## Other Major Outputs in This Period

### Theses/Dissertations

Custodio, A. 2003. *Local Community Responses to Trainings on Participatory Landscape Lifescape Appraisal for Natural Resources Management in Bukidnon, Philippines*. M.S. Thesis. University of the Philippines Los Banos, College, Laguna, Philippines.

Gulliermo, M. 2003. *Community Adaptation to the Changing Landscape of Mt. Pinatubo, Central Luzon, Philippines*. A Ph.D. Dissertation. University of the Philippines Los Banos, College, Laguna, Philippines.

Magdato, Jr., F. 2003. *Impact of Participatory Landscape Lifescape Appraisal on the Communities in Bukidnon*. M.S. Thesis. Central Mindanao University, Musuan, Bukidnon, Philippines.

# SANREM CRSP

Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
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## Technical and Institutional Innovations to Evolve Agroforestry Systems for Sustainable Agriculture and the Management of Protected Ecosystems in the Framework of a Watershed Model

Principal Investigator  
James Rochetko

Co-Principal Investigator  
Gilceto Dagondon

### OBJECTIVE 1

Design, test and scale up community-operated agroforestry seed collection/production, processing and management systems in two municipalities in Bukidnon.

### Achievements

In a nutshell, community-managed plant material production systems continue to be demonstrated and shared to visiting peer farmer groups and institutions nationwide. Working with groups provide individual members the needed support systems, either from support organizations or through other networks, technical information and skills, innovative propagation techniques, market linkages, training opportunities and stronger institutional networks, to name a few. To enhance sustainability and with the help of the work plan, ATSAL initiated steps to improve and strengthen their organizational structure. A review of the by laws and articles of incorporation was done during their first meeting in 2003. After which, a re-election ensued but retaining the Board of Directors. Leadership of the group was maintained considering his significant contributions since its inception. Policies on income sharing schemes were discussed assuring a fair and just distribution of income for

the individual seed collectors and seedling producers, the marketing person, and the organization.

Documentation of ATSAL seeds and seedlings distribution processes and pathways was done through interviews and survey instruments, enabling facilitators to know the members' views and feelings about ATSAL's management and development. Results gathered during the process is also one way of enhancing their strengths as an organization, and at the same time improving on their weaknesses. Analysis and writing of the report is currently on going in partnership with SANREM.

Decentralized nurseries continue to be a major mode for seedling production. As of March 2003, close to 170,000 timber and fruit trees were planted in farmers' fields in Lantapan alone. These came from the 67 communal and household nurseries that were established by different Landcare groups as well as by ATSAL members. Some are producing seedlings as a response to differing market needs, for reforestation projects of local governments, commercial tree farms and individual planters. The more common species grown are *Maesopsis eminii*, *Eucalyptus deglupta*, *Eucalyptus torillana*, *Eucalyptus robusta*, *Acacia mangium*, and *Albizia lebbekoides*.

Three species have already been subjected to processor's rigid procedures and came up with very promising results. All three passed the requirements of the industry with Mosizi being classified as premium lumber, followed by *E. robusta* and *E. Torillana*. Other species will also be sent for evaluation and testing by processors.

In support to the drive of ATSal and Landcare members to increasing the diversity of tree crops grown in agroforestry systems, while at the same time increasing the economic activities of members, ICRAF and the Local Government Unit of Lantapan organized a training on fruit tree nursery practices and orchard establishment and management. The technical experts of the Philippine Tropical Fruits Research Center (PhilFruits) and the Bukidnon Agriculture and Fisheries Complex (BAFC) of the Department of Agriculture were tapped. Through the training, ATSal and Landcare were able to establish linkage with the Davao-based PhilFruits for technical information, and with the BAFC for quality scions.

ATSal and Landcare members participated in a formal training course sponsored by ICRAF for Farmer Trainers in Northern Mindanao. They formed the Lantapan Farmers Training Group (FTG). As FTG members, they are exposed to various modes of facilitating technology transfer to peer farmers and at the same time catering to technical and institutional facilitation needs of visiting farmers and institutions coming to Lantapan. These activities provided them additional income through facilitation fees during training events aside from actual sales of their produce. They serve as resource persons to visiting farmers, field technicians and project managers from local and international organizations, particularly on appropriate techniques on seed selection, collection, storage and production, as well as conservation farming.

ATSal and Landcare members in turn, were invited in several regional and national fora. Farmer leader Felicisimo Alsola participated in the Farmers' Technology Forum (July 2002) in Cagayan de Oro that brought farmers from all over Northern Mindanao for a discussion and access to new technologies developed by the member-institu-

tions of the Northern Mindanao Consortium on Agriculture and Resources Research and Development (NOMCARRD). Farmer leaders Alberto Ceballos, Felicisimo Alsola and Leo Sambrano also participated in the Second National Tree Farmers' Congress (July 2002) in Butuan City. The Congress saw the presentation of new propagation and agroforestry technologies and approaches. Resolutions were discussed during this congress looking at DENR's role for the enhancement of a farmer-friendly policy environment for productive and profitable tree farming and marketing. Three posters were exhibited by ICRAF and ATSal highlighting the initial results of the tree species evaluation and the initiatives on market linking with local processors. A ranking official of the DENR commended the posters for the information provided. Participation in the congress resulted to a linkage with the Total Reforestation for Economic and Ecological Sustainability (TREES) Consortium of Mindanao and with other potential markets for planting materials. TREES Consortium facilitates different tree farmer groups especially in eastern Mindanao areas and provide marketing linkages and information packages for furthering tree plantation management strategies. It also provides strong advocacy in the government sector for the protection of small tree farmers in the Island of Mindanao. Furthermore, strong linkages with existing markets could provide Lantapan tree growers an opportunity for expanding the market base for their products. The ICRAF and ATSal participants were supported by the Agencia Espanola de Cooperacion Internacional (AECI).

Last July 2002, the Security and Exchange Commission approved ATSal's Articles of Incorporation and By-Laws. As such, ATSal now has a legal personality to further its business transactions and operations.

ATSal members have identified strategic sites as their seed production areas (SPAs). These were selected based on a number of criteria, such as species planted, number of fruit bearing trees and vigor of tree stands. Although their individual small tree farms have already been a source of quality seeds of various exotic species, further identification of suitable seed production areas especially for

indigenous species were planned in support to their role in enhancing biodiversity.

A documentation of the various propagation techniques for indigenous tree species is on going. Assistance is being provided by the staff of the DENR's reforestation project in Impalutao, Impasugong, Bukidnon, particularly in the identification and photo-documentation of endemic species. Reference materials are being collated to support production of quality indigenous tree species for agroforestry systems, as well as part of their marketing strategies. The group is also looking at various clonal propagation techniques such as the establishment of household propagation chambers (improvised misting chambers) to test alternative propagation (vegetative) of various tree species.

## **OBJECTIVE 2**

Build and nurture an enabling environment for the establishment, development, and management of smallholder tree-based production systems as viable enterprises and as a vehicle for rehabilitating deforested upper watersheds and to utilize idle and marginal lands.

### **Achievements**

With reference to a recommendation made earlier to improve the production practices of smallholder tree farmers, a demonstration-study on silviculture management (thinning) was initiated. Three (3) tree farms, representing three (3) timber species, namely: *M. eminii*, *E. torillana* and *R. grevillea* were identified for the activity. Basic information was collected and translated into tree farm maps to serve as decision support guide for the farmer-cooperator in determining which trees to be thinned. As part of the information campaign for tree farmers to promote improved silviculture management practices, pruning was also done in *R. grevillea*. This demonstration also gives farmers the information needed to produce quality timber trees for better marketing as opposed to the traditional notion of "more trees" being equated to more income. This misconception led to production of undersized, deformed and poor performing trees.

ATSAL and Landcare farmers have been linked with local wood processors for the supply of raw materials for veneer and plywood manufacturing. Additional discussions have also been held with Asiatic Wood Industries, which supplies the wood requirements of furniture manufacturers in Northern Mindanao; the Davao-based Alcantara Plywood Corporation, which is maintaining the production of quality plywood under ISO standards; and with some other processors/manufacturers. Wood processors committed to test the quality of new species, such as those belonging to the Eucalypts, aside from those that have been tested earlier. Evaluation will be continued as soon as identified species reach the desired diameter for harvesting.

Exploring potential markets for tree and tree products including fruits, shall be a continuing activity beyond project life. This will consist of studies, particularly on marketing channels and arrangements, dissemination of market information, and existing tree-site matching references.

## **OBJECTIVE 3**

Establish and foster the adoption of a range of agroforestry systems and component technologies in CBFM and other land areas, using the Landcare approach.

