

Sustainable Use of Land and Resources

**SANREM CRSP
2000 Annual Report**

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Table of Contents

Sustainable Use of Land and Resources	9
Southeast Asia Project Overview and Activity Reports	17
Policy Analysis for Environmental Management Planning	22
Integrated Watershed Modeling for Decision Support and Policy Planning	25
Water Resources Management and Education	28
Adapting and Transferring Lessons Learned from the Manupali Watershed to Other Critical Watersheds in Southeast Asia	31
Replicating Models of Institutional Innovation for Devolved, Participatory Watershed Management	35
Capability Building for Natural Resource Management at the Local Level	39
Technical and Institutional Innovations to Evolve Agroforestry Systems for Sustainable Agriculture and the Management of Protected Ecosystems	42
Weather Monitoring Using Automatic Weather Stations	46
Andes Project Overview and Activity Reports	49
Ethnoecology: Stakeholder Perceptions and Use of Andean Landscape Maps and Models	54
Integrated Institutional Management: Social Capital, Institutional Capacity, and Environmental Capital in the Andes	58
Water Resources and Environmental Education in Two Andean Watersheds	63
Sustainable Mountain Futures: Linking People and Information for Effective Land- scape Decision Making in the Andes	66
Effects of Land Use Change on Long-Term Soil Fertility, Crop Productivity and Water Quality in Cotacachi	70
Regional Node for Training and Upscaling of Community-Based Natural Resource Decision Making	74

West Africa Project Overview and Activity Reports	76
Workshop on Conflict and Natural Resource Management: Emerging Lessons and Directions from West Africa	81
Reinforcement of the Organizational Capacity of the Natural Resource Management Advisory Committee	83
Development of Methods and Tools for Evaluation and Decision Making	86
Farmers' Decision-Making Aides for Improved Soil Fertility Management	89
Community Decision-Making Aides for Improved Pasture Lands	91
Global Impacts and Information Exchange Project Overview and Activity Reports	93
SANREM Year 2000 Conference in Chile	96
Communications and Information Exchange	98
Development of Decision-Maker Priorities and Decision Support Opportunities	101
Decision Support System Project Overview and Activity Reports	105
Global Level Analysis	109
Development of Economic Models	114
Development of Biophysical and Environmental Models	117
Spatially Explicit Analysis	120
National and Regional Applications of Decision Support Systems	123
Delivery Systems and Capacity Building	126
Acronyms	128

Sustainable Use of Land and Resources

This document describes the progress of the SANREM CRSP¹ for the period June 1, 2000 to May 31, 2001.

The coming year will mark the 10th anniversary of the 1992 Earth Summit in Rio de Janeiro. That summit launched Agenda 21, a plan that outlines new ways to invest in the future and achieve sustainable development in the 21st century. As we move toward the next Earth Summit — the World Summit on Sustainable Development to be held in Johannesburg, South Africa in 2002 — countries will review the progress made since the Rio Summit.

Sustainable development articulates solutions that are economically viable, environmentally sound, and socially and culturally responsible. Agriculture and natural resources are at the center of sustainable development. Success in achieving sustainable development goals depends on making informed decisions regarding sustainable agriculture and natural resources management. Supporting such informed decisions through research, training and information exchange is the focus of the Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program (SANREM CRSP).

SANREM's Mission and Objectives

SANREM's mission is to assist in the creation and successful application of decision support methods, information, institutional innovations and local capacity to support participatory sustainable agriculture and natural resource planning, management and policy analysis at local, municipal, provincial and national levels.

SANREM's decision support tools aim to enable the formulation and answering of questions that link

the economic and social development goals with the long-term viability of the environment and natural resource base. These tools are essential to the achievement of the Agenda 21 target of sustainable development.

Three focused objectives contribute to SANREM's long-term goal of improving decision making by natural resource managers:

Objective 1. Landscape/Lifescape Decision Support. The first objective is to develop methods, tools and institutional capacity that support sustainable agriculture and natural resources management policy design, issue analysis, planning and implementation at the landscape/lifescape level.

Objective 2. Regional Decision Support. The second objective is to develop methods for assisting decisions made at the global regional and national levels on broad issues related to sustainable agriculture and natural resources.

Objective 3. Technology Transfer. The third objective is to develop methods that facilitate exchange of natural resources management information and knowledge within and across multiple scales.

SANREM's Cornerstones

The SANREM research approach is built upon the cornerstones of participation, interdisciplinary collaboration, inter-sectoral (or multi-stakeholder) cooperation, and research at a landscape/lifescape scale. The project brings together experts from U.S. and host country universities, local and national government officials, regional and international agricultural research centers, and U.S. and host country non-government organizations.

An interdisciplinary, multinational team of scientists works with local people to tailor research to community priorities. Research focuses on both understanding the complex biological processes within an individual ecosystem and the human dimensions.

¹ SANREM CRSP is an abbreviation for the Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program. SANREM is funded by the U.S. Agency for International Development and is managed by the University of Georgia.

Where SANREM is in the World

SANREM projects work in West Africa, Southeast Asia and Latin America to provide natural resource decisions-makers with:

- Access to appropriate data and information,
- Access to appropriate tools and methods to analyze the data and information, and
- Enhanced individual and institutional capacity to make decisions.

In West Africa, SANREM supports decision makers in circumstances where there is stakeholder conflict over access and use of natural resources. In Southeast Asia, SANREM supports decision makers in circumstances where global and regional markets in combination with decentralization of government services strongly influence local natural resource decisions. In the Andes, SANREM supports decision makers concerned with sustainable mountain development in regions characterized by fragile highland-lowland interactive landscapes. Additionally, SANREM has Global projects that tie together common threads that run through all the projects and support decision makers that work at national, regional, and global levels.

Year 3 Achievements

Using a participatory, interdisciplinary and inter-institutional approach on a landscape scale, SANREM research supports improved natural resource decision making at all levels, from local residents to grassroots organizations, non-governmental organizations, provincial and national governments, and national and regional research and policy institutions. The research addresses multiple levels of decision-making because natural resource management decisions made at the local level are indirectly and often strongly impacted by decisions made at higher levels.

Achievements for Year 3 fall into the following categories: tools and methods, capacity building, policy, information exchange, transferring lessons learned and bringing back lessons to the U.S.

Tools and Methods for Sustainable Agriculture and Natural Resource Management

Agriculture and Natural Resource Management Research

Water quality and quantity monitoring

- ▶ Substantial progress has been made developing a Global Water Quality database that will link Ecuador, Philippines, Alabama Water Watch, and other developing community-based water quality monitoring projects.
- ▶ In the Philippines, citizen volunteers monitored water quality and erosion rates for four rivers in

Lantapan, Bukidnon Province, and six rivers in Maitum, Sarangani Province. This is the seventh year of data collection for the Lantapan group and the first year for the Maitum group. Data from 1997 to 1999 indicate that all sub-watersheds of Lantapan are degrading. However, increased awareness has prompted farming communities and local governments to take action, such as creation of riparian zones.

- ▶ In Ecuador, citizen volunteers monitored streams, springs and irrigation canals for the presence of fecal coliform bacteria in 46 communities affiliated with the local organization UNORCAC in Canton Cotacachi and surrounding towns. High levels of coliform bacteria counts in most sites, which represents a significant health hazard to residents, is stimulating actions to improve local water supplies.
- ▶ In Peru, physical-chemical tests validated local suspicions that the Mantaro Valley's most important irrigation canal is being contaminated by heavy metals from a mining operation upstream. Local leaders have requested further research by SANREM.

Research on soil fertility, erosion prevention and conservation cropping systems

- ▶ In the Philippines, researchers studied long-term sustainability of vegetable cropping in the Manupali watershed. Data was collected on vegetable yields, tree growth, soil erosion, tree production costs, the effects of tree and sunflower production on soil properties, and the impact of fallow on productivity. These data are used in a watershed model that predicts yield loss due to continuous cropping without or with soil conservation practices.
- ▶ Through soil conservation campaigns, more than 2700 farmers from Lantapan, Philippines, and nearby municipalities learned about effective technologies to control soil erosion.
- ▶ In Ecuador, major soil types in cultivated fields, pastures and forests within the study area were identified and described. In three communities, some 31 different fertility regimes were evaluated in field plot experiments to assess factors limiting the growth of maize. In Cotacachi, model input parameters (climate, soils, land management) were collected for field scale modeling and input coverage (digital elevation model, land-use map, field management data) was generated for the GIS-watershed scale modeling.
- ▶ In Mali, research to improve soil fertility was carried out in field trials using rock phosphate (PNT) and rotation with legumes. An economic analysis comparing farmer practice with and without PNT and the use of millet and cowpeas in

association showed that integration of cowpea proved more profitable than current farmer practice. SANREM researchers are creating a multi-year database of weather, main soil types, main crop varieties and existing cropping management practices for millet, sorghum, cowpea and rice based on data collected at 59 sites. Research on the quantity and quality of forage resources in the Commune of Madiama continues.

Biodiversity conservation research

- ▶ In response to the priorities of local people and the USAID mission in Ecuador, SANREM is helping communities conserve local knowledge about traditional food and medicinal plants threatened by rapid development. Using a method called “memory banking,” cultural knowledge is collected along with planting materials (especially seeds) and culturally acceptable ways to stimulate conservation are identified. A biodiversity inventory of the flora and fauna of the Cotacachi site was completed. Women displayed traditional food crops and demonstrated culinary preparations during a biodiversity fair. Young scholars were trained to document their elders’ knowledge, to collect seeds of culturally significant plants, and to tend *in situ* gardens of traditional edible and medicinal plants.
- ▶ Research on tree seed conservation and tree species evaluation for agroforestry systems continued in the Philippines. Where farmers once harvested wood and other resources from a national park, they now propagate indigenous tree species and fruit trees for timber, fuel, food and income generation. Researchers also trained farmers in modern seed technologies and indigenous practices. A local group, ATSA, grossed nearly 2 million Philippine pesos (nearly 40,000 U.S. dollars) from sales of seeds and seedlings in the past two years.

Agroforestry systems research

- ▶ In the Philippines, eight timber tree species were added to ongoing trials that evaluate plant performance and diversify the on-farm species base. A simple portable sawmill was tested to improve timber processing and has proven popular with farmers. This work was complemented by participatory surveys conducted to assess the growth of the local timber processing industry and marketing opportunities.

Planning and decision-support tools for sustainable agriculture and natural resource management

Future Visioning community planning methodology. Future visioning is a community-based planning tool that was pilot tested by SANREM researchers in Ecuador and Minnesota. The tool uses derived maps and photo-

manipulation techniques to simulate environmental changes for a community over time. In Ecuador, the land use change model for the Nanegal site was completed, involving thirty projections (1966-2014), and four major derived land-use change rules were defined. Additionally, landscape photo-simulations (1900, 1950, 2000, and 2030) based on the model and oral history workshops were completed. The modelers’ rules were field tested in Nanegal. A beta-version of the multi-temporal analysis of land use (1963-1993) also was completed for Cotacachi along with a database framework.

Local perceptions and behavior toward the landscape. Community-based sustainable land use planning starts from an appreciation of how different landscape users conceptualize and engage space, time and space-time relationships. Through ongoing ethno-ecological research in Ecuador, different groups’ perception of their environment was analyzed (disaggregated by gender, age, ethnicity, and class). Forty-eight previously collected cognitive maps of people’s environments (24 each from Nanegal and Cotacachi) were systematically analyzed using SPSS.

Institutional analysis and advocacy coalitions. The advocacy coalition framework for institutional analysis is being used in Ecuador and Peru to understand the perspectives of actors from different societal sectors (market, state, and civil) working at five levels in the decision making hierarchy (local to international) on specific natural resource management issues. By understanding different stakeholder perspectives on issues and proposed solutions related to water quality, bio-reserve management, and large-scale mining, coalitions that cut across sectors and levels have been identified and provide a basis for taking action on commonly desired solutions. The results are being used to form alternative advocacy coalitions related to water and bio-reserve management issues.

Assessment of decision maker priorities. This research activity was geared to identify the desired outcomes, issues and decisions of natural resource managers to ensure that decision maker support tools designed by SANREM correspond to the needs and demands of the stakeholders. Based on assessments completed in the Philippines, Ecuador and Mali, the methodology and results were compiled for use by a broader audience.

Food insecurity and vulnerability research. The Food Insecurity and Vulnerability Mapping Information System (FIVIMS) — a product of the World Food Summit (WFS) — is intended to monitor progress towards achieving the goal of reducing hunger by 50 percent in the year 2015. SANREM researchers working with FAO carried out FIVIMS pilot studies in Mali and Kenya.

Agricultural Sector Models were used to examine generic technology and policy interventions that would ensure affordable, available food in Kenya and Mali. On-going research includes a case study on the impact of intensification on cropping systems with technology supported by the most recent agronomic research and an *ex ante* study on the impact of major breakthroughs such as the use of genetically modified plants and/or substantial increase in mechanization. Other studies address drought, off-farm income and livestock management strategies.

Development or adaptation of biophysical and socio-economic models

- ▶ Erosion Productivity Impact Calculator (EPIC) models in Ecuador. EPIC is being used to simulate long-term changes in soil fertility and crop productivity as affected by land use and land management practices in selected Cotacachi communities. On a watershed scale, soil erosion and sedimentation are being estimated and its impact on water quality evaluated using WaTEM (Water and Tillage Erosion Model).
- ▶ Watershed simulation model in the Philippines. A policy simulation model used to study a broad range of potential national and local policy options and their potential impacts on economic and environmental outcomes was completed and widely disseminated via CD ROM and the Worldwide Web. The model has been demonstrated to researchers and policy makers from more than 12 countries in Southeast Asia. Recent progress includes structural changes to the model to measure nitrogen and pesticide loadings, incorporate pest population dynamics in vegetable production, and refine household and zone weights based on GIS and survey data. The model was successfully linked to the widely used biophysical model SCUAF, which expands the ability to model a range of biophysical phenomena.
- ▶ Soil, Water, Air and Nutrient (SWAN) System. A new interface called the "Soil, Water, Air and Nutrient" System (SWAN) was added to the EPIC model. SWAN is a modification of the CroPMan Shell (a system previously designed for addressing individual farm and precision agriculture modeling issues) and is designed to address technology impact and policy issues. This new, user-friendly interface is structured to allow easier adaptation for international use.
- ▶ Crop growth simulation in Mali. CropSyst, an existing user-friendly biophysical modeling package integrated with GIS, was used to simulate alternative crops in response to soil, weather and management, and to estimate water erosion, residue decomposition, tillage and other effects in West African conditions.
- ▶ Total forage availability and stocking adjustments model in Kenya. The PHYGROW model was improved to include plant growth functions and deep-rooted tree species. It was used to derive the total forage available for cattle at 30 simulation points in Southern Kenya. The model simulates forage yield and stocking adjustments for complex, multi-species plant communities, multiple grazers and associated hydrology. Normalized difference vegetation index (NDVI) and rainfall estimates were used to determine the extent to which satellite derived information could be used to project simulated forage production.
- ▶ Global Agricultural Sector Model. U.S. negotiators used GASM and associated forestry models to formulate the U.S. negotiating position for the November meeting of the U.N. Convention Framework on Climate Change. GASM also has been used in assessing the value of multinational satellite-based ocean observing systems.
- ▶ Almanac Characterization Tool. The ACT was delivered in Mali along with in-country training. Special attention was given to regional plans to extrapolate results from one country to another. Based on trainee feedback, improvements in the ACT include an area-weighted averaging utility for the area calculator, enhanced capacity for metadata handling, enhanced graphics, a more robust interface, the addition of modules for map layout (a cartographic tool), a shapefile editor, a tool to automate conversion of GPS coordinates into a shapefile, and a full intersection capability. The Mali ACT contains simulation zones and simulated crop results for both Burkina Faso and Senegal. In cooperation with CIRAD, the Mali ACT was provided with a French language tutorial and manual.

Building the Capacity of Institutions and Communities for Sustainable Agriculture and Natural Resource Management

Strengthening grassroots institutions

Strengthening farmer-managed tree production systems. The ICRAF-SANREM partnership has developed and tested tree-based agroforestry systems and component technologies that have significantly contributed to the sound management of the buffer zone of the Kitanglad Nature Park in the Philippines. This system has included work with farmers in nurseries established under the Landcare Approach and with ATSAL, a farmer-based tree seed association. Eight hundred farmers underwent intensive seedling production and tree management training. Trees have been established on their farms and farmers are maintaining 62,608 seedlings of a variety of timber and fruit tree species.

Water Watcher groups in the Philippines. With the technical support of SANREM researchers and Heifer Project International, the Tigbantay Wahig, a citizen group of Lantapan, Bukidnon, has become more experienced, stable and respected within the Lantapan community and beyond. The Tigbantay Wahig's has made significant contribution to the Local Government's Natural Resource Management Plan in Lantapan and tree planting and streamside restoration. A livelihood project on Fish Culture and Goat Rearing has helped members augment their family income while being a volunteer "water watcher."

Strengthened local natural resource management group in Mali. A workshop for farmers in Madiama was conducted on Holistic Management and rotational grazing drawing on successful activities in Chad. The local natural resource management group (NRMAC) used rotational grazing principles to explore the conditions for improved pasture management including aspects such as identifying stakeholders and their perspectives, and restoring a seasonal wetland forage grass called *bourgou*. CARE, a SANREM partner in Mali, provided literacy training to NRMAC members using CARE training materials that stress democratic governance and government decentralization.

Strengthened natural resource management group in Ecuador. Jambi Mascaric is the primary outreach and training center for dissemination of SANREM findings, technologies, methods, and information within the Andean region. The center houses a databank and training room to house computers, assistants, seeds, herbarium specimens, etc., as well as an area for interviewing and writing. Training has taken place related to indigenous activities and water quality monitoring.

Establishing partnerships for research, outreach and training/education activities.

Watershed modeling. Working with staff of the Philippine Institute of Development Studies SANREM continues to strengthen institutional capacity for using the watershed model developed for Lantapan for policy studies in the Philippines. This has allowed SANREM to expand its base of users beyond the University of the Philippines, Los Baños. SANREM researchers are currently working to adapt the model to a setting in Vietnam.

Ag Sector models. One Malian scientist was trained to use and modify the Mali Agricultural Sector Model. Two additional Malian scientists were trained in the use of the Decision Support System methods and will provide training workshops on the methods for others in the region. Four major planning and training workshops were conducted in Kenya and Mali.

SANREM actively participated in planning workshops in the Institut du Sahel (INSAH) and at the regional level in East Africa with a consortium of Kenyan, Ugandan, and Tanzanian collaborators on the development of models and interpretation of the results of case studies.

Impact Assessment. A major workshop on impact assessment methods, sponsored by USAID, brought together senior staff of USAID, representatives from all the CRSPs, representatives of the international agricultural research centers, and the World Bank. Detailed presentations and discussions on the global decision support system were made and the Impact Assessment Workshop proceedings are available from the SANREM CRSP.

Bridging the CRSPs. SANREM and Soils joined forces to develop a successful proposal to study carbon sequestration potentials in Mali.

Policies for Sustainable Agriculture and Natural Resource Management

Policy partnership. A partnership with PIDS, a Philippines policy research group, will strengthen SANREM policy research activities and contribute to the utilization of research outputs at the national level. SANREM will use the existing PIDS system for monitoring upcoming environment and natural resource legislation and making policy briefs available to decision-makers for congressional and senate hearings.

Tracking national policies. Documents for twelve national environmental policies have been collected and summarized providing a basis for tracking policies for environmental management from the national level to the local level. A training workshop on policy analysis was held for local officials in the city of Malaybalay, Bukidnon in which participants were introduced to different methods of policy analysis, tools and guidelines for problem identification, formulation of alternative solutions, and implementing a monitoring and evaluation scheme.

Water and pesticide use ordinances. SANREM provided assistance to the local legislators of Lantapan in drafting ordinances for imposing water user fees and banning aerial spraying within the municipality.

Policy brief. A writing workshop on preparation of policy briefs was held to identify issues relating to implementation of national policies on natural and environmental management at the local level. Eleven policy briefs were drafted incorporating the facilitating factors and constraints to local level policy

implementation. These are now being presented to local constituents and finalized for presentation to policy makers at the national level for further policy action.

Local government natural resource planning. The Lantapan natural resource management model is considered a milestone in the decentralization of planning and management to the local government level representing a shift toward participatory multi-sectoral planning and research-based decision-making. SANREM's work with municipal government has resulted in a model of municipal-level natural resource management planning and implementation that has received national attention. The program is being replicated in five additional Philippines municipalities and in Vietnam.

Local government self evaluation. Self-assessment workshops were conducted in three municipalities in the Philippines providing the opportunity for the NRM members to self evaluate their planning team performance and rate the Local Government Unit in terms of the support provided to the planning team. Surveys were conducted to ascertain the factors that affect the sustainability of local NRM in four municipalities. The "sustainability factors" identified included local financial investment, local technical capability, political culture, and national mandate.

Information Exchange

Conferences. More than one hundred representatives from national and international academic and research institutions, national government agencies, NGOs, local governments, private sector, donor and development agencies, and SANREM administrators, project researchers attended the conference on Sustainable Development of Upland Communities in Southeast Asia. Co-sponsored by SANREM SEA, PCARRD and PIDS, the conference captured the diversity of information and exchanges brought about by the attendance to multi-stakeholders. It offered SANREM a strategic venue to communicate its accomplishments to a broad set of audience in the region

Books

- ▶ *Tendiendo Puentes Entre Los Paisajes Humanos y Naturales*, edited by Robert Rhoades was published in Spanish by Abya Yala Press, Quito. Five hundred copies are being distributed to researchers, organizations, libraries, and bookstores in Spanish-speaking countries. The book details research results conducted by SANREM-Andes in the Nanegal area between 1994-2000. An expanded English version of the same book is in press at Kendall/Hunt Publishers.

- ▶ *Experiences and Lessons from Integrated Conservation Development Programs in Tropical America: Linking People, Policies, and Programs* based on a 1999 joint international conference in Quito sponsored by SANREM-Andes, USAID-Ecuador, and CARE-Ecuador is with the publisher (Abya Yala Press).
- ▶ *Seeking Sustainability: Challenges of agricultural development and environmental management in a Philippine watershed* edited by Ian Coxhead and Gladys Buenavista draws on five years of experience of the SANREM CRSP in Southeast Asia. This monograph explores how agricultural development might be balanced with sustainable use of natural resources.
- ▶ *Enhancing participation in local governance: Experiences from the Philippines IIRR, LGSP and SANREM CRSP/ Southeast Asia* During the past two decades, the roles of local governments have been undergoing dramatic changes. With these changes in mind, this book was developed as a resource to promote sustainable development by institutionalizing good governance.
- ▶ *The First Bukidnon Watershed Summit: Bukidnon Watershed Wealth in the Making* edited by Vel Suminguit, Gladys Buenavista, Rowena Baltazar and Rex Sario (editors) documents a Philippines summit attended by more than 180 representatives from local governments, non-government organizations and others.
- ▶ *Broadening the Research Agenda: Integrating Sustainable Food Security Dimensions into the NARS Research Agenda (in FAO press)* edited by Constance Neely, Carla Roncoli, Julia Earl, Thomas Price, and Abubaker Maddur provides guidelines on implementing participatory research for food security.

Scaling Up SANREM Lessons

Water quality teams. The community-based water-monitoring model in Lantapan has received considerable interest from other regions in the Philippines. In the Visayas region (Bohol Province), initial activities to develop a water monitoring team have been conducted by HPI with the strong participation of the Local Government Unit.

Buffer zone management. Success in the sound management of the buffer zone of the Kitanglad Nature Park focused on some villages in Lantapan will now be scaled up to other buffer zone villages in Lantapan and other municipalities in Bukidnon. Advances made in capacity building and in agroforestry research, will be scaled up to partners and stakeholders, including NGOs, smallholders, and grassroots organizations.

Farming systems symposium. SANREM led a symposium entitled *Cultivating Community Capital: The*

experiences of the SANREM CRSP at the International Farming Systems Association (IFSA) meetings in Santiago, Chile. This meeting brought together PIs from the SANREM CRSP to provide 5 presentations from activities in Ecuador, Mali, and the Philippines. The papers were also drafted into a book that was distributed during the symposium.

Electronic and face-to-face conferences. An electronic conference on *Integrating Sustainable Food Security Dimensions into the Research Agenda of the National Agricultural Research Systems* was led by SANREM with the Food and Agriculture Organization (FAO) and the Global Forum on Agricultural Research (GFAR). An e-conference entitled *Looking Forward to Rio+10: Reporting Progress on Land and Agriculture* was conducted to precede a multi-stakeholder dialogue in conjunction with the *FAO Forum on Sustainable Agriculture and Rural Development* and prepare for the World Summit on Sustainable Development. Members of five of the major groups of Agenda 21 met in Rome to discuss solutions and collaborative efforts.

Other communications products. A traveling exhibit, fact sheets, and brochures were developed for use by SANREM partners.

Bringing SANTEM Lessons Back to the U.S.

Proposal for the Piedmont. SANREM initiated proposal development in response to the 2001 call for proposals by Integrated Future Agriculture and Food Systems (IFAFS) in collaboration with the Center for Holistic Management, USDA-ARS, and the University of Georgia among others. The proposed research would bring together land users, community members, government agencies, non-governmental organizations and local governing bodies to assist small to mid-size private land managers and their communities in the Piedmont region of the Southeastern United States and would help them to identify and seize profitable, land-based economic opportunities while protecting the environment and enhancing rural community life.

Citizens water quality work. The water quality and water quantity citizen research and methods developed by Auburn University's SANREM CRSP team are widely used in Alabama and Georgia. Community water monitors continue to collect data on stream flows and water quality in their local communities.

Advocacy coalitions. SANREM research and advocacy coalition efforts by Iowa State University that bring together local government officials, the private sector, and non government organizations to resolve natural resource management issues related to community-

based drinking water protection are being used in Iowa, Minnesota, Maryland and New Mexico.

Biodiversity conservation. SANREM CRSP's memory banking methodology developed through the University of Georgia has been adopted by two regional seed-saving organizations (Native Seed Search and Southern Seed Legacy). This method is helping conserve U.S. germplasm as well as the cultural heritage underlying its preservation. The National Seed Laboratory has requested a proposal to collect germplasm and cultural information with the Vietnamese.