### **Achievements**

The Landcare program implemented in Lantapan, Malaybalay City and Manolo Fortich, is the major dissemination pathway for agroforestry, soil and water conservation and environmental technologies and innovations. LGU support for farmers' Landcare initiatives in Manolo Fortich is picking up after the local election last year. The LGU earmarked P2.5 M (for 5 Years) for Landcare support (as part of the recently developed Municipal Watershed Management Plan, which has been formulated based on the NRMDP experience under SEA 34). The municipality is still in the process of establishing its Municipal Environment and Natural Resources Office (MENRO).

Landcare in Malaybalay City is progressing positively with the active support and involvement of the City Government and the City Agriculture Office (CAO). There are more than 70 adopters of the Natural Vegetative Filter Strips (NVS) technology in 13 upland villages of the City. CAO initiated the purchase of fruit tree seedlings to be distributed to farmers who have adopted the technology as reward mechanism under the City's Upland Resource Conservation Project. This project was allocated a P500, 000 budget and focused initially on 10 upland areas, mostly in eastern Malaybalay.

The City also supported a Lakbay Aral (Study Tour) for the AT's and farmers of Malaybalay City. The CAO sponsored the First Malaybalay's Farmer's Congress, which was attended by more than 400 farmers from different barangays. An ICRAF facilitator was one of the resource speakers during this event. The occasion has prompted several barangays in Malaybalay to invite ICRAF in their communities to help promote sustainable agriculture activities in their respective areas.

Lantapan continues to serve as host to a number of visiting agencies, groups and individuals, both local and international (about 50). Agencies include those from the CARAGA Region, Western Mindanao (IFAD-Western Mindanao Community Initiatives Project), Cordillera in Northern Luzon (IFAD-CHARM Project), NGO from the Bicol (CARE Philippines), Catholic Relief Services - Southeast Asia and the Pacific, Ministry of Forest and Soil Conservation of Nepal (USAID-NEPAL), Training Centre for Tropical Resources and Conservation Sustainability, the Watershed Management Coalition (Western Visayas Chapter) and the EU-funded Upland Development Programme (UDP) in Southern Mindanao, covering the provinces of Compostela Valley, Davao Oriental, Davao del Sur, Sarangani and South Cotabato.

With the support of the ACIAR-ICRAF Landcare Program, a Participatory Monitoring and Evaluation (PME) exercise was conducted for Landcare initiatives in Northern Mindanao. The exercise looked into the adoption of simple conservation practices, their impact on addressing degrada-

tion of natural resources and the potential of Landcare as an extension model. Adoption at the 3 scaling up sites has been well documented and analyzed. The ACIAR-ICRAF project ended on 30 June 2003. An extension (bridging) project, from July 2003 to June 2004, will address the impact of technology adoption on landscape and economic changes (plot and micro-watershed levels) utilizing tested models. The extension project will also be the venue for start up discussions for a potential new project, looking at further scaling up Landcare in new sites.

## Advances

**In Research:** Seven years of data of the first generation trials in Phase I, and the 4 years of the second-generation trials in Phase II, are consolidated and tabulated, ready for statistical analysis, and presented in graph form.

**In Capacity Building:** Landcare Training Manual on upland technical and institutional innovations developed and tested. Subsequent Agroforestry training for BENRO, LGUs and DENR for CBFM project is under preparation.

ATSAL and Landcare members participated in the Farmers' Technology Forum in Cagayan de Oro City, and Annual Tree Farmers' Congress In Butuan City. Lantapan Farmers' Training Group (FTG) formed, and ATSAL registered at SEC.

**In Scaling Up:** Farming guides improved and disseminated.

Farming guides for the propagation of indigenous tree species is on going.

**In Policy Impact:** SEA-44 participated in Tree Farmers' Congress and showcased tree domestication innovations that became one of the basis of a resolution made to promote smallholder tree farms.

LGUs invested in the Agroforestry development and Landcare program that is in line with the NRMDPs and the recently developed Municipal Watershed Management Plans.

**In Improved Environment In Natural Resource Management:** ATSAL's SPAs for both fruit and timber tree species were identified.

A new network with furniture manufacturers for market linkages (e.g. Asiatic Wood Industries) was established.

Close to 170 000 timber and fruit trees in farmers' field in Lantapan, which came from the 67 communal and household nurseries, were planted. Demonstration-study on thinning and pruning is on going.

PME of Landcare program, which includes adoption of upland technologies is a continuing process.

## **Other Major Outputs in This Period**

### **Research Reports**

ACIAR-ICRAF M & E team. 2003. Adoption of conservation farming in Lantapan, Bukidnon: Analysis of the 2001 adoption survey ACIAR Project ANRE9852. M&E Report No. 5.

# SANREM CRSP

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July 2003  
Annual Report  
SEA-50

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## SANREM-SEA Environmental Research Grants Program

**Principal Investigator**  
Ian Coxhead

### OBJECTIVE 1

To provide opportunities to export SANREM methodologies, import methodologies from non-SANREM projects, or capitalize on synergies and collaborations with high potential productivity in terms of the overall goals of SANREM SEA.

### Achievements

The following projects have been funded:

William Sunderlin, CIFOR, *A literature review and bibliography on the link between forest resources and poverty alleviation in Vietnam.*

Merlyne Paunlagui, UPLB, *Social capital and natural resource management: A study of communities with varying levels of economic development in Bukidnon, Philippines.*

Eliseo Baltazar, PCARRD, *Translation of SANREM technology briefs into Tagalog and Cebuano comics format.*

Victor Ella, UPLB, *Packaging stream-flow and soil erosion prediction technology based on the WEPP model for the Manupali subwatersheds.*

### Advances

**In Research:** Literature review on poverty and the use of non-timber forest products in Vietnam in preparation; should be a major contribution to understanding in this subject area.

Development and use of WEPP model for prediction of runoff, erosion and sediment yield.

Empirical study of social capital as input to community decision-making.

**In Capacity Building:** Technical Bulletins for use of WEPP model prepared and published; workshop on the use of the model held in Lantapan, March 2003.

Seminars on social capital held in Los Baños and Lantapan (for the Association of Barangay Captains).

Several SANREM comics produced in local languages, for local training and information dissemination purposes.

### Other Major Outputs in This Period

#### Research Reports

Ella, V. 2003. *Procedures for preparing Philippine climatic data input for the*

**Co-Principal Investigator**  
Gladys Buenavista

John Rowe

Rogelio Serrano

*WEPP model using breakpoint climate data generator (BPCDG)*. SANREM ERGP Technical Bulletin No. 1/2003. 12 pp.

Ella, V. 2003. *Procedures for using the WEPP model for predicting runoff, soil erosion, and sediment yield in the Manupali subwatersheds in the Philippines*. SANREM ERGP Technical Bulletin No. 2/2003. 11 pp.

Paunlagui, M., M. Nguyen, and A. Rola. 2003. *Social capital, eco-governance and natural resource management: a case study in Bukidnon, Philippines*. Los Baños: University of the Philippines at Los Baños, Institute of Strategic Planning and Policy Studies. Working Paper No. 03-04. 27 pp.

### **Working Papers**

Huynh, B. and W. Sunderlin. 2003. *Poverty alleviation and forests in Vietnam: a literature review*. Manuscript in preparation.

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
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**July 2003  
Annual Report  
SEA-52**

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## **Development of a Spatial Information Management System**

**Principal Investigator**  
Steven Ventura

### **OBJECTIVE 1**

Identify and locate data series that can be used to create GIS layers that will support natural resource management decision-making in the Manupali watershed.

#### **Achievements**

Spatial information created during Year 4 and Year 5 has been made available to SANREM-SEA partners through the SANREM-SEA website and CD-ROM. Data layers include a 30-meter grid digital elevation model (DEM), watershed boundaries, slope map, and land cover classification for years 1994 and 2001. Satellite data from 1994 and 2001 and weather station data, collected by SANREM weather stations, were used to create a change detection map for tree and forest cover.

To facilitate the use of Phase I and Phase II research, political boundaries, at the barangay level, are being created by the Site Coordination Office. The survey records and process to create this series of data layers have been identified. Expected completion of this project will be early in Year 6.

### **OBJECTIVE 2**

Create a spatial information management system (SIMS) with an interactive website to facilitate data sharing among SANREM personnel and its partners

### **Achievements**

SANREM-SEA website provides access to spatial data through a secure ftp site. CD-ROMs located at SANREM offices in Madison, Wisconsin or Malaybalay, Philippines contain similar data and have been made available to SANREM-SEA partners. A web based interactive GIS is not currently feasible due to limited bandwidth.

### **OBJECTIVE 3**

Develop protocols to create a land suitability index for the Manupali watershed and create the land cover classification. Provide training during this process to promote capacity building and the sustainability of GIS in the region.

#### **Achievements**

Land cover classification for the Manupali watershed is complete. SANREM-SEA continues to work with provincial government agencies to expand this effort for the entire Province of Bukidnon. Training was held for Environment Department (BENRO) and Planning department (PPDO) personnel in July, 2002. Spatial data to support a land suitability index now exists. Completion of the index will be delayed until stakeholders define criteria for suitability index.