Models. The methods of acquiring and using spatially explicit information and the use of biophysical and environmental models developed by Texas A&M University and previously used in the United States have been linked and updated through SANREM CRSP efforts in Mali and Kenya. These improved models linking biophysical and environmental parameters will have immediate utility for U.S. analyses, while providing an important planning and extension tool to extrapolate geographic equivalence.

Holistic Management. Holistic Management and conflict management trainers working in West Africa work towards the same ends here in the United States among ranchers and also in Native American communities.

*Carlos Perez
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SANREM Southeast Asia

Project Overview

SANREM-Southeast Asia is managed by the University of Wisconsin-Madison and the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD). Its institutional partners are the Municipality of Lantapan, the Province of Bukidnon, Tigbantay Wahig Inc., the SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), the University of the Philippines at Los Baños, Central Mindanao University, the International Institute for Rural Reconstruction, Heifer Project International, Auburn University, Purdue University, Central Queensland University, and the International Center for Research in Agroforestry. The cooperation of the people of Lantapan municipality, Bukidnon, Philippines is an essential feature of the project.

Introduction

The goal of SANREM-Southeast Asia is to enable better natural resource management decisions by upland communities. Through partnerships between researchers, government and civil society the project can play important roles in the generation and dissemination of information, in capacity building, and in policy advocacy as means to support communities and local and national governments engaged in natural resource management for sustainable development.

The geographic scope of our project extends from the municipality of Lantapan, our Philippine research site in Bukidnon province, to other municipalities and provinces in the Philippines and similar areas elsewhere in Southeast Asia. Similarities are defined not merely by common geographical characteristics, but by the fact that countries in the region share certain experiences that are instrumental in shaping the direction of natural resource use and the logic of local natural resource management (NRM) strategies. These experiences include rapid economic growth, which tends to slow the rate of net migration to upland areas; expansion of commercial opportunities for upland farmers, including intensive vegetable cultivation for urban markets; and above all, rapid devolution of powers from central to sub-national jurisdictions.

In keeping with the principles of interdisciplinary and participatory scientific research, our work involves close collaboration among U.S. and host country researchers, and between researchers and natural resource managers at all levels, to ensure that output of the project is rigorous, relevant and accessible.

Project Objectives and Strategy

Our primary objective in Phase II (1998 to 2003) is to assist in the creation and successful implementation of decision-support tools for natural resource management and planning at both a community and a watershed scale. By decision support tools we mean materials, including research findings and simulation models, to enable the formulation and answering of questions that link economic and social development goals with the long-term viability of the environmental and natural resource base.

Our other objectives complement the research that produces decision support tools. The effective use of such tools in a specific locality depends on conditions both locally and in broader economic, political, policy and technological contexts. Our second and third objectives are, respectively, to help build analytical and decision-making capacity at local levels; and to promote structured discussion of NRM and sustainable development through information exchange and policy advocacy both across levels (local to national and beyond) and among institutions at each level. The capacity-building objective *backstops* our research by helping ensure that decision support tools can be used efficiently in NRM planning by communities, provincial and sub-provincial governments and other local institutions. The information exchange and policy advocacy objective *follows through* on SANREM research. Done well, it will ensure that our findings and their implications—as well as those from related research ventures—reach the right influence-makers and decision-makers, take appropriate forms for different audiences, and ultimately contribute to broader debates on the question of sustainable development.

Progress Towards Objectives

For details see activity reports identified by the final two digits, e.g. 24 for SEA-01-24

Methods and tools to support sustainable agriculture and NRM policy planning and implementation are currently being developed and in some cases applied beyond our research site in the Manupali Watershed [24, 32]. Demand for these methods and tools by local governments and non-governmental organizations continue to increase as evidenced by numerous on-site and off-site workshops conducted by SANREM researchers, including our community partners [25, 42]. Strong institution building especially at the community level greatly

complements the development and dissemination of NRM methods and tools [25, 34, 42, 44].

Our sustained and continuing interactions with Lantapan civil society and governance institutions has given the project a practical advantage in sharing knowledge and information on the decentralization of natural resource management. Participatory NRM planning processes conducted at the municipal level have served as enabling mechanisms for local governments to support the implementation of municipal comprehensive land use plans. Positive experiences gained at the local level have motivated municipal governments to make NRM planning a part of their institutional structure [23, 34, 42]. At the national level, we are now fully and formally engaged in policy advice and briefings through a number of channels, including our recently formed partnership with the Philippine Institute for Development Studies (PIDS).

At the end of Year 3, SANREM-SEA, in partnership with PCARRD and PIDS, hosted an International Conference on Sustaining Upland Development in Southeast Asia in Manila. This conference showcased the breadth and depth of SANREM activities, established the project as one with Southeast Asia-wide relevance and cemented its position as a key source of research and policy advice on the management of natural resources in the upland agricultural areas of the Philippines.

Three publications released at the conference provide further documentation of SANREM-SEA progress. These are the research monograph *Seeking Sustainability* edited by I. Coxhead and G. Buenavista and published by PCARRD; the SANREM-SEA multimedia CD-ROM; and a SANREM-sponsored IIRR publication, *Enhancing Participation in Local Governance: Experiences from the Philippines*.

Benefits to the U.S.

SANREM's work in Southeast Asia continues to strengthen links between U.S. research institutions and their counterparts and clients in the region. This benefits the U.S. institutions through student training, faculty involvement in international experiences and opportunities for policy-relevant applied research. The research site serves as a research laboratory for U.S.-based graduate students to gain experience in environmental and natural resource management. Graduate students conduct on-site research or work on research activities led by U.S. and Philippine-based researchers affiliated with the project. Graduate students gain valuable knowledge and skills in addressing environmental issues in the U.S. and abroad through the development of innovative research methodologies.

Year 3 Impacts

As a result of information exchange activities and improved internal communications, the project has begun to occupy a very prominent niche within the Philippine research and development community. Work plans and SANREM-supported community-based institutions are receiving many requests for training and related outreach activities beyond those specified in earlier proposals. SANREM-supported groups such as BIDANI (42) are integrating NRM principles into their more general development-oriented extension programs.

SANREM's presence in Lantapan has greatly shaped research and development activities undertaken by other projects in the area. These projects not only work with our partners in the community but also incorporate SANREM principles of participation, inter-institutional collaboration, interdisciplinary teams and a landscape-approach to natural resource management.

At the national level, SANREM is now recognized as a clear leader in research and policy advocacy on NRM in upland agriculture. Insights from policy initiatives at the municipal level have been formalized in a set of policy briefs, some of which are directed at the national level as proposals for reform of the Philippine Local Government Code. In the next step, these will be linked to Web-based resources used by legislators involved in sustainable agriculture and natural resource management initiatives.

Our Vietnam initiative continues to build momentum, as was apparent at the Manila conference. We are confident that the proposed environmental research grants program (ERGP) initiated in Year 4 (2001 to 2002) will help SANREM establish similar activities in other parts of the region, notably Indonesia. The ERGP should make these innovations possible at minimal cost to the project, leveraging funds and research energies through the provision of seed money for new or amended projects.

SEA 00-23

Policy Analysis for Environmental Management Planning

Local and national policies have been shown to exert significant influence over natural resource management decisions in upland areas. Projects aiming to achieve sustainable development in such areas must engage in policy analysis and advocacy and provide support for the building of local policy-making capacity to maximize their chances of success. This project analyzes Philippine environmental policies at the local and national levels. It implements a data gathering system to monitor the impacts of the Lantapan municipal government's Natural Resource Management and Development Plan (NRMDP) as well as national policies, and to strengthen the capacity of officials of local government in policy analysis, design, and advocacy.

In Year 3, researchers established links with relevant local and national agencies. Twelve national environmental policies were documented and analyzed, with emphasis on their local effects.

To enhance local policy capacity, researchers held training workshops, kapihans (informal seminars among researchers, policy makers, and development planners), and held meetings bringing local policy makers together with key informants as well as representatives of national agencies. These activities enabled local officials to better appreciate the use of empirical data in the formulation of locally based environmental ordinances and policies.

Insights gained from these workshops and meetings were developed into a set of brief policy analyses intended to serve as the bases for local policy initiatives and as inputs in the national policy advocacy effort. The policy briefs will be presented to local and national legislative bodies as a component of our advocacy sustainable upland natural resource management.

SEA 00-24

Integrated Watershed Modeling for Decision Support and Policy Planning

This collaborative research studies land and resource use in upland agriculture, especially as influenced by economic policy changes. Biophysical and economic data, derived from experimental plots and field surveys in Lantapan, Philippines, are being used in a computer-based economic model to address issues related to land use change in low-income agriculture and the potential economic and environmental impacts of policy changes affecting agricultural land use. Specifically, this work plan integrates continuing biophysical research dealing with soils and agroforestry with policy modeling activities using results from biophysical research as input. The policy simulation model has been completed and

disseminated via CD ROM and the Worldwide Web.

The model continues to be refined in light of new empirical data from the field experiments and the interests expressed among the population of potential users. Recent progress includes modifications to the model to measure nitrogen and pesticide loadings, incorporation of pest population dynamics in vegetable production, and refinement of household and zone weights based on GIS and survey data. The model has been used to study a broad range of potential national and local policy options and their potential impacts on economic and environmental outcomes over time.

SEA 00-25

Water Resources Management and Education

Work plan activities were primarily a continuation of seven years of water quality monitoring by the Tigbantay Wahig, Inc., a citizen group in Lantapan, Philippines that received technical support and training from Auburn University and Heifer Project International (HPI). A total of 537 physico-chemical samples were collected as proposed. The principal investigator made one trip to the Philippines (May 2001) for SANREM Conference presentations, a data interpretation session with the Tigbantay Wahig and visit to Bohol as part of outreach and scaling up. All data from Lantapan have been summarized and much has been graphed and presented to the Lantapan community, the local government unit and the scientific community. Impacts included: 1) increased organization and capacity of the Tigbantay Wahig, Inc., 2) greater participation by the Tigbantay Wahig in the local government's natural resource management planning, 3) extension of the SANREM Landscape/Lifescape Approach within other local government units, HPI and other non-government organizations, 5) increased capacity and assistance to Central Mindanao University and to other universities in the Philippines and 6) work plan presentations made at the Watershed Enhancement Program at the Philippine House of Representative, Quezon City. There remains a high potential for spread of the community-based water-monitoring model to other parts of the Philippines and to other countries.

SEA 00-32

Adapting and Transferring Lessons Learned from Manupali Watershed to Other Critical Watersheds in Southeast Asia: Focus on Vietnam

This work plan aims test decision support tools for natural resources management learned from Manupali watershed in the uplands of Central Highlands in Vietnam. This year, the research team completed the participatory baseline research using Participatory Landscape-Lifescape Appraisal (PLLA) of a selected village in Vietnam uplands.

Analysis at the local level shows that changes in policies and market conditions result in a rapid transformation of the socio-economic and biophysical landscape of the study area. Large forest areas have been converted into commercial agricultural land. Results of the study also show that farmers base their decisions on short-term market expectations rather than on long-term market information. This makes them more vulnerable to greater economic losses in the long term as shown by the behavior of mulberry and coffee producers. Farmers had not only opened new forest land for coffee cultivation but also shifted from mulberry to coffee after 1993 when the price of coffee beans increased. The study provides empirical evidence to the complex interplay of policies and market conditions on land use, land management and livelihood system of the Vietnamese upland farmers. The study raises issues relating to the promotion of sustainable agricultural practices and the need for agricultural land use planning that aims to deal with the fluctuating global market without compromising the welfare of small farmers and landholders.

SEA 00-34

Replicating Models of Institutional Innovation for Devolved, Participatory Watershed Management

The Philippine Local Government Code of 1991 provides the impetus for local governments to manage the resources within their territorial and political boundaries. Within the decade of Philippine decentralization, implementation has not met expectations. Although, discussions about effective natural resources management at the local level are becoming more popular, local government units (LGUs) are grappling with ways to implement environment-related programs. We hypothesized that there are policy and institutional hurdles impinging upon the success of sustainable local natural resource management.

Our experience working with Lantapan and other municipalities in Bukidnon, Philippines provides the promise for long-term sustainability if the LGUs are able to: 1) provide a permanent allocation of funding for NRM programs; 2), acquire technical capabilities; 3) gain sound political culture that is inclusive of NRM priorities; and 4), receive guidance from clear national government mandates. These sustainability factors posed some policy implications at the national level. This year, the LGUs of Baungon, Libona, Manolo Fortich and Impasug-ong have completed their NRM plans and are working to install a social infrastructure by which NRM programs can be vigorously pursued despite budgetary and human resource constraints.

These four municipalities border the Mt. Kitanglad Range Nature Park, and their efforts indicate greater support to protected area management in the context

of a Preventive Systems Approach. The initial experience also indicated effective governance in NRM. The links between NRM and governance have been explicit in terms of budget allocation for NRM, institutional refinement and enhancing people and civil society participation. The experience and lessons in Lantapan, along with other LGU experiences from selected sites (those of USAID-ARD GOLD Project Sites), were pulled together in a caselet that highlights “ten basic steps” in NRM planning (forthcoming), that will soon be shared to other LGUs more widely.

Indeed, this humble experience demonstrates that local governance in natural resource management may not necessarily be an expenditure activity. It is a people’s activity needing a proactive leadership support from LGUs as public institutions in the arena of natural resource management (NRM).

SEA 00-42

Capability Building for Natural Resource Management at the Local Level: Focus on Six Communities of Lantapan and Valencia, Bukidnon

This year 28 trainers were trained in for participatory natural resources management (NRM), which included training on Participatory Landscape Lifescape Appraisal (PLLA) methods using the manual developed by the team from Central Mindanao University (CMU) and the University of the Philippines at Los Baños. The local trainers came from CMU, the local government units of Lantapan and Valencia, community leaders of six villages and Heifer Project International (HPI). The main reason for the NRM training at the local level is the belief that the participatory process is imperative in agricultural development work because of the dismal failures of conventional top-down models. Because farmers are the main stakeholders of the Manupali watershed, they need to become equal partners in development actions that concern them. The local trainers have already conducted NRM training at the community level. They completed the PLLA of three sites. The activity was delayed because of the local elections.

SEA 00-44

Technical and Institutional Innovations to Evolve Agroforestry Systems for Sustainable Agriculture and the Management of Protected Ecosystems in the Framework of a Watershed Model

This work plan focuses on developing technical and institutional innovations to promote agroforestry systems for sustainable agriculture and watershed management. Although, this is still a work in progress, significant progress was made in monitoring and evaluating different component activities of our agroforestry research and strengthening local institutions in natural resource conservation through adoption of conservation and agroforestry practices.

SEA 00-22

Weather Monitoring Using Automatic Weather Stations

This work plan is designed to gather weather data in the Lantapan watershed and provide a sound meteorological description of the landscape. A brief report of the results of this year's weather monitoring is reported in the results and outcomes section. Analysis is also in progress comparing current data with those compiled since 1994.

In addition to monitoring and data interpretation, the AWS work plan initiated strategies leading to the institutionalization of weather monitoring activities. The process involved formalizing partnerships with national and local level institutions to ensure the continuation of activities after the work plan's funding cycle and regular production and dissemination of quality data. The project management facilitated the signing of a Memorandum of Agreement (MOA) among national and local institutions: the Philippine Atmospheric...(PAGASA), Department of Environment and Natural Resources (DENR), Department of Agriculture (DA), Central Mindanao University (CMU), Bukidnon Provincial Government and the Lantapan Municipal Government to transfer the management and operation of the AWS. Under this MOA, PAGASA will lead in the operation and maintenance of the AWS, collect data, and distribute data to partner institutions, including SANREM work plans, on a regular basis. The other institutions will assist in the upkeep and security of the equipment.

Utilization of information produced by the AWS work plan has been remarkable. Other than SANREM researchers incorporating data into modeling and decision support research activities, government and private agencies use meteorological information to assess/support agricultural investment projects in the region.



Policy Analysis for Environmental Management Planning

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Introduction

One of the significant outputs of SANREM Phase I is the development of a Natural Resources Management and Development Plan (NRMDP) for Lantapan, Philippines. This is a five-year indicative plan aimed at achieving local economic growth with sustainable environmental management. The plan sets guidelines on how the natural resources of the municipality should be utilized and/or protected. Most Philippine municipalities now have similar plans. What is unique with the Lantapan model is that the process was participatory and technical inputs were provided by the SANREM researchers.

The effectiveness of the NRMDP can only be gauged based on how the suggested courses of actions (programs and projects) are implemented. The impact of the plan can only be established if specific courses of actions or decisions can be attributed directly to the plan. Our primary mechanism for this is a semi-annual survey of land use and related decisions by Lantapan farmers, and a counterpart weekly survey of prices received and paid for major agricultural commodities. Conducted since 1994, these surveys enable us to track land major changes in natural resource use and through farmer interviews and formal data analysis, and to determine the extent of policy influence over their decisions.

Results of this analysis have value not only for Lantapan, but also for municipalities in other parts of the country. They include insights on natural resource management (NRM) in an unstable political and institutional environment, on the financing of NRM activities at the municipal level, and on the best means for ensuring community participation in locally based NRM efforts.

A distilling of lessons learned from this exercise would also benefit national policymakers and planners. A major goal of the policy analysis activity is to derive lessons from local experience for use at the level of national policy advocacy. To do so is both necessary and desirable, especially as many of the policies governing local NRM activities originate in national-level laws or in the operational practices of national-level agencies.

Objectives

1. To monitor the impacts of the NRMDP and national policies on farm households and the use of the community's natural resource endowments
2. To strengthen policy analysis and policy advocacy skills at the municipal and the provincial level through:
 - a. Developing a mechanism and linkages with other involved agencies that will ensure continuity of programs and policies contained in the plan even with the changing political situation;
 - b. Developing a system of tapping technical and financial resources from local, national, and international agencies both in the public and private sectors to implement the plan.
 - c. Strengthening the capacity of the provincial and municipal development staff through hands-on training on policy analysis on specific issues to be identified by them;
 - d. To make the plan more understandable to farmers and other stakeholders by organizing a local advocacy (Information, Education, and Communication) plan to support the NRMDP.

3. To distill lessons learned from Lantapan at the national level.
7. A national seminar was held on June 18, 2000 at the Bureau of Plant Industry – Department of Agriculture (BPI-DA) where Dr. Agnes Rola presented a paper entitled, “Research Program Planning for Natural Resource Management: A Background Analysis”.

Methods or Approach

To achieve the above-mentioned objectives, secondary data pertaining to national level policies on environmental management were collected. Executive orders, presidential decrees and Acts of Congress addressing environmental protection were also analyzed. In addition, the following activities were undertaken.

1. Primary data collection on land use, agricultural production, and prices, as described above, was continued.
2. Twelve national environmental policies were identified and documents relating to them were collected and summarized. This provided the project team with a basis for tracking national environmental policies to the local level with focus on the province of Bukidnon.
3. A training workshop on policy analysis was held on August 7-9, 2000 for local officials in the city of Malaybalay, municipality of Lantapan, and the province of Bukidnon. Participants were introduced to different techniques or methods of policy analysis, tools and guidelines for problem identification, formulation of alternative solutions, choosing the appropriate recommendation and how to devise a monitoring and evaluation scheme.
4. A *kapihan* (informal seminar) held on August 9 to present the results of research to barangay (village) and municipal officials. This meeting helped enhance the level of awareness of the local officials on the status of the environment, the threats to their natural resources and possible preventive measures. The *kapihan* included discussion of specific possible local environmental management initiatives, such as user fees for the use of water resources.
5. Assistance was provided to the Sangguniang Bayan (municipal legislative body) of Lantapan in drafting ordinances for the application of water user fees and for banning aerial spraying within the municipality.
6. A writing workshop on preparation of policy briefs was held on February 6-9 2001. Participants were enjoined to identify issues relating to implementation of national policies on natural and environmental management at the local level, specifically their own area. Eleven policy briefs were drafted. The briefs incorporated the facilitating factors and constraints to local level policy implementation. These are now being presented to local constituents and finalized for presentation to policy makers at the national level for further policy action.
8. A meeting with the Director of the Bureau of Local Government and Development under the Department of Interior and Local Government (DILG) was held in September 2000. The purpose was to solicit the Bureau’s support to the project team in advocating policy reforms and amendments to the Philippine Local Government Code. Several sections of the code are relevant to the design, implementation and financing of local environmental initiatives.
9. Researchers took part in the SANREM international conference held in Makati City on May 28-30, 2001. Two technical papers drawn from the policy analysis activity studies were presented.
10. At the same conference, policy analysis researchers organized a workshop/panel discussion on proposed amendments to the Local Government Code (LGC) in relation to environmental and natural resource management. Representatives from the DILG, DENR and several other national agencies, as well as representatives of several LGUs and non-government exports exchanged views on the efficacy of the LGC in relation to environmental management, and on proposed amendments to the Code.

Results and Discussion

Please refer to specific activities stated above.

Impacts

The project was expected to have the following impacts:

1. Enhanced capability of the LGU officials in policy analysis
2. More empirically and locally based policy development
3. Higher priority, e.g., in budgetary allocation, for environmental projects
4. Formulation and adoption of local ordinances for sustainable resource management at the local level
5. More scientific local policy decisions

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- Policy Brief 2000-2. Strengthening Environmental Management: Proposed Amendments to the Philippines' Local Government Code (A.C. Rola)
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Integrated Watershed Modeling for Decision Support and Policy Planning

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Introduction

This research focuses on three sets of activities aimed at improving natural resource management in upland agricultural systems: (1) measurement and analysis of farm-level biophysical data in the Manupali watershed, Philippines, including crop-input and crop-technology performance and associated soil and erosion impacts; (2) continued development and dissemination of a computer-based economic model to support policy research and planning for natural resource management at the watershed scale; and (3) filling of important gaps in our understanding and ability to model key economy-environment linkages.

Objectives

The research provides empirical evidence regarding biophysical and economic conditions that lead to sustainable use of soil and water resources, as well as practical tools to aid decision makers in natural resource use and planning. Data from experiments and biophysical monitoring are being used in an economic simulation model 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. Measurements focus on outcomes such as erosion rates, soil productivity, pesticide loadings, runoff and stream flow under both agricultural and agroforestry cropping systems.

Methods and Approach

A computer-based model of economy-environment linkages has been constructed using STELLA™. The model uses previously identified agroecological zones and relies on representative farm households as units of analysis. Relevant and available economic

and biophysical data from SANREM Phase I activities in the Lantapan watershed have been used to parameterize the model through statistical analysis. Gaps in data and knowledge are being filled using data from other sources and on-going biophysical monitoring and experiments. Policy simulations are being conducted with the model based on scenarios identified by stakeholders and members of the policy research community. Meetings in the Philippines and email exchange among collaborating scientists are being used to identify potential sites for transfer of research and modeling to other sites in the Philippines and elsewhere in SE Asia.

Results and Discussion

The policy simulation model is being disseminated in a self-extracting version (bundled with a run-time version of the Stella modeling software) via CD ROM and the Worldwide Web. The model has been demonstrated to researchers and policy makers from more than 12 countries, representing a majority of countries in the Southeast Asia region. Recent modifications allow measurement of nitrogen and pesticide loadings, incorporation of pest population dynamics in vegetable production, and refinement of household and zone weights based on GIS and survey data. Transfer of the model to other sites appears feasible and we are currently working with researchers to determine whether the model can be adapted to a setting in Vietnam. The most likely user groups for the model are researchers and national-level policy makers. We will be working with the staff of the Philippine Institute of Development Studies to expanding our base of users in the Philippines beyond researchers at the University of the Philippines, Los Baños.

We continue to make progress in strengthening the empirical foundations of the model. David Midmore visited Gerald

Shively at Purdue in March 2001 to incorporate recent experimental data into the watershed model. This is an ongoing process and each new version of the model incorporates the updated information on biophysical parameters obtained in the project. Recent modifications to the model include recent data on the use of technologies to contain soil erosion at the watershed level as well as forestry and agroforestry systems.

Fieldwork is aimed at filling gaps in our knowledge regarding on- and off-site effects associated with agricultural production systems. Dr. Dano of the Philippines Department of Environment and Natural Resources, Ecosystems Research and Development Bureau (DENR-ERDB) was closely involved in field activities in 2001. Field staff installed a new experiment (soil scrape/liming) to complement the data matrix that we have on erosion rates, yields, and loss of fertility parameter, to derive a potential yield-loss relationship for the mid-upper cultivated areas of Lantapan. This will improve the central biophysical core of the watershed model.

Pesticide test kits are being used to measure pesticide loading in eroded soil and runoff water in the Victory test site. Other simple monitoring close to the Victory plots will also be undertaken. Discussions in May 2001 resulted in agreement to have these tests used for monitoring in the water-watch work plan. Analysis will be undertaken once data has been exchanged with the water-watch project. This may require a visit to Auburn University. Following analysis, new findings will be incorporated in the simulation model.

Nissen and Midmore's visited the Lantapan site in November 2000 to collect information on timber prices in Bukidnon Province. Tree harvesting costs are being studied. In March 2001, sunflower plots in the Victory erosion site near Lantapan, Philippines, were cleared and planted with vegetables to monitor performance of plots compared to those with continuous vegetable cropping. Tree growth data, vegetable yields, and erosion data have been collected from four experiments. Researcher-managed plots have been maintained. Tree growth data indicate they are closely in line with predictions for biomass accumulation (Nissen et al., 2001). The field plots at the Victory erosion site near Lantapan are now in cropping season 15. Despite greater loss of soil in treatments where rows run up and down the slope (Table 1), crop yield was not directly affected by the soil loss (Table 2). However, yields declined from cropping season 10 onwards. Current yields are below those considered economically acceptable. Bringing fallow plots into production will provide interesting information on longer-term sustainability of vegetable cropping in the watershed.