**Co-Principal Investigator**  
Gregg Clark

## Advances

**In Research:** Most of the research being conducted by SANREM/SEA is spatial in nature. Developing procedures for researchers to include a spatial component to economic, demographic and social data as well as share the data will enhance research in the area. A site visit by Gregg Clark (UW-Madison) in June- July 2002, and collaboration with the Site Coordination Officer, SANREM-SEA has completed a base map and digital elevation model of the Manupali watershed. Coverages containing physical boundaries and changes within the watershed are complete. Political boundary data layers for barangays are in the process of being created. Survey records and process for importing data into a GIS has been acquired. Barangay data series will be completed early in Year 6.

**In Capacity Building:** Maps are a powerful tool for communicating ideas and for solving problems. Through the process of collecting and creating spatial data layers, SANREM participants throughout the Manupali watershed will be able to visually identify changes in the research site and enhance their ability to analyze the spatial data. During a recent visit to Bukidnon, local government units (LGU) at the Provincial and Municipality were very interested in utilizing a GIS and RS system. Data layers for the Manupali watershed and parts of the Province of Bukidnon have been created as well as a mechanism to share the data. Spatial data is now available to assist LGU's answer questions regarding efficient use of land resources. SANREM efforts to expand the use of spatial data have been well received at all levels within the province, including the Governor's office. Currently the Provincial Technical Working Group is expanding purchases of GIS software and hardware to increase the use of its spatial data.

**In Scaling Up:** The lessons and processes used to create a land cover classification and land cover change detection map are available for use by the Bukidnon Environment And Natural Resource Office (BENRO). This information can be used to complete a national government directive to create

a land cover classification for the entire province. Similar process can be used in other research sites (i.e. Vietnam).

**In Policy Impact:** The spatial data accessible to SANREM partners is beginning to assist decision makers in evaluating potential choices regarding land use and natural resources. Spatial data continues to be developed and improved. Through training and discussions with SANREM personnel, the Provincial government has begun to expand its geo-spatial capabilities.

**In Improved Environment In Natural Resource Management:** Spatial data is being used to in support of SANREM activities as well as to help quantify and qualify SANREM sponsored projects. A forest cover change detection map was produced from SANREM spatial data. The data set shows an overall increase of 11.9 percent forest/tree cover in the watershed. Potential location and size of deforestation have been identified for further investigation by provincial authorities and local community organizations.

# SANREM CRSP

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**July 2003  
Annual Report  
SEA-53**

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## Water Policy Research

### OBJECTIVE 1

Contribute to scientific knowledge and policy advocacy in the area of water resources management in the Philippines.

### Achievements

As of this writing, a total of nine research papers have been completed addressing the issues of the links of watershed health to water services, allocation of water uses, and governance of water resources. Six of these papers were presented in a Policy Forum on Water Resources Management in August 2002 and three are additional papers suggested during the discussions in the Forum and meant to complement and reinforce the findings and recommendations of the other papers. The papers are to be published in a book tentatively titled *Winning Water Wars: Towards a Watershed-based Approach to Water Resource Management*. The original schedule of the book's release was July 2003 but since the manuscript is currently still being reviewed, the date of release has been reset to October 2003.

Production of policy and research briefs continued with the issuance of two Policy Notes touching on the benefits of adopting a watershed-based strategy to water management and on the use of community-generated data for water management policy as well as with the publication of three research briefs in the

PIDS' widely-circulated newsletter, the Development Research News (DRN). The research briefs touched on the topics of the competing uses of water, model of water governance for the Philippines, and a proposed water policy agenda for the country. All issues of the Policy Notes and DRN were distributed to members of the two Houses of Congress and members of the Cabinet executive departments, especially those involved in the administration and management of water resources. Copies were also circulated to members of the media.

In addition to these writeups, a special issue of the Philippine Journal of Development (PJD) was also published which included various SANREM-sponsored studies on NRM and community participation in resource management.

The Policy Forum on Water Resources Management was held on August 12, 2002 with a multisectoral group composed of officials of national agencies involved in water administration, members of the legislature, local government officials and representatives of local communities, nongovernment organizations involved in the advocacy of good and effective resources management especially of water resources, representatives from the private business sector, members of the academe, and media, in attendance. The presentations and discussions during the Forum were the basis for coming up with a policy advocacy action plan that consisted of inter-

**Principal Investigator**  
Christina David

**Co-Principal Investigator**  
Ian Coxhead

Agnes Rola

actions and advocacy activities at the legislative and executive levels.

The interactions involved a meetings and briefings for certain legislators (and their technical staffs) at the two Houses of the Philippine legislature who have filed bills related to water issues. Focus of the interactions was on the previously filed Clean Water Act. Meetings with members of the Technical Working Groups' (TWGs) committees involved in the drafting of such bill were also arranged. The briefings and discussions involved the preparation of talking points and briefing kits for the legislators, their staffs and members of the TWGs. They centered on the prospects of including some of the key recommendations of the project studies as provisions in the Clean Water Act. Among these points are: (a) adoption of a watershed-based approach to water management; (b) provision of a comprehensive framework for policies in water resource management; (c) adoption of a water pricing policy covering the full economic cost of water production and distribution; and (d) use of a portion of the proposed water users' fees for rehabilitation and other restorative mechanisms for watersheds.

Prior to the Policy Forum held in August 2002, the project proponents and forum organizers met with the chairs of the policy and technical level inter-agency committees based at the National Economic and Development Authority (NEDA) who were tasked with the responsibility of consolidating the agenda for a National Water Summit originally scheduled for October 2002. The purpose of the meeting was to acquaint the NEDA-based officials on the key findings and recommendations of the studies to be presented in the SANREM-UP Los Banos-PIDS sponsored Policy Forum. As a result, the NEDA officials participated actively in the Forum by presenting to the Forum participants the plans and tentative items for discussion in the National Water Summit and by noting that the Forum's discussions and recommendations would be considered for possible inclusion in the Summit's agenda wherever appropriate. Members of the SEA-53 and -23 project teams were also later invited to participate in working groups looking into aspects of the water agenda for the Philippines.

## Advances

**In Research:** A special joint issue of the Philippine Journal of Development (PJD), Volume XXIX, Number 53, First Semester 2002, was published by the SANREM and PIDS. Nine research papers have been completed and proposed to be included in a publication volume. Two Policy Notes were released and three research briefs appeared in various issues of the PIDS' Development Research News (DRN).

**In Scaling Up:** Policy notes and research briefs were distributed to all the members of the Senate and to the Chairpersons (Congressmen) of the Committees on Natural Resources and Environment, Ways and Means, Local Governments, and Appropriations at the House of Representatives, among others. In addition, linkages were established with: (a) key legislators in the Senate and House of Representatives; (b) technical staffs of said legislators; and (c) key members of the technical working groups of committees in both Houses of Congress that tackle the bills, in particular, the proposed Clean Water Act. At the Senate, meetings with the staffs of Senator Edgardo Angara who filed a bill on the Clean Water Act have focused on the recommendation regarding the adoption of a watershed-based approach to water management. The Senator's bill is now ready for floor deliberations and insertions of additional provisions. At the Lower House, a similar bill filed by Representative Nereus Acosta includes the key recommendations from the project's studies. The bill is now in its second reading and has gained considerable support among legislators at the Lower House.

**In Policy Impact:** Various media exposures of the Policy Notes were monitored. The media exposures led to increased requests for copies of the studies of the project as well as queries and further clarificatory questions on some aspects of the studies. In addition, the Secretary-General of the House of Representatives directed the chair of the House Committee on Public Works and Highways to act upon recommendations contained in one of the Notes regarding institutional issues on water. Interactions with members of the legislature, their technical staffs and TWGs have resulted in the

inclusion, among others, of some of the key findings and recommendations of the study along the following lines: a) adoption of an integrated, holistic approach in addressing the interrelated issues of water supply planning and operation, demand management, pollution control, and watershed and groundwater protection; b) management of water not just as a social good but more importantly as an economic good; c) adoption of a water pricing policy that covers the full economic cost of water production and distribution; and d) upholding of the principles associated with a watershed-based approach by considering the watershed as the basic unit in managing water resources in the country. Finally, earlier interactions with the NEDA-based inter-agency committees tasked to consolidate the agenda for a National Water Summit had resulted in the invitation of members of the project team to participate in working groups looking at aspects of the water agenda for the Philippines.

**In Improved Environment In Natural Resource Management:** No major impact at this level has been measured yet.

## Publications

### Journal Articles

Buenavista, G., A. Sumbalan and I. Coxhead., 2003. *How do research projects influence the design of local policies for environmental and natural resource management?* Philippine Journal of Development, a special joint issue of the SANREM CRSP/SEA and PIDS. 29(1), First semester 2002. 127-150.