Tree growth (Victory site, planted with *Eucalyptus robusta*) shows no response to previous cropping pattern

or to whether the trees were planted in plots with or without associated vegetables (Tables 3-6). This latter result contrasts to earlier trials where a marked growth benefit to trees was noted if planted with vegetables. With continuous cultivation, soil in all plots would be expected to be of reasonable fertility down the profile, or with low pH that limited growth of trees with or without the extra fertilizer applied to trees. Other trials (*Eucalyptus deglupta*) show benefits for greater planting population in terms of stand basal area and timber volume (Tables 7 and 8), with a four-fold increase in planting population resulting in a two-fold increase in the parameters mentioned. Such an effect was evident at the second site where planting population of *E. torrelliana* was one of the variables studied (Table 9). In species comparison, where trees were originally intercropped with maize, *Paraserianthes falcataria* produced close to 50% more volume than *E. torrelliana*, with *E. deglupta* approximately 30% less than *E. torrelliana* (Table 10). Intercropping brassicas and then maize with *P. falcataria* for the first two years resulted in a maintained advantage for DBH in those trees compared to those established into fallow land (Table 11). This effect was still evident 4.5 years after tree planting. Poorest girth was evident on plots with trees that were neither intercropped nor fertilized at planting.

A household survey was conducted in Lantapan in November 2000. Data will be used to verify the benefits of research undertaken by the Asian Vegetable Research and Development Center (AVRDC), Central Queensland University (CQU), and the International Center for Research in Agroforestry (ICRAF) in terms of improving sustainability and farm-level income.

In May 2001 38 individuals participated in a modeling workshop as part of the PIDS-SANREM conference in Manila. Individuals exposed to the model represent the core of the academic and NRM policy-making community in the Philippines. In February 2000 nine individuals participated in a one-day workshop held at the School for Environmental Studies and Management (SESEAM) at UPLB. Participants included representatives from PCARRD, the Bukidnon PPDO, SEARCA and four academic departments at UPLB. The Manupali Model and a user's guide were disseminated to work plan partners and the research community in Los Baños. The model was installed on four computers in the SESAM computer center, one computer in the College of Public Affairs, one computer at SEARCA, and on one computer used by the Bukidnon PPDO. In June 2001 the prototype model was again demonstrated in the office of the Provincial Planning and Development Officer of Bukidnon province. Fifteen PPDO staff members attended a workshop on the use of the model.

Impacts

This work is having an impact on provincial and national government policy makers in the Philippines by improving understanding of the role of economic policies in encouraging sustainable use of upland agricultural resources. Capacity for policy analysis and planning is being strengthened at local, provincial, and national levels. Proper and necessary groundwork is being undertaken to translate work to settings outside the Philippines.

Other Issues

An integrated model of timber and agroforestry production, including modeling of carbon sequestration, is being developed as part of a Ph.D. dissertation at Purdue and will be made available during year 4. We continue to exercise caution regarding the expansion of activities to a setting in Vietnam. Many scientific and institutional issues remain to be resolved before a serious attempt at policy analysis can be undertaken in Vietnam.

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- Shively, G. E. 2001. Poverty, Consumption Risk, and Soil Conservation. *Journal of Development Economics* 65:267-290.
- Shively, G. E. 2001. Price Thresholds, Price Volatility and the Private Costs of Investment in a Developing Country Grain Market. *Economic Modelling* (in press).

- Shively, G. E. 2001. Agricultural Change, Rural Labor Markets, and Forest Clearing: an Illustrative Case from the Philippines. *Land Economics* 77(2):268-284.
- Shively, G. E. and E. Martinez. 2001. Deforestation, Irrigation, Employment, and Cautious Optimism in Southern Palawan, the Philippines. In *Agricultural Technologies and Tropical Deforestation*, ed. A. Angelsen and D. Kaimowitz. Wallingford: CAB Int'l.
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SANREM CRSP

Sustainable Agriculture and Natural Resource Management
Collaborative Research Support Program

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Water Resources Management and Education

Principal Investigators

Introduction

The Water Resource Management and Education work plan of Auburn University and Heifer Project International (HPI) has been implemented at the SANREM/Philippines site in Lantapan, Bukidnon, Philippines since the program inception in 1993. The first training workshop was conducted in July 1994 and has been followed by scores of workshops and meetings, and a systematic monitoring of water quality throughout the municipality. The community group, Tigbantay Wahig, is the primary data collector with oversight from an HPI Field Office and quality assurance from the HPI/Philippines and Auburn University. The goal of the work plan is to promote the development and spread of community-based, water quality and quantity monitoring in Lantapan, Bukidnon and Southeast Asia as a significant component of natural resource management and planning.

Objectives

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 (including Sarangani Province)
2. To collect water quality and quantity data for addition to a seven-year database. This information will be useful for local water management and as a model for other communities.
3. To organize the water database for use in watershed models to be developed by the SANREM Southeast Asia Program.
4. To conduct a feasibility study for the extension of the Lantapan model of community-based water monitoring through an NGO network in Southeast Asia.

Methods or Approach

There were three data-gathering activities for watershed analyses:

1. *Total Suspended Solids (TSS) Monitoring*
A known volume (usually one liter) of stream water is filtered through a plastic filtering system using a hand pump. The filters are prepared and weighed before and after sampling according to standard methods. Measurements are recorded as mg/L TSS.
2. *Water Chemistry Monitoring*
Seven parameters (dissolved oxygen, turbidity, pH, hardness, alkalinity, air temperature, water temperature) were measured using a customized LaMotte Company test kit.
3. *Stream Velocity and Discharge Measurements*
A cross-sectional map of each of four streams has been made at the main bridges. A rope is stretched perpendicularly across the stream between two fixed points and stream depth is determined at one-meter intervals along the rope. Measurements of stream width and depth are used to draft cross-sectional maps and calculate area. Another rope of known length is stretched parallel with the stream bank to mark the distance that a floating orange would travel while being timed. Multiple measurements of the time required to float a known distance in different parts of the stream are used to determine average current velocity. Together, the cross-sectional area of the stream (square meters) and its current velocity (meters per second) are used to estimate stream discharge (cubic meters per second). Concurrent TSS and discharge measurements resulted in estimates of soil export.

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June 6, 2000. The TW demonstrated water monitoring as part of a study tour of Ms. Alice Sylvia Ramos of ICRAF and MOSCAT (Misamis Oriental State College of Aquaculture), Claveria, Misamis Oriental.

June 15-16. Tigbantay Wahig Officers attended a 2-day training on Leadership Skills held in Alanib, Lantapan.

July 26. The TW Project Coordinator attended the presentation of the Lantapan Comprehensive Land Use Plan conducted at MGM, Maramag, Bukidnon.

August 10. TW did a water analysis for irrigation project of NIA in Bukidnon.

August 16-18. The Treasurer and Auditor of the Tigbantay Wahig group participated in a Financial Management training in Cagayan de Oro.

October 9-10. The Tigbantay Wahig Project Coordinator participated the Trainers Training on Capability Building for the Natural Resource Management facilitated by SEARCA at Central Mindanao University, Musuan, Bukidnon.

October 18. The Project Coordinator attended the Municipal Forest Protection Committee meeting held at the Lantapan Legislative Hall, Lantapan, Bukidnon.

November 7. The TW demonstrated water monitoring to HPI donors from the US.

December 17. The TW group held their Annual General Assembly and Christmas Program.

January 29, 2001. The Project Coordinator and Ms. Dinah Orellano (HPI Staff) attended the meeting of the Lantapan-based R&D Council in Malaybalay, Bukidnon.

February 7-9. The Tigbantay Wahig Project Coordinator attended the HPI Strategic Planning Meeting held in Duka Bay, Medina, Misamis Oriental.

March 18. The group conducted its annual election and Mr. Vincente Molina of Alanib, Lantapan was elected as the new president of the Tigbantay Wahig.

April 2. The group conducted an Organizational Diagnosis facilitated by Mr. Ven Vallente at the HPI Field Office, Alanib, Lantapan.

April 23. The Project Coordinator and Ms. Dinah Orellano (HPI Staff) attended the meeting of the Lantapan-based Research and Development Council in Malaybalay, Bukidnon.

April 30. The Project Coordinator attended a workshop for designing evaluation tools in Cagayan de Oro City, Philippines.

May 3-4. The Tigbantay Wahig officers conducted a review of their structure, by-laws and polices. This was followed by an exposure trip in Damulog, Bukidnon, where the TW group visited the office of Bukidnon Integrated Services Assistance Program. They also met a People's Organization organized by BISAP and learn from them techniques on organizational management.

May 25. A planning workshop was conducted for the Tigbantay Wahig members and officers. The group was able to develop their plans and activities related to organizational development and project implementations.

May 26-31. The PI was in the Philippines with Eve Brantley and Billy Earle from Auburn University, for Conference presentations, and meetings with the TW and groups in Malaybalay and Bohol.

Results and Discussion

Four hundred thirty two (432) Total Suspended Solids (TSS) samples were collected from the four river sampling sites in Lantapan from June 2000 through May 2001. One hundred thirty five (135) samples were collected during this period from the six river sampling sites of Maitum, Sarangani by a newly formed monitoring group.

Forty-eight (48) measurements of water chemistry were made from the four river sampling sites of Lantapan. Forty-four (44) measurements were made from the six river sample sites of Maitum, Sarangani.

Forty-eight (48) samples were collected for Stream Discharge and Soil Export from Lantapan. Data summaries of TSS from 1997-99 suggest that all subwatersheds of Lantapan are degrading. This finding was a key issue of the May 2001 Conference presentation and subsequent data interpretation session in Lantapan.

Impacts

The Tigbantay Wahig group has become more experienced, stable and respected within the Lantapan community and beyond. They have significantly contributed to the Local Government's Natural Resource Management Plan in Lantapan, contributed to tree planting and streamside restoration and have served as resource people for many visitors to the SANREM projects. The TW continued a project of "Fish Culture and Goat Rearing" supported by HPI and the Tankersley Foundation of Auburn University. This livelihood program has helped several TW members

to augment their family income while being a volunteer "water watcher."

The community-based water-monitoring modeling Lantapan has received considerable interest from other regions in the Philippines. In the Visayas region of the Philippines (Bohol Province), initial activities to develop a water monitoring team have been conducted by HPI. The activity will be with the strong participation of the Local Government Unit. A meeting with the Bohol LGU representatives with Bill Deutsch, Jim Orprecio and other work plan partners, followed by a reconnaissance survey for the possible sampling sites, is scheduled for June 2001.

Publications and Presentations

Book Chapters

Deutsch, W., A. Busby, J. Orprecio, J. Bago-Labis, and E. Cequina. 2001. Community-based Water Quality Monitoring: From Data Collection to Sustainable Management of Water Resources. Chapter 7, pp. 138-160 *In: Coxhead, I. and G. Buenavista (Eds.) Seeking Sustainability: Challenges of agricultural development and environmental management in a Philippine watershed.* Los Baños, Laguna, Philippines: PCARRD, 2001. 267p.

Deutsch, W., J. Orprecio, and J. Bago-Labis. 2001. Community-based Water Quality Monitoring: The Tigbantay Wahig Experience. Chapter 9, pp. 184-196. *In: Coxhead, I. and G. Buenavista (Eds.) Seeking Sustainability: Challenges of agricultural development and environmental management in a Philippine watershed.* Los Baños, Laguna, Philippines: PCARRD, 2001. 267p.

Deutsch, W.G. and Jim L. Orprecio. 2000. Formation, Potential and Challenges of a Citizen Volunteer Water Quality Monitoring Group in Mindanao, Philippines. pp.13-20, *In: Kathleen Cason (Ed.) Cultivating Community Capital for Sustainable Natural Resource Management. Experiences from the SANREM CRSP.*

Presentations

Deutsch, W.G. and J. L. Orprecio. Formation, Potential and Challenges of a Citizen Volunteer Water Quality Monitoring Group in Mindanao, Philippines. Presentation made at the International Farming Systems Association Conference, Santiago, Chile. December 2000.

Orprecio, J. L. and W.G. Deutsch. Presentation made at the Agro-Ecology Conference of Heifer Project International, Tamuco, Ecuador. January 2001.

Yages, Mayor George (Municipality of Maitum), Mr. Rene Paraba (Planning and Development Office of Sarangani Province) and Jim Orprecio (Country Director, HPI/Philippines). Panelists at a Workshop

(chaired by W. Deutsch) entitled, "Participation and Group Formation for Local Natural Resource Management" at the SANREM-sponsored Conference in Manila, "Sustaining Upland Development in Southeast Asia" May 28-30, 2001.

Teaching and Outreach Resources

Work plan data were used as references in the Resource Management topics both undergraduate and graduate students at Central Mindanao University, Musuan, Bukidnon, which were also utilized by the Monitoring and Evaluation Team of the university during the evaluation of the Comprehensive Land Use of Lantapan and Valencia, Bukidnon.

Translation of the water quality monitoring training manual into the Cebuano dialect is underway.

Two brochures that were to be completed by the end of year 3 are in draft form, with a new completion date set for early year 4:

Deutsch, W., J. Orprecio, J. B. Labis and J. Sumampong. The Citizens, Role in Watershed Management and Protection. Brochure in Visayan/English.

Deutsch, W., J. Orprecio, J. B. Labis and J. Sumampong. What is a Watershed? Brochure in Visayan/English.