Coxhead, I. 2003. *Development and the upland resource base: economic and policy context, and lessons from a Philippine watershed.* Philippine Journal of Development, a special joint issue of the SANREM CRSP/SEA and PIDS. 29(1), First semester 2002. 1-32.

Manasan, R., 2003. *Devolution of environmental and natural resource management in the Philippines: analytical and policy issues.* Philippine Journal of Development, a special joint

issue of the SANREM CRSP/SEA and PIDS. 29(1), First semester 2002. 33-54.

Nissen, T. and D. Midmore. 2003. *A bioeconomic rationale for the expansion of tree planting by upland Philippine farmers.* Philippine Journal of Development, a special joint issue of the SANREM CRSP/SEA and PIDS. 29(1), First semester 2002. 85-100.

Rola, A. and I. Coxhead., 2003. *Does nonfarm job growth encourage or retard soil conservation in Philippine uplands?* Philippine Journal of Development, a special joint issue of the SANREM CRSP/SEA and PIDS. 29(1), First semester 2002. 55-84.

Shively, G. and C. Zelek. 2003. *Linking economic policy and environmental outcomes at a watershed scale.* Philippine Journal of Development, a special joint issue of the SANREM CRSP/SEA and PIDS. 29(1), First semester 2002. 101-126.

## Other Major Outputs in This Period

### Research Briefs

Contreras, A. 2002. *Is there still a need to legislate? A water policy agenda for the Philippines.* PIDS Development Research News. 20(4): 1-4, 7.

Elazegui, D. 2002. *A law of nature: the command-and-control approach.* PIDS Economic Issue of the Day. 3(1).

Francisco, H., 2002. *Why watershed-based water management makes sense.* PIDS Policy Notes 2002-09. November.

Malayang, B. 2002. *A model for water resource governance for the Philippines.* PIDS Development Research News. 20(4): 4.

Oprecio, J., A. Rola, W. Deutsch, I. Coxhead and A. Sumbalan. 2002. *Using community-generated data for water management policy.* PIDS Policy Notes 2002-10. November.

Oprecio, J., A. Rola, W. Deutsch, I. Coxhead and A. Sumbalan. 2002. *Addressing the water resource management issue*. PIDS Development Research News. 20(2): 6.

Oprecio, J., A. Rola, W. Deutsch, I. Coxhead and A. Sumbalan. 2002. *More efficient water pricing may avert a water crisis*. PIDS Development Research News. 20(2): 8.

Oprecio, J., A. Rola, W. Deutsch, I. Coxhead and A. Sumbalan. 2002. *To reduce pollution: polluters should pay*. PIDS Development Research News. 20(2): 7.

Tabios, G. and C. David. 2002. *Competing uses of water: the cases of Angat, Laguna Lake, Batangas and Cebu City*. PIDS Development Research News. 20(6): 1, 3-6, 9.

#### **Conference Presentation Papers**

Acosta, R. 2003. *Implementation of the watershed approach in natural resources management in the Philippines: an assessment*. Policy Forum on Water Resources Management. August. Philippines.

Contreras, A. 2003. *Water policy agenda for the Philippines: is there still need to legislate?* Policy Forum on Water Resources Management. August. Philippines.

Elazegui, D. 2003. *Governance of water resources: realities and challenges in the Philippines*. Policy Forum on Water Resources Management. August. Philippines.

Francisco, H. 2003. *Water allocation in the Philippines: dealing with competing uses*. Policy Forum on Water Resources Management. August. Philippines.

Francisco, H. 2003. *Watershed-based water management strategy: the missing link to sustainable water services*. Policy Forum on Water Resources Management. August. Philippines.

Malayang, B. 2003. *A model of water resource governance in the Philippines*. Policy Forum on Water Resources Management. August. Philippines.

Rola, A. and H. Francisco. 2003. *Towards a watershed-based water resources management strategy in the Philippines*. Policy Forum on Water Resources Management. August. Philippines.

Rola, A., I. Coxhead, W. Deutsch and A. Sumbalan. 2003. *Economic development and water resources management: what can community-generated data offer?* Policy Forum on Water Resources Management. August. Philippines.

Tabios, G. and C. David. 2003. *Competing uses of water: cases of Angat reservoir, Laguna Lake and groundwater systems of Batangas City and Cebu City*. Policy Forum on Water Resources Management. August. Philippines.

#### **Working Papers**

Rola, A., I. Coxhead, W. Deutsch, and A. Sumbalan. 2002. *Economic Development and the Use of Water Resources: Lessons from Lantapan*. Manuscript. University of the Philippines, Los Baños.



# SANREM West Africa

## Project Overview

SANREM CRSP-West Africa Phase II was initiated as a complement to USAID/Mali's Special Initiative to reduce conflict in the northern Mali. The primary goal of the SANREM CRSP-WA is to develop a holistic approach to managing natural resources and their associated conflicts in northern Mali. The project seeks to develop science-based solutions that promote sustainable agriculture and natural resource management while building local management and problem solving capacity. The SANREM CRSP Project in Mali demonstrates that when a local population is provided with a methodology for Holistic Management, and an institutional vehicle for inter-village, inter-ethnic dialog, it can become proactive in addressing major NRM issues. This then leads to the rapid adoption and dissemination of improved agricultural, livestock and natural resources practices.

SANREM CRSP-WA researchers have routinely met with both the USAID/Mali Democracy and Governance (DG) and Sustainable Economic Growth (SEG) teams to debrief them on SANREM CRSP activities in Madiama. This relationship has grown over time and the USAID/Mali staff has come to greatly appreciate SANREM CRSP-WA achievements. In fact, this year's design of the new Country Strategy has drawn on SANREM CRSP-WA examples in the elaboration of its Strategic Objectives. During 2002, the new

USAID/Mali Mission Director visited the SANREM CRSP-WA site in Madiama because of its reputation as an example of a good project activity. The delegation especially appreciated the synergies our project has between IER, the community, and a PVO.

### **Research Accomplishments**

SANREM CRSP-WA has developed a research program to address both the NRM conflict issues and the need for more accurate data and tools for agricultural and natural resource management and policy dialog. The project has established a multi-year, geo-referenced database of weather, soil, cropping system, land use, and water point data. This database is used for the construction of maps and modeling at the commune level. Agronomic decision-making can now be informed by the calibrated CropSyst Model that simulates the long-run viability of potential new technologies. Database and model parameter files (previously non-existent for the study region) were created for weather, soils, crops and different management schemes. Integration of CropSyst with GIS (Arc Info and Arc View) was completed using the soil map and database constructed for Madiama commune. For the 2002 rainy season, biophysical (crop growth parameters, harvest/yield, weather and water points) and socio-economic (labor hours, input prices) data were collected from monitoring and

field tests sites, processed and entered in the multi-year database for exploitation. A technical report and synthesis publication on existing cropping and management systems are being prepared with host country collaborators. A technical soil survey report has been completed and the findings will be discussed with community members in Madiama.

An article on "Linking Field Testing and Simulation Modeling for the Evaluation of Long-term Impacts of Soil Fertility and Conservation Management Practices in the Sahel" is in preparation and will be submitted for publication after review of findings with Malian collaborators and community members in Madiama. An economic analysis of data from two years of soil fertility studies was conducted. Technical and economic reports for soil fertility improvement tests using cowpea-millet rotations, organic and inorganic fertilizers, and paddocking cattle for different number of days are being reviewed and refined for final publication.

Recognizing that technical problems are not divorced from day-to-day community life, the Natural Resource Management Advisory Committee (NRMAC) has become the focal unit for project interventions. The NRMAC bridges the rural knowledge divide linking civil society with local government. Local leaders have been trained and in turn have become trainers in conflict resolution and community consensus building to assist in managing transformations of the production systems and mobilizing community action for an improved environment and NRM. With the assistance of Holistic Management trainers and IER researchers, they are establishing a method for community controlled open range rotational grazing. Also in the area of pasture management, assessments of dry season livestock feeding resources demonstrated the abundance of *Cassia tora* (an invasive leguminous weed) in pastures, and additional work was begun on the possibility of ensiling this plant material for supplemental feeding purposes as it is unpalatable to livestock in its green stages.

Preliminary analysis of data collected in the follow-up household survey (panel study) shows that the population's perceptions of conflict and the seriousness of conflict between herders and farmers have diminished over the past three years. In addition, the NRMAC is perceived by much of the population as important for environmental protection and economic development of the Commune. Structured interviews with local leaders in the Commune of Madiama were also completed. These interviews have been transcribed and a preliminary report presented on the findings. This is a rich qualitative database, helping to clarify and elucidate many issues of democratization, decentralization, conflict resolution, and NRM in the Commune. Findings are being incorporated into the paper on social capital and will also contribute to another paper on decentralized local leadership.

Research and analysis for the drafting of the paper "Building Social Capital in the Sahel" were conducted and an initial draft of the paper should be completed soon. Leveraged funding from the NASA Carbon from Communities Project for research in Madiama is examining the potential of holistic management of rangeland strategies to sequester carbon in the soils of West Africa. This led to the drafting of a paper analyzing the institutional potential for scaling up the open-range rotational grazing practice for community-based carbon trading. This paper was presented at the International Workshop on Reconciling Rural Poverty and Resource Conservation: Identifying Relationships and Remedies at Cornell University.

# SANREM CRSP

Sustainable Agriculture and Natural Resource Management  
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July 2003  
Annual Report  
WAF-01

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## Coordination and Management of West Africa Regional SANREM Project

Principal  
Investigator  
S. K. DeDatta

### OBJECTIVE 1

Provide leadership for regional project development and implementation.

#### Achievements

Implementation is proceeding well for those project activities within the controllable domain. However, lack of rainfall has halted, delayed and/or otherwise negatively impacted several bio-physical project activities (all bourgou projects; controlled grazing).

Collaborative exchanges with PPPOA in Chad, Texas A&M's regional activities in Mali, and other Holistic Management partners have been maintained.

### OBJECTIVE 2

Coordinate program development among U.S. and international collaborators.

#### Achievements

Bio-physical and social scientists are meeting more frequently and learning to integrate their research outputs into user friendly tools. Bio-physical scientists and economists have pooled efforts to begin work on evaluating economic feasibility of soil fertility interventions at the farm level. Full integration of research outputs is developing, but not yet achieved.

### OBJECTIVE 3

Coordinate financial and programmatic reporting of regional activities.

#### Achievements

Timely and complete reporting of financial and programmatic activities has been maintained.

#### Advances

**in Research:** This is a coordination activity and as such does not produce research outcomes and impacts. See other activities for advances in research.

**in Capacity Building:** The SANREM CRSP-West Africa Team has attained increased information exchange between project partners and participants across project activities.

**in Scaling Up:** The SANREM CRSP-West Africa Team has expanded its network of partners to include those at both the provincial and national levels within Mali, and those at the regional level across the Sahel.

**in Policy Impact:** This is a coordination activity and as such does not address policy issues.

**in Improved Environment In Natural Resource Management:** SANREM WAF project activities are contributing

Co-Principal  
Investigator  
Michael Bertelsen

significantly to improved NRM methods through community level decision-making for NRM and individual soil fertility management decisions.

### **Other Major Outputs in this Period**

#### **Degree Training**

Todd Crane, Ph.D., 2001-2006

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Sustainable Agriculture and Natural Resource Management  
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July 2003  
Annual Report  
WAF-05

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## Workshop on Conflict and NRM: Emerging Lessons and Directions from West Africa

Principal  
Investigator  
Michael Bertelsen

### OBJECTIVE 1

Review the present (annual) state and progress of strategies to deal with conflict and NRM in agro-pastoral systems in order to coordinate research with other related ongoing activities in the region.

scaling up of carbon-sequestering pasture management technologies is an important aspect of this project. The project attracted substantial interest from the committee since the NRM Pole is also considering developing a program in this area.

Co-Principal  
Investigator  
Keith Moore

### Achievements

The core activity during this period was a presentation made to the annual meeting of the Regional Coordinating Committee of the NRM Research Pole held in Niamey, Niger March 10-13, 2003. RCC members include the National NRM Coordinators from the nine CILSS countries as well as representatives from CIRAD, ICRISAT, ICRAF, and IFDC. The NRM Pole provides a key mechanism for the dissemination of research results and institutionalization of successful methodologies. The presentation centered on progress in building strategies to mitigate conflict and improve NRM in the Madiama area and the positive impact of capacity building initiatives (i.e. trainings) and institutional approaches (i.e. NRMAC) fostered by SANREM WAF. The presentation also included a report on the NASA-funded Carbon from Communities project, which articulates with the SANREM WAF activities on sustainable pasture management in Madiama. Efforts to enhance communities' capacity to anticipate and resolve conflicts potentially associated with the

### Advances

**in Research:** We have maintained contact with research partners in the West Africa Region and will continue to take the opportunity to assure maximum exposure for SANREM CRSP West Africa research and policy achievements at all convenient fora in the region.

**in Scaling Up:** The annual RCC meeting and NRM Research Pole network provide excellent avenues for scaling up successful approaches to NRM conflict management and linking SANREM WAF outcomes to other experiences in the region.

**in Policy Impact:** Although each country in the Sahel has its own particular platform to facilitate NRM policy dialog with national decision makers, the individual NARS play a crucial role in every country. Because the NRM Research Pole reports directly to the regional organization of the NARS Directors General and its representatives are national NRM coordinators, the Pole is well placed to support policy dialog at both the national and regional levels.

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
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**July 2003  
Annual Report  
WAF-06**

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## **Creation and Support of a Commune-Level NRM Advisory Committee**

**Principal  
Investigator**  
Salmana Cisse

### **OBJECTIVE 1**

Reinforcement of the institutional capacity of the NRMAC through training in functional literacy and numeracy, financial management, and strategic planning.

### **Achievements**

With the assistance of NGO partner CARE/Mali, basic training in functional literacy and numeracy, financial management and strategic planning has been completed. Initial training in strategic planning, self-evaluation, civic action, communication techniques, and project development has been completed. This year CARE/Mali organized a meeting of the technical services responsible for Communes in the Cercle of Djenné with the NRMAC. At this meeting and open-ended discussion of community services, the NRMAC learned how the community can access these services and the role that the NRMAC can play in service delivery. These trainings have made use of curricula and materials produced by CARE, which have been translated in local language with SANREM's support. Exchange visits of community members with other NRM projects have occurred this year.

On-the-job training and assistance in the preparation and submission of requests for financing from the French govern-

ment and the World Bank has been conducted. This resulted in a grant from the Foundation de France for the NRMAC to develop an improved communication strategy with the assistance of a local NGO (GRAD). An initial diagnostic identified roadblock in communications and an action plan is being developed to overcome them and to transfer communication skills to NRMAC members and other key agents. Radio programs in local language on the NRMAC role and activities continue to be produced and broadcasted by a local radio station based in Djenné.

The first electoral mandate of NRMAC members is completed and elections were held for the next committee's term. These elections began with the village level committees leading to a Commune-wide General Assembly in which the mandate of each original committee member was renewed. An supervisory board representing the Commune Council, village chiefs, religious leaders, technical service agents, IER, and NGOs has been established to provide guidance for the NRMAC after the departure of SANREM. The NRMAC has developed and approved a new triennial plan of action and successfully raised funds for its partial implementation through the fees from over 250 memberships. Two additional villages, whose territories are adjacent to the Commune of Madiama, requested and obtained to join the NRMAC. Although

**Co-Principal  
Investigator**  
Abdoulaye Toure

they fall within different administrative units (Cercle and Region), these villages fall within the same social and economic landscape of Madiama and have close interactions in terms of exploitation of natural resources. Surveys have been implemented to assess the impact of these capacity building activities on decentralized NRM governance at the Commune level (see Objective 3).

## **OBJECTIVE 2**

Reinforcement of the NRMAC capacities in Holistic Management of natural resources.

### **Achievements**

Two bourgoutières management agreements have been finalized and signed. One other agreement could not be concluded because of previous over-riding land use agreements concerning the larger resource zone in which it was found.

Management plans for open range grazing in the dryland areas have been established and are being implemented at two separate village sites. The NRMAC played key roles in negotiations concerning the identification of sites, the recruitment and training of volunteer environmental monitors to oversee implementation, the development of pasture management schedules for various times of the year, communication with herders representatives and other users, and resolution of conflicts surrounding the scheme. While important discussions between and within villages have proceeded this year, due to the drought, little practical experience was achieved in implementation. However, the technical and capacity building trainings and the community consultations have established a solid base for full implementation during Year 6. Training materials on Holistic Management has been produced and translated in the local language (Bamanan). Agreements for the management of the two open range pastures, including the exploitation of wood and other natural resources, are being developed.

The institutional frameworks surrounding the open range holistic management experiment, and their potential for scaling up of sustainable NRM technologies, were analyzed in a paper presented at an International Workshop on “Reconciling Rural Poverty Reduction and Resource Conservation: Identifying Relationships and Remedies” at Cornell University, May 2-3, 2003. The paper is being revised for submission to World Development.

## **OBJECTIVE 3**

Increasing members’ capacities to manage conflict situations involving natural resources.

### **Achievements**

A conflict management training module on "Managing Change" has been conducted with the full membership of the NRMAC and three development agents. Conflict resolution training has been conducted in seven villages by NRMAC trainers (with and without the supervision of SANREM trainers). Training materials for NRMAC trainers on conflict management have been drafted in local language (Bambara). As a result of this training the NRMAC has intervened successfully in at least two cases of conflict and provided conflict management training at the village level.