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

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Introduction

Selection of Vietnam for expansion of SANREM collaborative research initiatives (scaling up activity) is strategic. Vietnam is undergoing rapid transformation of both its economic as well as its biophysical landscape. Economic reforms, which include de-collectivization of agriculture (decentralization of resource management), elimination of an array of administrative prices, and liberalization of trade, to name a few, resulted in a 7 percent rise in Gross Domestic Product (GDP) and Vietnam became one of the largest rice exporters. With a population of 78 million and an annual population growth rate of 2 %, environmental pressures on land resources are expected to become a serious problem in the near future.

In Vietnam, coffee is one of the major export crops. In 1997 alone, the production of coffee green beans reached 364,000 tons, the highest since 1990. Coffee exports totaled 310,000 tons in the same year (Hung 1998). It was also estimated that about 330,000 tons were exported in 1998. In terms of value, coffee is second to rice. As it is, coffee is expected to play a significant role in the modernizing period of South Vietnam.

This seemingly good fortune is not without some costs. The economic benefits of coffee production have environmental as well as sociocultural consequences. Farmers, encouraged by good prices for coffee, gradually clear forest areas to plant more coffee. This trend increases the vulnerability of the farmers to fluctuating markets. In addition, monocultures are more susceptible to pests and diseases and pose as a threat to the ecological balance. Already, water scarcity for irrigation of coffee farms is becoming a major problem among coffee growers.

Discussions on sustainability of upland productivity in the context of expanding coffee plantations center on pertinent research questions: *What factors would influence the upland farmers to adopt/adapt sustainable agriculture and natural resources management? How could farmers and policy makers balance production and environmental protection? What are the factors that affect land management decision at the household, commune and district levels? What are the appropriate interventions and decision support tools to facilitate adoption of sustainable farming practices?*

This work plan aims to address all of these research questions using a study village in Central Highlands, Vietnam. It is located in Lam Dong Province in the district of Bao Loc. The selection of this particular site is strategic because it is an area that is currently in a period of rapid transition from traditional crops (e.g. tea, ginger) and natural vegetation (e.g. forests and grasslands) to coffee monoculture. In contrast with Dac Lac, which is primarily dominated by coffee, Lam Dong is following the process of land use conversion and provides an opportunity for researchers to study the process of transformation.

Objectives

1. Determine the suitability of the SANREM Phase I tools and processes in a different socioeconomic and political context like Vietnam
2. Examine the dynamics of resources management in the uplands of South Vietnam using a case study approach;
3. Examine the interlocking influences of economic, cultural and biophysical factors as they influence upland agriculture and its environment
4. Determine policy implications of the changing agricultural practices among farmers in Southern Vietnam.

Methods or Approach

Central to this research methodology is the concept of participatory action research (PAR), where various stakeholders are involved in the whole research process (Fig. 1). The extent of coffee cultivation and issues associated with it were also examined, including economic, sociocultural and environmental factors. Participatory Landscape-Lifecycle analysis (PLLA) was employed in this portion of the research. PLLA is a rapid, flexible, iterative, systems-oriented, cost effective, participatory, and interdisciplinary method of site assessment that provides an understanding of the agro-ecological and socio-economic conditions prevailing in an area. Process documentation enabled the researchers to have a clear picture of the research process (Fig. 2).

The results of the case analysis were presented to a multi-sectoral forum attended by both farmer leaders, people's committees at the commune and district level, and fellow researchers from University of Agriculture and Forestry (UAF). The objectives of the workshop were: 1) to present to concerned policy makers at different levels the implications of the results of the study, 2) to validate findings that will be collected from the field; and 3) to come up with a common sustainable agriculture planning framework that can assist the concerned agencies in implementing their programs.

The step-by-step procedure for the conduct of the research is shown in Figure 3.

The following activities (meeting, field work, and workshop/conference) that were conducted/attended in Year 3 are the following:

1. An initial Participatory Landscape Lifecycle Appraisal (PLLA) in Bao Loc District, Lam Dong Province was conducted on October 11 to 21, 2000 by a team of five professors from UAF and SEARCA-SANREM CRSP/SEA. One commune was covered during the initial PLLA and following activities has been completed: 1) reconnaissance survey of the study area was conducted; 2) identification of key informants was done; 3) guide questions during the survey/interview have been formulated; 4) initial interviews with the farmers, local government units and officials of the farmer's organization – the "State Farm" – were conducted; 5) secondary data such as maps and commune profiles were gathered; and 6) information was consolidated and integrated; and 7) data gaps were identified based on the initial information collected. Representative.
2. The second PLLA field activities in the community of Bao Loc District, Lam Dong, Province, Vietnam, was conducted on March 7-13, 2001. The data gaps that were identified at the end of the first PLLA were the focus of the second PLLA. Aside from the

members of the PLLA team from UAF and staff of SANREM CRSP SEA, officials of the farmer's organizations, farmers and members of local government units are now involved in conducting second PLLA. Interviews with key informants, farmers, local government officials and focus group discussions were done. After the field trip, the team also conducted a writing workshop to come up with a paper as an output of the work plan to be presented during SANREM CRSP/SEA meeting in Manila. This was conducted in University of Agriculture and Forestry (UAF), Vietnam.

3. A seminar workshop entitled "Challenges for Sustainable Agriculture and Natural Resources Management in Vietnam" was held at the University of Agriculture and Forestry (UAF) from April 24 to 25, 2001. This was conducted to validate the results of the Participatory Landscape-Lifecycle Appraisal (PLLA) conducted by the SANREM Vietnam team and to identify issues, concerns and research and development priorities of Vietnam. Twenty participants from the local people's committee, provincial extension office, Bao Loc District state farm, UAF and SEARCA attended the activity. Two related papers were presented namely, "From swidden to sedentary agriculture: Case in Kado, Central Highlands, Vietnam" and "Estimating soil erosion of three main crops in Bao Loc District: Coffee, Tea and Mulberry".
4. Dr. Victoria O. Espaldon, Assistant Professor of the School of Environmental Science and Management, UPLB and Principal Investigator of SANREM/CRSP/SEA and Ms. Annielyn O. Magsino, Project Management Associate of SANREM/CRSP/SEA delivered a seminar for students and faculty members of Department of Economics, UAF on April 27, 2001. Dr. Espaldon's lecture centered on the topic, "Integrating environmental considerations in sustainable agricultural planning". Ms. Magsino presented a lecture on the potentials of environmental audits in assessing the environmental performance of agricultural systems.
5. Representatives of the team from UAF and SEARCA-SANREM CRSP/SEA attended and presented the paper during SANREM Conference entitled "Sustaining Upland Development in SEA: Issues, Tools, and Institutions for Local Natural Resource Management" held in ACCEED, Manila on May 28-30, 2001. The papers that were presented during the said conference are the following: a) "Soil Erosion And Land Management Decisions In Bao Loc District, Lam Dong Province, Central Highlands Of Vietnam"; b) "Impacts Of Changes In Policy And Market Conditions On Land Use, Land Management And Livelihood Among Farmers In Central Highlands Of Vietnam"; and c)

“Environmental Audit as a Tool of Improving Environmental Performance of Agricultural Farms in the Philippines.”

Results and Discussion

The UAF team together with the UPLB/SEARCA expertise was able to employ the PLLA as a research methodology for understanding the dynamics of land use transition in a selected upland village in Vietnam.

Using the PLLA as a research methodology, the study provided empirical evidence to the hypothesis that the decentralization of control over agricultural land from the state to households in the period from 1975 to present has influenced the way upland farmers use this resource (Fig. 4). Fieldwork showed that farmers had shifted from state-led mulberry production, an adjunct of the sericulture industry in the Central Highlands, to coffee cultivation for export to global markets in the early 1990s because of attractive prices (Fig. 5). However, coffee prices dipped starting in 1997, which led farmers to shift to the traditional tea cultivation and mulberry (Fig. 6). Mulberry was limited to areas suitable to this crop, which were mostly the flatlands and close to irrigation services. The team also found out that some innovative farmers have turned to crop diversification as a mechanism for adapting to fluctuations in market prices of farm produce (Fig.7). Environmental problems, such as soil erosion have also influenced the way farmers and local government officials and state farms make decisions. The decisions of the government official and members of the state farms were influenced by environmental conditions of the farm they have. Farmers and local government officials will decide on what type of crops to be planted and cropping systems to adapt based on the environmental conditions of the area they have. Like for example in the area, at present, coffee and tea are planted on hilltops and hillsides while mulberry, which requires more fertile soils and water, is planted on relatively flatlands.

The two papers presented during the SANREM Conference entitled “Impacts of Changes in Policy and Market on Land Management Decisions in Central Highlands” and “Soil Erosion and Land Management Decisions in the Uplands of Vietnam” detailed the findings of the PLLA.

A strength of the PLLA as a research methodology is its ability to draw the local stakeholders into the whole process of research problem formulation, data collection and analysis of results. In the process, trust and rapport is built up, which necessary in building up linkages in the study region. One area that may need refinement is how to improve involvement of local stakeholders in the preparation of the final report. There is room for improvement here as the team is in the process of preparing the final PLLA report that will

be edited by SANREM for publication as a monograph.

Impacts

This activity provides empirical evidence on the impact of decentralization of natural resources management and agriculture, particularly changes in land tenure patterns. The findings will assist in formulating policies sensitive to the dynamics of resource use in the uplands of Vietnam and will optimize the benefits that farmers will derive from any trade agreements that U.S. may enter into with Vietnam in the near future.

The team also tested and refined the PLLA methodology and will develop a manual that will be useful to other research and development workers.

From out of the work, a network with selected local institutions was established that will hopefully be useful in other scaling up activities of SANREM CRSP/SEA.

Publication or Presentations

- Espaldon, M.V.O. and A.O. Magsino. 2000. *Manual on Participatory Landscape-Lifescape Appraisal for Community Resource Management (Draft)*. SANREM CRSP-SEA.
- Ha, D. T., P.H. Duc Phuoc, N. N. Thuy, L. V. Du, P. T. Hung, M. V. O. Espaldon and A. O. Magsino. 2001. *Impacts Of Changes In Policy And Market Conditions On Land Use, Land Management And Livelihood Among Farmers In Central Highlands Of Vietnam*. Paper presented during SANREM Conference entitled “Sustaining Upland Development in Southeast Asia: Issues, Tools, and Institutions for Local Natural Resource Management” held in ACCEED, Makati City, Philippines on May 28-30, 2001.
- Ha, D. T., P.H. Duc Phuoc, N. N. Thuy, L. V. Du, P. T. Hung, M. V. O. Espaldon and A. O. Magsino.. *Soil Erosion And Land Management Decisions In Bao Loc District, Lam Dong Province, Central Highlands Of Vietnam*. Paper presented during SANREM Conference entitled “Sustaining Upland Development in Southeast Asia: Issues, Tools, and Institutions for Local Natural Resource Management” held in ACCEED, Makati City, Philippines on May 28-30, 2001.
- Espaldon, M.V.O. 2001. *Integration of Natural Resources Management in Sustainable Agricultural Development Planning*. Lecture presented to the students and faculty of the College of Economics, University of Agriculture and Forestry, Ho Chi Minh City.
- Magsino, A. O. and A. J. Alcantara. 2001. *Environmental Audit as a Tool of Improving Environmental Performance of Agricultural Production in the Philippines*. Paper presented during SANREM Conference entitled “Sustaining Upland Development in Southeast Asia: Issues, Tools, and Institutions for Local Natural Resource Management” held in ACCEED, Makati City, Philippines on May 28-30, 2001.

- Magsino, A. O. and A. J. Alcantara. 2001. *Application Environmental Audit as a Tool of Improving Sustainability of Agricultural Farms in the Philippines*. Paper presented to faculty and students of College of Economics, University of Agriculture and Forestry, Ho Chi Minh City, Vietnam on April 27, 2001.
- Magsino, A. O. and A. J. Alcantara. 2001. *Application Environmental Audit as a Tool of Improving Sustainability of Agricultural Farms in the Philippines*. Paper presented during Global Change and Sustainable Development in Southeast Asia held on Feb. 17-19, 2001 in Chiang Mai, Thailand.



Replicating Models of Institutional Innovation for Devolved, Participatory Watershed Management

Introduction

The search for better watershed management derives from global concerns and national environmental concerns, but poverty reduction and household food security are also central issues. As participatory demand-driven approaches to watershed management gain wider attention, there is an urgent need for research to evaluate their performance, analyze those cases where they have been tested and identify important constraints, indicators and methods of application that point the way to accelerated progress.

In Lantapan, Philippines, the natural resource management process and experience is a significant advance in municipality-led NRM planning. The model is considered a milestone in the decentralization of planning and management to the local government level. It is a shift from traditional top-down planning approaches toward participatory multi-sectoral planning and research-based decision-making. It combines technical concerns with policy, social and institutional issues in a holistic manner. From this experience in Lantapan, we began conducting a replication program for this model to four municipalities surrounding the Mt. Kitanglad Nature Park within the province of Bukidnon.

We will analyze, evaluate and compare the performance of this model in these municipalities, in the context of the diversity of biophysical, socio-economic-political and institutional conditions encountered. An analysis of sustainability factors in local natural resource management will be also conducted. This will form the basis for an analysis of policy implications at the national level. We will package the results of this analysis and impact assessment into modules that will serve as decision-support tools that assist local governments and community stakeholders to further

improve the processes of natural resource management planning and implementation and communicate these to broader levels, nationally and regionally in Southeast Asia.