To assess the impact of capacity building activities on NRM governance and conflict, a series of research activities have been conducted, including a) a leadership survey, targeting 31 traditional, administrative, and civil society leaders in the Commune; and b) a follow-up on the socioinstitutional household survey, using the panel sample of 120 household heads and their wives (first established in the 1999 economic survey conducted by Daniel Kabore). The leadership survey addresses questions concerning awareness and understanding of the decentralization process, the role of the NRMAC and other organizational structures, and NRM conflict management within the Commune. The socioinstitutional survey collected data on associational membership, confidence in local insti-

tutions (including the NRMAC), knowledge of decentralization legislation, identification of key NRM issues, adoption of sustainable NRM technologies, and perceptions relative to NRM conflict in the Commune. These data are being processed and analyzed, and findings are being synthesized into a paper on “Building Social Capital in the Sahel” (Moore, Cissé, and Touré, 2003).

## Advances

**in Research:** Initial and follow-up survey data have been collected and preliminary analyses conducted to determine the impact and relative importance of the various tools and methods (HM and Conflict Management) employed by SANREM in Madiama. Initial findings confirm a lowered perception of conflict within the commune and improved inter-village relations. The Leadership survey confirms that the NRMAC is providing positive leadership in the Commune and is respected by village chiefs as well as elected Commune Counselors.

**in Capacity Building:** NRMAC members and villagers with whom they work have applied their skills in consensus building through the negotiation of two bourgoutière management agreements. The NRMAC has also provided a viable framework for negotiations over and implementation of an open range holistic management grazing plan in two villages. NRMAC members have developed a strategy for reproducing centrally held training activities throughout the 10 villages of Madiama. NRMAC members are developing skills as conflict resolution trainers and have conducted conflict resolution training workshops in seven villages as well as developing a skit encouraging conflict management learning and discussions at the village level. They have intervened successfully in resolving instances of conflict over NRM and non-compliance with management agreements. A mechanism (advisory board) is being developed to provide technical and administrative guidance to the NRMAC after the withdrawal of SANREM support.

**in Scaling Up:** Work still needs to be done to further improve the inclusion of transhumant stakeholders in bourgoutière and open-range manage-

ment. A key mechanism is the Nérékoro Herders Association, which has a representative on the NRMAC. NRMAC members are communicating with a multi-commune audience during their radio emissions and promoting the lessons they have learned through Holistic Management and Conflict Resolution training and the negotiation of local agreements concerning the management of specific resources. Two additional villages, located in a commune neighboring Commune, have joined the NRMAC.

**in Policy Impact:** The NRMAC has drafted and approved its by-laws and obtained administrative recognition of the Governmental Delegate (Préfet) for the Cercle of Djenné. The leadership and socioinstitutional surveys identify the NRMAC as a key institutional mechanism that enables the participation of civil society in local level NRM governance, as mandated by the decentralization policy reform undertaken by the country in the late 1990s.

**in Improved Environment In Natural Resource Management:** The partnership between the NRMAC and the Commune Council has re-dynamized conservation and restoration activities in the Commune. For instance, the NRMAC has mobilized new momentum behind the campaign to protect the acacia albida (a tree that has fertility enhancing properties), has launched a tree-planting campaign, and has disseminated information about environmental protection codes. The Forestry Service is looking to the NRMAC as a mechanism for promoting its activities at the local level. Local officials have remarked about the lower levels of NRM conflict during the past two years and preliminary analysis of the household surveys confirms this observation.

## Other Major Outputs in This Period

### Conference Presentations - Papers

Roncoli, C., K. Moore, A Berthi, S. Cissi, C. Neely, and C. Perez. 2003. *An Analysis of Institutional Supports for Community-based Land Management Systems with Carbon Sequestration Potential in Mali*. Presentation at the Workshop on

Reconciling Rural Poverty Reduction and Resource Conservation: Identifying the Relationships and Remedies. Cornell University. May 2-3.

## **Tools**

Goebel, J., 2002. *Restoring Community Through Consensus*. OIRED/Virginia Tech. SANREM CRSP-West Africa Working Paper No. 03-02. December 2002.

Nadif, A. 2002. *Formation des delegui techniques (auxiliaries d'environnement) pour la gestion des parcours de la Commune de Madiama*. CARE/Djenni (in French and Bamana).

## **Non-Degree Training**

### **Workshop**

Strategic Planning/Civic Action/Project Development was attended by 22 person(s) and lasted 5 day(s).

Community Consensus Building was attended by 21 person(s) and lasted 5 day(s).

Holistic Pasture Management was attended by 25 person(s) and lasted 5 day(s).

Pastureland Management Accords was attended by 22 person(s) and lasted 5 day(s).

# SANREM CRSP

Sustainable Agriculture and Natural Resource Management  
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July 2003  
Annual Report  
WAF-07

## Development of Methods and Tools for Evaluation and Decision Making

Principal Investigator  
Oumarou Badini

Co-Principal Investigator  
Charlene Brewster

### OBJECTIVE 1

Establish a multi-year database for crops, soils, weather, and management technologies for modeling and evaluating the impacts of NRM practices on productivity and the environmental sustainability.

### Achievements

A multi-year (1999-2001) geo-referenced database of weather, soil, cropping systems, and land use was established and used for development of maps and modeling at commune level. This database exists in Mopti and in the US. It comprises data collected from weather monitoring, soil survey, fields monitoring and soil fertility management test sites (cf. WAF-08). For the 2002 rainy season, biophysical and socio-economic (labor hours, input prices) data were collected from 26 fields. Fourteen fields (12 rice) were lost due to drought and lack of seasonal flood waters from the Bani River. The 2002 season was one of the driest in the past 10 years with rainfall in the commune varying from 316 mm at Tatia to 441 mm at Tombonkan. The gross average from last year was approximately 630 mm commune-wide. Crop Growth Parameters, harvest and weather data from 2002 have been processed and entered in the multi-year database for exploitation.

A technical report and synthesis publication on existing cropping and manage-

ment systems was drafted in May 2003 (Touré et Badini, 2003). Data processed from 24 fields include crop type and cultivar, area under cultivation, growth cycle and yields. For each field, the crop/cultivar, the cropping patterns (monoculture, mixed and rotation cropping) and practices as well as the labor requirements and inputs were quantified. Field sizes were calculated using a GPS to record the coordinates and the GIS software ArcView to determine the total field areas. The average cultivated area was 1.66 ha for millet, 5.3 ha for sorghum and 5.7 ha for intercropping millet/sorghum.

Millet (*Pennisetum spp.*) and sorghum (*Sorghum vulgare*) dominate the cropping pattern, generally as intercrop with cowpea (*Vigna unguiculata*). The lowland areas near the Bani river are used for rice cultivation. More favorable microenvironments of the highlands with favorable moisture and nutrients conditions are cultivated to sorghum, water melon, okra (*Hibiscus esculentus*), maize (*Zea mays*) and sorrel (*Hibiscus sabdarifa*). In general, all crops respond well to fertilizers, but fertilizer use is insignificant (less than 2% of farmers) and the rates applied are very low (e.g. 20 kg/ha Nitrogen DAP for water melon and 50 kg/ha of urea on rice). Farmers in the commune dry seed or seed with the first sufficient rains after plowing in mid to late June. Reseeding is often necessary due to early season drought. Planting can continue through July in most of the years. Two weedings

and hoeings are customary though dependent on labor availability and prospect of potential crop yield. Harvesting is usually done in late October to mid November for millet and sorghum and late December for rice. Overall, the crop calendar varies depending on the rainfall pattern. Final crop yields are strongly dependent on time of planting with higher yields obtained in years of early planting dates. Average yields of cereals were 477 kg/ha in Madiama in the cropping season 2002-2003. These values are comparable to yields found elsewhere for the region which are estimated to 466 kg/ha . These low yields are due to the low rainfall of the year but also to the low levels of applied fertilizers. Also, most millet fields were infested by mildew and striga causing in many cases more than 50% loss of potential yield. The average cost of production estimated at 10700 CFA Francs is low. The unit production cost is 50 FCFA for millet/sorghum and 40 Fcfa/kg for maize.

The multi-year database has been developed in collaboration with researchers at IER, and the contents have also been shared with colleagues at Virginia Tech and the University of Florida.

## **OBJECTIVE 2**

Create cartographic and geographic information systems (GIS) for the commune of Madiama from remotely sensed data for more refined planning and a geographic representation of natural resources.

### **Achievements**

The Soil survey of Madiama commune allowing the determination of the main types of soils, their distribution, potential and constraints has been completed. The study of local knowledge of soils allowed researchers to elucidate farmers' understanding of soil types and fertility potential and to relate the identified mapped soil units from the classic survey to classifications used by local farmers. Soils and land uses maps of the commune have been produced.

Data for 145 surface water points were collected throughout the commune and have been converted into an Arc View shape file. Each point is associat-

ed (by attribute tables) with the date of data collection, village, altitude, type of water source, depth of open wells, rating of water quality, available access, town uses for water, and months of useful water. Photographs have been scanned as JPEG images and added as themes to the view. We are currently linking each photograph to its associated water point.

The GIS support integrating biophysical layers (soils, land uses) and socioeconomic infrastructures such as water points, roads and schools is being developed with the contribution of the newly trained counterparts from IER and SANREM collaborators from Virginia Tech's Center for Environmental Applications of Remote Sensing. Quickbird images were acquired in Nov. 2002, and all ground cover images have now been digitized. In-situ land cover data is now integrated with GIS data and the final classification for the 2002 growing season (2002-2003) is now in progress. GIS training of two Malian researchers has taken place at Centre AGRHYMET in Niamey, Niger. This is related to a joint SANREM CRSP-NASA grant to assess carbon sequestration and land use management technologies, providing capacity building support for this activity.

## **OBJECTIVE 3**

Development of biophysical modeling techniques to monitor and evaluate the biophysical performance of existing and alternative natural resource management technologies and practices.

### **Achievements**

CropSyst model has been adapted for West African conditions. Database and model parameter files (previously non existent for the study region) were created for weather, soils, crops and different management schemes. Integration of CropSyst with GIS (Arc Info and Arc View) was completed using the soil map and database constructed for Madiama commune.

Analysis of rainfall records and predictive information combined with GIS and biophysical modeling of soil water balance and crop production allowed

us to assess growth potential of some crops and management systems in Madiama commune. Crop water stress, crop yields as well as overall stress indices in reference to yield potential permitted by different soils under low and optimum nitrogen input levels have been simulated and mapped to illustrate how this approach could improve advisors and managers' decision making in the study area. An agroclimatic assessment of the commune was completed to analyze long-term rainfall variability and reliability as well as the length of crop growing period.

A report on "Linking Field Testing and Simulation Modeling for the Evaluation of Long-term Impacts of Soil Fertility and Conservation Management Practices in the Sahel" is being drafted with input from Malian collaborators and community members in Madiama.

#### **OBJECTIVE 4**

Development of tools to monitor and evaluate the social and economic viability of current and alternative soil and pasture management practices.

#### **Achievements**

Market data is being regularly collected by the agro-economist at IER. This is an on-going activity that allows the monitoring of market conditions both inside and outside of the commune. Data on input and output prices are collected regularly, and these are providing critical data for the economic analyses of soil fertility technologies currently away.

An additional information collection effort was planned to supplement the market information, update the original social and economic baseline data for the commune and for the SAM, and permit additional economic modeling work by Daniel Kaboré (a former SANREM-funded graduate student at VT who is employed by Burkina Faso's national agricultural research institute (INERA) and currently a Ph.D. student at Groningen university in the Netherlands). Insufficient funding prevented travel for Kaboré and undertaking of large-scale survey work; however farm level economic data is

being collected and analyzed on a smaller scale by IER social scientists, and this will be used to update the SAM.

Discussions were held with Texas A&M personnel on linking the SAM with the sector model. Although in principle both modeling groups are enthusiastic about linkages, to date it has been difficult to employ a methodology for linking the SAM and sector model because of differences in spatial and temporal scales, as well as modeling formats. Integration of the biophysical and socio-economic models will not be completed until both models are completely refined and updated.

Work on evaluating the economic viability of soil fertility techniques was begun as a large-scale collaborative effort between SANREM-WAF economists, IER social scientists and the biophysical scientists working in project WAF-08. Data from two years of soil fertility trials is now available and has been analyzed to determine economic profitability and sustainability of soil fertility interventions. The data demonstrate the economic feasibility of micro-dosing techniques and systems involving contracts between farmers and herders for manure management and exchange, over those involving use of rock phosphate, though some differences exist between cropping systems. The data are being analyzed and a report is being drafted.

#### **OBJECTIVE 5**

Transfer evaluation tools including models, methods and skills to IER and other regional partners.

#### **Achievements**

A small workshop was held in July 2002 where IER researchers were briefed on the construction and use of the Social Accounting Matrix (SAM). A basic SAM model was presented and explained, followed by discussions on its application to Madiama commune, the data collection process and interpretation of the results.

A workshop with the NRMAC members and community leaders was held in Madiama to convey the results of the SAM research with the community

and discuss the implications for future economic policy and research directions.

Individual sessions with the IER agro-economist were held to transfer the methodology and enable him to modify the existing model and develop new ones.

All models are developed collaboratively with IER partners, thus transfer of tools and training in modeling methods are on-going project activities.

## Advances

**in Research:** The created biophysical database and models are used for the analysis of the impact of farming and pasture management practices on soil fertility and erosion, crops yields and pasture carrying capacity over a period of at least 20 years. The socio-economic models have permitted a better understanding of economic links among the various occupational groups (farmers, agropastoralists, sedentary pastoralists, and transhumants) and of some of the most widely used farming practices. Knowledge of weather characteristics, soils, crops, and cropping systems of the study region has been improved as a consequence of the biophysical database and modeling and survey work. Field measurement, modeling, and mapping allowed the analysis of soil potential and erosion rates products and increased the people awareness about the limitations and potential of their natural resources.

Collaborative Research approaches and outputs fostered the capacity of local research partners to generate information from data and facilitated discussions with community members. GIS is being developed and colored maps produced to facilitate discussions and linkage with farmers. The SAM analysis demonstrated the importance of stimulating growth in the tradable sectors within both agriculture and livestock. Growth strategies directed solely toward microenterprise development are possibly misguided: there appears to be little potential to stimulate broader growth within the commune since most microenterprise activities are non-

tradable. The process of multiplier decomposition permits an understanding of interactions among production activities and among socio-economic groups. These latter interdependencies are important to understand in a commune such as where rivalry among groups for resources is strong.

**in Capacity Building:** The biophysical modeling results presented in the form of colored maps facilitate discussion with NRMAC and other Commune members. Discussion of these and the socio-economic research results have improved the understanding of all the participants involved – villagers and researchers – regarding appropriate research topics, and farming and pasture management practices. IER researchers have a fuller understanding and ability to use economic modeling tools such as the SAM through our collaborative efforts. Community members through the NRMAC, have an increased understanding of the economic interactions between various occupational groups, and how income changes can trickle through the entire community and affect all members beneficially, in addition to those receiving direct benefits.

**in Scaling Up:** Social accounting matrices can be constructed at any geographical scale, including the region and nation. It is not anticipated that actual matrices will be developed at these higher levels but the results obtained in Madiama Commune will be applicable other areas where similar socio-economic conditions prevail. Under Objective 5, these results will be passed on to others in the nation and region. Meetings were held with IER researchers and national level administrators on the use of and implications of results of the Social Accounting Matrices developed for Madiama.

**in Policy Impact:** The results of this research have implications for targeting research efforts and for determining which farming practices are most appropriately pursued. The SAM results suggest directions for future research and policy interventions. For example, research efforts may need to be targeted specifically towards transhumants for them to achieve the potential benefits of other groups.

## **Other Major Outputs in this Period**

### **Working Papers**

Touré S. and O. Badini. 2003. *Analyse économique comparée de pratiques paysannes et de techniques améliorées de production de mil et sorgho dans la commune rurale de Madiama dans la 5ème région du Mali* (Technical Report). SANREM CRSP, WAF, Washington State Univeristy, Pullman, WA.

### **Non-degree Training**

#### **Workshop**

*SAM Construction and Use* was attended by 20 person(s) and lasted 0.5 day(s).

# SANREM CRSP

Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program  
Funded by the U.S. Agency for International Development (USAID)

July 2003  
Annual Report  
WAF-08

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## Farmers' Decision Making Aides for Improved Fertility Management

Principal Investigator  
Boureima Traore

### OBJECTIVE 1

Document the state of the art concerning existing and newly introduced cultural practices.

#### Achievements

This activity was completed during year 4.

### OBJECTIVE 2

Development of improved technologies for improvement in soil fertility.

#### Achievements

The following data has been gathered and analyzed for years 2001 and 2002. Reports on data for year 2001 have been completed, while those for 2002 are in process.

Direct and residual effects of cowpea-millet rotations on production and soil fertility - data from 2000, 2001, and 2002.

Production and soil fertility effects of the use of natural phosphate on millet-cowpea rotations - data from 2001 and 2002. Production and soil fertility effects on sandy soils of different manuring rates from cattle and sheep - data from 2001 and 2002.

Production and soil fertility effects of amending 3 (above) with natural phosphate - data from 2001 and 2002.

Production and soil fertility effects of paddocking cattle for different numbers of days - data from 2001 and 2002.

Sorghum production and soil fertility effects of different organic (manure) and inorganic (micro-dose chemical, PNT) fertilization rates - data from 2001 and 2002.

Sorghum production and soil fertility effects of different micro-dosing strategies - data from 2001 and 2002.