Objectives

1. Develop methods for participatory monitoring and evaluation of impacts of the NRMDP in Lantapan, implement these methods with local partners in Lantapan, assess their effectiveness, and suggest refinements to overcome constraints.
2. Continue to replicate the NRM model of Lantapan to five other municipalities in the Mt. Kitanglad area, leading to the development of a new approach to protected area management, in collaboration with Bukidnon's Provincial Planning and Development Office and the Protected Area Management System. (four municipalities completed, and one in progress)
3. Scale-up the NRM model to selected municipalities in Misamis Oriental, where ICRAF has already been working, particularly in the Claveria Watershed cluster under the Cagayan-Iligan Corridor Watershed Management Program. (excluded in the second semester of year 3)
4. Strengthen collaboration with GOLD, through joint development of learning modules, case studies, and technical notes on guidelines for implementing participatory NRM planning and implementation, and illustrating different local practices and innovations for NRM and watershed management.
5. Strengthen collaboration with DENR's Forest Management Bureau for scaling-up the Lantapan methods for NRM and watershed management in their pilot watersheds under implementation of

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the National Watershed Management Strategy. (excluded in the second semester of year 3)

6. Develop and implement methods for scaling-up the NRM model in Vietnam in collaboration with the SEARCA work plan. (excluded in the second semester of year 3)
7. Analyze, evaluate, assess, and compare the performance of the NRM model in these different municipalities, and develop this knowledge into modules that serve as decision-support guidelines to local governments in pursuing local NRM planning and implementation.

Methods or Approach

Our main method in the replication process is generally described as “Technical Assistance” (TA), which involves conducting meetings, workshops, and follow-up sessions or coaching. The TA was based on the “Eight-Step NRM Planning Process” that was developed during the first year.

For the research side, our main methods or approaches were:

- Self-Assessment Workshops, conducted already in Baungon, Libona and Manolo Fortich.. This is a participatory approach used to elicit information using focus questions.
- Personal Interviews with key informants were conducted to verify and or supplement results obtained from the survey.
- Formal Survey. We developed a survey instrument to determine the sustainability factors affecting local NRM. The survey was conducted in Manolo Fortich, Baungon, Libona and Impasug-ong.

Results and Discussions

Preventive Systems Approach (PSA). This is a model for protected area management that evolved from the scaling-up of the Lantapan experience in local NRM to the municipalities surrounding MKRNP, consequent to the linkage with the Integrated Protected Area Management through the Protected Area Management Board. The PSA aims to unify the efforts of different management regimes encompassing the three land belts — from the protected area to the buffer zone down to the privately held agricultural areas in an integrated ecosystem. Its management objectives extend beyond the boundaries of the natural systems to the managed ecosystem, and that enjoins larger communities and institutions’ participation with the objectives of those living within. We hypothesized that when Local Government Units are effective in implementing NRM programs at their level, pressures in the protected area will be greatly reduced. Therefore, municipal-led NRM planning and implementation is a preventive approach to protected area management—hence, the PSA. The

last component of the NRM work plan will be to conduct an assessment on the effect of PSA to protected area management.

Presently, we are implementing a rapid and informal assessment through personal interviews with random respondents around the municipalities of Mt. Kitanglad to get a glimpse of the effect of the interaction between and among the communities in the buffer zone and the local governments in relation to protected area management.

Local Governance and NRM. The Local Government of Manolo Fortich has set-up a new organizational structure that would supervise the implementation of major NRM programs. A particular department created is the Environmental Protection and Natural Resources Management Office where the NRM Project Management Office (PMO) will be integrated and tasked to implement the NRMDP. Manolo Fortich has integrated the NRM plan into its municipal Comprehensive Development Plan — hence, the establishment of their social and financial infrastructure to implement the NRMDP. Baungon has also started implementing its NRMDP upon the organization of their Project Management Office. With this underway, these Local Government Units are positioned ready for take-off next year. In fact, they have already started implementing some of the key activities in the plan such as the formation of Landcare groups in different barangays. Various training for capacity-building of Landcare facilitators have been conducted as well as training on farming technologies such as nursery establishment, contour farming and others. The Local Government Unit conducted these trainings through the Municipal Agriculture Office in collaboration with ICRAF’s Landcare Facilitators and other technical persons.

The NRM Plans also supported the design and implementation of the municipal Land Use Plans, as well as, the development of Municipal Environment Code. Land use planning almost came simultaneously with the NRM planning. Local Government Units best captured both processes as dovetailing activities and generally supportive-initiatives.

We have been closely coordinating with the Bukidnon Watershed Management and Development Council and successfully embedded a capacity-building program for the Municipal Technical Working Groups (TWG), that were organized from the respective Municipal NRMCs. Initial implementation of this, was a training on “Technology of Participation” to the members of the municipal TWGs to equip them with skills needed in facilitating their respective NRMCs.

The municipal-level NRM planning: An alternative to the “Watershed Cluster Approach.” This municipal-level NRM planning approach as adopted by the northern municipalities of Bukidnon has been identified as an alternate approach of the “Cluster Approach” to

watershed planning. The Cluster Approach, requires several LGUs covering a delineated watershed to undergo planning using the watershed as a planning unit. The municipal-level approach is undertaken by a single LGU using the municipal territory as a planning unit. In areas where traditional leadership and limited funding constrained the LGUs in pursuing a Cluster Approach to planning, the individual municipalities can make a good start by initiating a municipal-level planning process. We are also planning to look at the cost-efficiency of these two approaches. The Municipal Government of Libona was privileged to present the planning and implementation process reckoned from Mt. Kitanglad of the northern municipalities during the Bukidnon Watershed Management Forum last October, together with the other two watershed clusters for Mt. Kalatungan and Maridugao River Watersheds.

Information and Dissemination. The work plan has produced three (3) editions of NRM Notes released quarterly and one NRM Caselet jointly published by ICRAF and ARD-GOLD. The NRM notes is a technical paper that comes in a newsletter format. This is made to popularize the strategies, approaches and lessons learned from our NRM work plan, and circulated to Local Government Units and other non-government organizations. The NRM caselet features the Lantapan experience and other Local Government Unit experiences around the country, particularly those assisted by ARD-GOLD.

LGU Gains in NRM Devolution. The above developments indicate the LGU gains in the devolution of NRM. Guess, Loehr and Martinez (1997) identified three dimensions of the gains of decentralization as: production, allocations and fiscal efficiency. LGUs become efficient with production when they are able to utilize local resources or inputs that are locally cheaper, as a substitute of expensive external resources or inputs. The capacity-building program of the Municipal TWGs and NRMCs, which they earlier developed is expected to curtail the costs incurred by conventionally hiring external Consultants to do NRM planning. Likewise, the NRM plans provide the venue for LGUs to leverage funds from their own resources with that of outside resources, thus, making them more efficient in allocating their limited resources. For example, Lantapan in 1998 allocated the amount of two hundred thousand pesos (200,000.00) to set-up an interim Project Management Office for the implementation of the NRM Plan. The purpose of which, is to invest on a social infrastructure that would mobilize community action and draw financial and technical support for the implementation of their NRM Plan from other stakeholders and development partners. Public-private partnerships in NRM as emulated by the LGU in these areas exhibit the gains of production, allocation and fiscal efficiencies of the

LGUs. Although, there are problems, these gains however, reflect a promise that decentralization of NRM creates more chances of success.

Impacts

The devolution of natural resource management to Local Government Units prompted politicians and decision-makers to find ways for environmental management to be integrated with sustainable development. With Lantapan's exemplary experience in initiating local natural resource management as well as the other municipalities' initiatives, there is now a better understanding on the benefits of participatory processes, not just for planning but also during the implementation phase, for social capital enhancement aimed at improving the natural capital of respective communities. The benefits of tapping local skills and indigenous knowledge available in the communities are now creating major impacts since people's involvement is now more pronounced. In areas where natural resource management is underway, local officials have been more conspicuously responding positively, innovating means and ways to successfully implement the plan.

Since NRMDPs are designed for implementation in public-private partnerships, more and more people in the communities tend to express their ideas on how to come up with appropriate and locally sensitive initiatives in natural resource management. Hence, a new sense of project ownership builds up and a higher percentage of success may be expected unlike nationally driven programs where no participatory processes are involved.

The national park superintendent reported a significant decrease in the number of cases filed against violators in the park and he noted that this was partly due to high awareness and commitment of Local Government Unit leaders to implement natural resource management programs and enforce local environmental laws as a result of the commitment developed through the natural resource management planning process. He also noted that Local Chief Executives are now more expressive in their quest for effective environmental programs and have found that environmental projects are noble and doable.

Publications

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- Catacutan, Delia & Mercado, A. Jr., "Technical Innovations and Institution-Building for Upland

Development: Landcare in the Philippines”, paper presented to the SANREM SEA International Conference on Upland Sustainable Development, May 28-30, 2001, Makati, Philippines and the START Regional Science-Policy Conference, February 17-19, 2001, Chaingmai, Thailand.

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Capability Building for Natural Resource Management at the Local Level

Introduction

Industrialization is gradually transforming rural landscapes into urban centers and metropolitan areas. Despite this, vast populations remain dependent on a productive natural resource base for a living. However, the long-term viability of the natural resource base is threatened by increasing exploitation of land, water and forest resources by a growing population. In recognition of the delicate balance between feeding a growing population and continuous industrial development, a need to focus on promoting sustainable agriculture and natural resource management is now becoming more pronounced.

Natural resource management is the rational utilization and conservation of land, water, and forest resources at farm-household and community levels for continuous improvement of livelihoods and human welfare in general (Sharma, 1998). However, the dismal failures of most natural resource development and management interventions in the past were attributed to the conventional top-down models of development. This approach was partially taken due to a lack of capability among local planners. Hence, to achieve rational natural resource management, a new paradigm is required. There is a need to adopt a model that widens the participation in decision-making that directly influences people's lives, such as how resources are to be used. Natural resource management needs to include the traditionally excluded members of society along with local stakeholders, such as the local community, the local government units and other organizations that have direct interest in a particular resource.

Starting 1998, a partnership between four organizations was forged that was committed to assist in building local capacity for natural resources management at the local level, specifically in the

Manupali watershed in the Philippines. This partnership was between Central Mindanao University (CMU), International Institute for Rural Reconstruction (IIRR), University of the Philippines Los Baños/SEAMEO Regional Center for Graduate Study and Research in Agriculture (UPLB/SEARCA). The objectives of the partnership were two-fold: 1) to build the capability of local planners, institutions, and local communities in natural resource management (NRM) and sustainable land use planning, and 2) to institutionalize the participatory process in the local political structures or institutions in the context of community resources management.

Objectives

1. Develop and strengthen the skills of trainers on Participatory Landscape-Lifescape Appraisal (PLLA).
2. Develop the ability of the community for participatory planning.
3. Establish a mechanism for collaboration with other work plans/organizations in the areas in the planning and implementation of activities.
4. Publish training manual on Participatory Landscape-Lifescape Appraisal for NRM and sustainable land use planning (SLUP).

Methods or Approach

In this report, we trace the general process of capability building for NRM and SLUP at the community level (Figure 1). It shows the type of participants by respective groups of participants at different phases of project development.

During SANREM Phase 2, Year 1 & 2, a study team from SEARCA and CMU conducted a Training Needs Assessment (TNA) focused on Manupali Watershed, at regional, municipal, and village levels. The results showed that government systems

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and structures for NRM planning were in place, and included the mandates, vision, and objectives at various levels. However, there was a need to integrate NRM into other plans, programs, and projects as well as to integrate these plans, programs, and projects into a unified whole that would ensure the integrity of the natural resource base of the area. Also, there was the need to enhance planning and implementation of the various plans and programs. The local planners and officials agreed that there was a need among local planners for training on sustainable land use planning (SLUP). In addition, the government through the Housing and Land Use Regulatory Board, placed enough pressure on every municipality in the Philippines to come up with a Comprehensive Land Use Plan (CLUP). We saw this as an opportunity for integration and institutionalization of rational natural resources management at the local level. Based on the results of the study, a training curriculum and materials on sustainable land use planning were developed.

In SANREM Phase 2, Year 2, training at the local level was conducted. Participants included representatives from the Provincial Government, Central Mindanao University (CMU), municipal and village governments, Barangay Integrated Development and Nutrition Improvement (BIDANI) Institute, and SANREM CRSP. Trainers and facilitators of the learning and sharing process were from SEARCA, UPLB and IIRR

In SANREM Phase 2, Year 3, the CMU team monitored and evaluated the CLUP of Valencia and Lantapan based on the SLUP format. The results showed that the needs of the communities were not captured in the CLUP. The plan was very general and there was insufficient factual data on natural resource management. A separate Forest Land Use Plan (FLUP) was prepared. Thus, data generation at the community level was recommended. This resulted in the preparation of Participatory Landscape Lifescape Appraisal (PLLA) manual for Community Resource Management. PLLA is a rapid, flexible, iterative, systems-oriented, cost effective, participatory, and interdisciplinary method of site assessment that provides an understanding of the agro-ecological and socio-economic conditions prevailing in an area. The PLLA includes broad analysis of the interactions across a watershed as well as detailed information regarding the major agro-ecological zones within a watershed. It helps to ensure incorporation of indigenous knowledge of the people in different agro-ecological zones. It also encourages people from different areas, organizations and disciplines to share ideas, experience and expertise. Most importantly, it promotes bottom up planning for identification of projects across the landscape. Lastly, it helps to establish friendships and collaborative relationships with community members and officials

in the area. With the PLLA manual, a training of trainers (TOT) in PLLA was conducted involving 28 participants from the provincial office, CMU, BIDANI, HPI, and SANREM CRSP. The trained manpower from CMU and BIDANI was organized into five small teams in preparation for a training-workshop involving six communities in the municipalities of Valencia and Lantapan, Bukidnon.