Data are being analyzed and compiled into updated technical reports which will be used for a synthesis monograph to be published during year 6. Data collected also feed into the decision support tools being developed by WAF-07.

### OBJECTIVE 3

Reinforce local capacity to apply the Holistic Management model in the monitoring and evaluation of soil fertility improving technologies.

#### Achievements

The Holistic Management Consultant (Sam Bingham) visited with cooperating scientists and the community to review

Co-Principal Investigator  
Oumarou Badini

soil fertility progress. A review of 2 years results with cooperating farmers and the community and discussion/restitution of results to farmers has taken place. Documentation of review and evaluation criteria, holistic management lessons learned is yet to be accomplished.

## **Advances**

**In Research:** Livestock stabling (paddocking) is providing an interesting means to integrate the soil fertility needs of farmers and the pasture requirements of the herders. This technology has yielded higher outputs compared to the use of microdosing whose performance varies according to rainfall level. The tests with microdoses (15/15/15) and the rock phosphate (PNT) will be continued in year 6 for a larger number of farmers with the application of the DAP to better assess efficacy in this rainfall zone of Madiama. Striga control experiments through millet-cowpea rotation will also continue.

**In Capacity Building:** Farmers are becoming familiar with fertilizer application alternatives (including PNT, micro-dosing, organic fertilizer interactions) and, based on their monitoring of the on-farm trials, have contributed to the design of on-farm trials.

**In Scaling Up:** Given the riskiness of the Sahelian environment (and the particularly poor rainfall this year), another year of data and farmer input is needed before the NRMAC can confidently propose the expansion of a particular soil fertility technology.

**In Improved Environment In Natural Resource Management:** These on-farm trials are providing a range of alternatives to farmers to improve the fertility of their soil.

# SANREM CRSP

**Sustainable Agriculture and Natural Resource Management  
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**July 2003  
Annual Report  
WAF-09**

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## **Community Decision Making Aides for Improved Pasture Lands**

**Principal  
Investigator**  
Ozzie Abaye

**Co-Principal  
Investigator**  
Amadou Kodio

### **OBJECTIVE 1**

Determine the quantity and quality of forage resources in the Commune of Madiama.

### **Achievements**

The quantity and quality of forage resources in the open range areas is being assessed by Holistic Management biological monitoring. This methodology allows managers of pasture to assess the impacts of their grazing plan using parameters such as soil cover, flora and fauna diversity, animal activity, and evidence of erosion. Measurements are taken once a year from 100 random points along an established transect. In October 2002, IER scientists collected these data on 4 transects in each of the selected open range grazing sites (Torokoro and Siragourou) and are now processing and analyzing the data.

Annual grasses and legumes are the dominant species in Madiama, and the leguminous plant *Cassia tora* covers approximately 10-20% of the Madiama commune area. This plant however is aggressive and excludes grasses from being grown with it. In addition, it is unpalatable (and toxic) to animals in its green stages. Given the prevalence of this plant in local pastures, investigations into the quality and palatability of ensiled *Cassia tora* were begun. At the end of October 2002, an ensiling project

was initiated at the Madiama Commune. Generally, all the *Cassia tora* in the Commune was at an advanced stage of maturity (more stem and fruits than leaves). In a “normal” growing season (in terms of rainfall and temperature), this legume would be at the early to late flowering stage at the end of October. Due to extreme drought conditions in 2002, the plant was forced to enter reproductive stages earlier in the season. *Cassia tora* was collected from three locations (Siragourou, Nèrèkoro and Madiama villages) within the Madiama Commune and ensiling was done in Madiama village. To enhance the quality of the silage and improve the nutritional value two treatments (water or honey) were added prior to ensiling. Since the fresh material was drier than desired for ensiling (less than 70% moisture), water was added to facilitate the ensiling process and improve silage quality. The addition of honey to the silage (honey instead of molasses was used because honey was readily available at the villages) will potentially improve silage quality by providing fermentable sugar. After 60 and 90 days, samples were removed and prepared prior to shipment to Blacksburg. The samples have been received at Virginia Tech and are currently undergoing laboratory analysis to determine quality and feeding value of the ensiled product, as well as to determine the effect of ensiling on chemical composition and toxin levels.

## OBJECTIVE 2

Describe and analyze the socio-economic characteristics of pastoral and agro-pastoral systems of the commune.

### Achievements

Research continues to be conducted to analyze strategies of access to and management of pasture and water resources in the Madiama commune and surrounding areas. The data will feed into an assessment of the technical viability and potential impacts of the Holistic Management technology being tested in the open range pastures of Torokoro and Siragourou (which is also the focus of the NASA-funded Carbon from Communities project, jointly implemented by SANREM and Soil Management CRSP). A working paper, which synthesizes information to date, has been completed (Ballo and Ouattara, 2003) and is being revised for submission to a journal specializing in pastoralism issues. The paper provides a rich database including data on population, nutrition and health of cattle and small ruminants in the Commune, seasonal variations in use of pasture and water resources, and pathways of transhumant movements by local and transient herds.

## OBJECTIVE 3

Develop mechanisms for community-based management of Madiama's pastoral resources using the Holistic Management model.

### Achievements

Negotiations between bourgoutière stakeholders were successfully completed for collective management of two bourgoutières. The open range holistic management of pastureland experiment was also launched during Year 5. Extensive consultations were conducted with representatives of all villages in the Commune and herders representatives to select sites and establish a rotational schedule. Two village sites were identified and marked off to implement the experiment. Training in holistic management of open range grazing lands and con-

flict resolution management of change was completed in targeted villages. Four environmental monitors were recruited and trained to assist in managing the pastures according to holistic management principles, to inform pasture uses about the established schedule, and to document and chart regeneration of pasture during the year. Unfortunately the quantity and distribution of rainfall in 2002 was extremely poor, leading to problems in pasture quantity and quality. Consequently collective management plans were executed only to the extent that pasture was available. The animals were forced to leave to seek other pasture and as a result there was not much impact of animals on soil fertility. The capacity building activities, particularly the conflict management training and the mediating work by the NRMAC, proved to be instrumental in addressing occasional problems that arose, such as one instance of non-compliance by transient herders and some unauthorized cutting of wood. An agreement, based on the bourgoutière conventions, is being developed to regulate wood cutting and other subsidiary activities in the pasture sites.

A modified controlled grazing research project has been finalized and is in its early stages. This work is complementary to the open range grazing management work. Specific objectives of this study are: 1. To determine the influence of tethered rotational grazing methods on biomass, plant diversity, forage quality and soil fertility. 2. To determine effects of tethered grazing on subsequent re-growth potential through natural succession (re-seeding potential) 3. To evaluate animal performance under tethered grazing systems.

### Advances

**In Research:** Research on strategies of access to and management of pasture and water resources in the Madiama area continues. Quality and quantity of forage resources in the open range pastures of Torokoro and Siragourou are being monitored according to the specifications of the Holistic Management methodology. This effort will also support an assessment of the carbon sequestration potential of open range rotational grazing technology for the Carbon from Communities project. A working paper on the quantity and quality of Cassia

tora forage resources in the Commune of Madiama was drafted. Work was begun on the possibility of using ensiled Cassia tora as a supplemental feed for livestock in the area.

**In Capacity Building:** Capacity of the NRMAC and villagers to sustainably manage their bourgou resources has advanced with the negotiation and establishment of bourgoutière management agreements. However, implementation has been hindered by the poor rainfall in 2002. The NRMAC committee has negotiated and obtained widespread stakeholder support throughout the commune for an HM open-range grazing program. Given the experience of this first year, the committee is now in a better position to monitor the results of the grazing program for the coming year, to explain the management plan to local and transient pasture users, and to address issues of non-compliance as they arise. Village environmental monitors have been trained and equipped to facilitate users' adherence to the grazing schedule and to monitor pasture regeneration.

**In Scaling Up:** The activities described in this workplan are in the early stage of implementation, so no scaling up has yet occurred. However, data being collected on pastoral movements, on access to pasture and water resources, and on and state of forage resources in the open range grazing sites will provide the basis for an assessment of the potential impact of scaled-up implementation.

**In Policy Impact:** The testing of innovative approaches and technologies under this workplan will yield results and build experience for local level management of pastoral resources and integration of pastoralists in decentralized governance, which is at the core of the 2001 National Pastoral Code.

**In Improved Environment In Natural Resource Management:** Baseline data has been collected and technical parameters are being monitored to assess impacts of holistic management grazing in two pasture sites.

## Other Major Outputs in This Period

### Working Papers

Ballo, A. and A. Ouattara. 2002. *Enquetes sur les mouvements des troupeaux bovins, ovins et caprins dans la commune rurale de Madiama, 2001-2002*. Working Paper 03-03. SANREM CRSP West Africa and IER.

### Degree Training

Meriem El Hadj , Ph.D., 2001-2004