The CMU team conducted a series of discussions and considered possible organizations as local anchors, organizations that will help to organize/coordinate, and supervise the implementation of different activities and monitor the activities outputs or impacts. Options include (1) the Barangay Development Council (BDC), (2) the Program Planning and Implementing Committee (PPIC), which was organized by BIDANI, or (3) a newly created Ad Hoc Committee. On the basis of the established criteria of stability, or sustainability, and equity of representation from various stakeholders, the PPIC came out as the appropriate organization. Because it includes various sectors, such as tribal groups, civic, NGO's, and community leaders. It is also less affected by changes in local leadership.

A training-workshop on PLLA under Year 3 was conducted involving the members of PPIC ranging from 22 to 41 members in six communities. The trained PPIC members were organized into sub-teams equivalent to the numbers of sitios (small group of households in a community) Actual PLLA work by sitios was then carried out with technical support from the BIDANI team. The primary and secondary data were collated and consolidated. Validation by the Barangay Assembly was postponed because of the national election but will be done soon. The validated data will be used as inputs to the next activity, which is the actual preparation of SLUP, a supplemental plan to be incorporated into the Barangay Integrated Development Plan (BIDP). The local SLUP or BIDP will then be submitted to the municipal level for integration into the municipal SLUP. Through the PPIC, the BIDP will also assist with, the formulation of farm plans.

The process is yet to be completed. There is a need for continuous monitoring of the community and household dynamics as these are always influenced by other external factors such as changes in market and policy incentives. Participatory monitoring and evaluation will be carried out to determine the success and failure indicators of this kind of initiative.

The framework of capability building for NRM and institutionalizing the participatory process at the local level is shown in Figure 2. This will be made through the BIDANI process.

Results and Discussion

Although the activity is still on going and the capability building is still in the PLLA application phase, the following indications are noted:

1. A local pool of community members is now trained in natural resource management, and is based in different organizations and levels of authority, such as the provincial development office, municipal development office and local barangay officials and community leaders. One main feature of this capacity building program is having a local anchorage—the Central Mindanao University-BIDANI Institute. The choice of local institutions like CMU is based on the fact that research and academic institutions are stable in terms of organization, as there is no rapid change of leadership and ideally is immune to politics, which is common in many localities in the Philippines. The university also has the mandate to do extension activities along this concern. This may be a long-term investment but can provide sustainability to many efforts in the management of local environmental resources.
2. The trained career professionals in the provincial as well as in the municipal levels can now have a common framework to discuss issues with local scientists and academics, with less and less dependence on imported expertise from Luzon and from abroad.
3. The local leaders (the PPIC members at the community level) are already able to conduct PLLAs in their respective barangays. One barangay has already validated its data with the Barangay Assembly. Hence, capability for PLLA is building up within PPIC. The community members can now do the conduct of the PLLA alone. They can do the planning wherein different aspects are considered - cultural, biophysical and socio-economic aspect. Members of the barangay are now participating and in different activities and sharing their ideas, experience and expertise from different area, organization and disciplines. Most importantly, members of the barangay are now able to integrate natural resource management in their plans. Lastly, community members can now established friendships and collaborative relationship with other community members and local government officials in the area.
4. The PLLA, NRM and SLUP concepts and process have enriched the already participatory nature of the BIDANI processes.

contribution of SANREM to the local community that has hosted SANREM research programs for a long time.

Publication or Presentations

- Arances, J.B. M.V.O. Espaldon, E. Cubillas and A.O. Magsino. 2001. *Participatory Process In Natural Resources Management And The Politics Of Empowerment*. Paper presented during SANREM Conference entitled “Sustaining Upland Development in Southeast Asia: Issues, Tools, and Institutions for Local Natural Resource Management” held in ACCEED, Makati City, Philippines on May 28-30, 2001.
- Espaldon, M.V.O. and A.O. Magsino. 2000. *Manual on Participatory Landscape-Lifescape Appraisal for Community Resource Management (Draft)*. SANREM CRSP-SEA.

Impacts

The capacity building activity enables the development of trainers and practitioners of participatory NRM that are accessible to the local communities. The approach that we took, that of anchoring local capacity building activities at a state university, is also strategic in the bid for the institutionalization of the process. This is one major



Technical and Institutional Innovations to Evolve Agroforestry Systems for Sustainable Agriculture and the Management of Protected Ecosystems

Introduction

This project aims to broaden and deepen researchers' knowledge-base on effective and cost-efficient technical innovations and farmer-driven Landcare approaches that foster, expand, and sustain smallholder participation in and adoption of conservation farming in upland watersheds. Landcare is an approach used to rapidly and inexpensively diffuse technologies through the group approach with farmers and with support from, local government units and technical service providers. An additional objective of this activity is to 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 the reforestation of deforested upper watersheds. The Landcare Approach is central to SANREM's Southeast Asia research and extension approaches and methodologies for the expansion and enhancement of adoption of agroforestry technologies.

In the past 3 years, the International Center for Research in Agroforestry (ICRAF)-SANREM partnership has successfully developed and tested tree-based agroforestry systems and component technologies that have significantly contributed to the sound management of the buffer zone of the Kitanglad Naure Park near Lantapan, Philippines. While proportionate attention will continue to be paid to buffer zone villages and landscapes in Lantapan, other municipalities in Bukidnon Province shall also be included. Advances made in capacity building, and in agroforestry research and training, will be scaled up to partners and stakeholders, including NGOs, smallholders, and grassroots organizations.

Employing agroforestry planning methods (Debrabandere and Clarke 1995; Duchhart *et al.* 1989), research and training tasks shall be undertaken collaboratively with farmers, non-government organizations and government organizations to meet development and conservation imperatives as outlined in this work plan's goal and objectives.

Objectives

1. To broaden and deepen the knowledge base on the effective and cost-efficient technical innovations and farmer-driven landcare approaches for fostering, expanding and sustaining increased smallholder participation in the adoption of conservation farming technologies in upland watersheds.

Soil conservation information campaigns. Information campaigns were implemented in many forms: slide shows, non-formal and formal trainings and field visits. Through slide shows, hundreds of farmers from Lantapan and nearby municipalities in Bukidnon in Malaybalay City, Manolo Fortich and Pangantuchan, learned simple but effective technologies to control soil erosion. In Lantapan, forty-three slide shows sessions were conducted and 2,776 farmers and other interested individuals had participated within a period of two years. For this year, we have conducted trainings with farmers in Lantapan, Manolo Fortich and Pangantuchan on the following with farmers in Lantapan, Manolo Fortich and Pangantuchan: 1) Nursery establishment, care and management, 2) Seed Collection and Handling, 3) Asexual Propagation, 4) Contour farming with Natural Vegetative Strips, 5) Farm Planning, and 5) Soil Analysis

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Maintaining the species evaluation trials. Data on growth performance of trees in the species-evaluation trials that were established during phase 1 of SANREM are collected annually. The expanded trials established almost two years ago are maintained; data collection has been on-going and data are presently encoded for analysis.

1.1 Working with NGOs (local), the Local Government Unit and other work plans (HPI, BIDANI/CMU), expand and scale-up Landcare activities in Lantapan and other municipalities in Bukidnon

The work is currently in progress in the municipalities of Manolo Fortich, Malaybalay City and Pangantucan, Bukidnon. This “scaling-up” initiative is linked with our current Landcare project with other partners. As we scale-up Landcare in these new sites, we also investigate the different modalities by which Landcare could be effectively implemented under different socio-political and institutional environments.

1.2 Test the Farmers’ Field Schools (FFS) approach to fostering adoption of agroforestry technologies that are germane to soil erosion control and protected areas management

We have implemented four joint-Landcare Farmer Field Schools in three villages, in cooperation with the National Integrated Pest Management program through the Municipal Agriculture Office and an Integrated Area Development Project of a in Lantapan. One Farmer Field School (Baclayon) is now on its third season, while the others are still in its first cropping season. The first FFS was integrated pest management with soil and water conservation, while the subsequent Farmer Field Schools are implementing rice-varietal trials vis-à-vis soil and water conservation. The FFS experience provided evidence that farmer-groups engaged in adult-learning activities develop more potential to adopt technologies and build capacities to implement simple action research activities.

1.3 Set up a data collection system to monitor the activities of new adopters of agroforestry technologies that the Landcare Approach promotes, and to examine adopters’ perception of benefits and constraints to adoption

The work is again linked to our Monitoring and Evaluation Program for Landcare under the ACIAR-ICRAF Landcare Project. A Participatory Monitoring and Evaluation Program has been developed to reinforce our existing monitoring activities. Our PME framework covers two areas: monitoring progress and impacts, and evaluating outcomes of the identified impacts. Aside from internal monitoring and

evaluation activities, we will also be referring to results of studies conducted by two Ph.D. students on the social capital formation of Landcare and the economics of technology adoption by Landcare.

2. To build and nurture an enabling environment for the establishment, development and management of smallholder tree-based production systems as viable enterprises and a vehicle for reforestation of deforested upper watersheds and similar landscapes.

Diversification of species on-farm. Measurement of plant performance and maintenance of the second phase of species trials continued. In this phase, eight timber tree species were added to the evaluation trials, diversifying the on-farm species base. Farmers need to plant different types of trees on their farms because of market uncertainties and the vagaries of the biophysical environment. Also, different farmers have different needs and preferences that can not be satisfied by a limited number of tree species.

Strengthening farmer-managed tree production systems. Working with farmers in nurseries established by Landcare chapters and sub-chapters, 830 farmers underwent intensive seedling production work, as well as the establishment and management of trees that are planted on their farms. These farmers have planted and are maintaining (weeding brushing, etc) 62,608 seedlings of a variety of timber and fruit tree species on their farms.

Strengthening grassroots institutions. Our work with the Agroforestry Tree Seed Association of Lantapan (ATSAL) continues. As an element of this work, ICRAF invited two ATSAL members to attend the 5-6 December 2000 Tree Domestication Workshop to be held in Los Baños, Philippines. These tree farmers related their experiences in tree seed collection and management. marketing, conservation, economic benefits, . constraints of tree farming and the want of support services. They also participated this year’s Seed Congress held in Cebu City.

2.1 Develop better collection / production and management methods and techniques for quality agroforestry tree germplasm.

We facilitated the development of ATSAL (Agroforestry Tree Seed Association of Lantapan) as a farmer-institution engaged in preserving tree germplasm. In support of ATSAL, we allocated funds for some farmers to participate in seed technology trainings in order to expand their knowledge base on modern seed technologies and indigenous practices. In two years of operation, the group earned a gross income of almost 2

million pesos from sales of seeds and seedlings (\$40,000) Our aim now is to document farmers' practices, as well as their success factors, and continue to provide the necessary technical backstopping such as the establishment of a "Seed Production Area" for both exotic and indigenous species.

2.2 Facilitate better timber harvesting, processing and utilization to add value and broaden its use.

Better timber harvesting and processing were investigated through tests of a simple portable sawmill made of a frame on which the log is held in place for sawing with a chain saw. The mill is popular with farmers. The local Landcare chapter has been using it in the construction of their new office/lab facility. Last year, we implemented a survey to assess the growth of the local timber processing industry in and near Lantapan. A paper has been written on the results of the surveys.

2.3 Conduct a rather detailed follow-up marketing case study for trees and tree products from smallholder-managed production systems

This case study was completed and a manuscript has been completed for imminent publication by ICRAF and by SANREM.

2.4 Develop methods and techniques for the appropriate and better propagation and husbandry of promising indigenous tree species (non-timber forest-based products) for local beverage tuba (a local drink from the coconut tree), weaving (mats, hats, etc.), food (fruit, nut) and pharmaceutical establishments on the village level to generate income and employment

This objective has not yet been implemented.

2.5 Collect data on growth and site factors and to maintain (weed, fertilize) newly established species trials

Data collection, analysis, and composition of a series of journal articles have been drafted on the data obtained to date.

Methods and Approaches

The main methods used are:

- ▶ On-farm trials of indigenous and exotic tree species to select the best species mix on sites of varying elevations.
- ▶ Facilitation and action research on technology-dissemination approaches using grassroots institutions, like ATSAL and Landcare.
- ▶ Market study of trees and tree products

Results and Discussions

Species evaluation trial. The species evaluation trial necessitates a clear implementation of management regimes, such as "thinning". The first trials were thinned on the basis of farmers' decisions on tree selection and timing for thinning. The need for appropriate thinning and timing is apparent in the trial sites. This will be done in the second-generation trials, more explicitly as a major management regime. We will bring our farmer-cooperators on a field visit to our trial sites in Claveria, Misamis Oriental to demonstrate the value of thinning.

Species Diversification. The demonstration effect of the trials and the dissemination approach apparently resulted in an unprecedented boost in the number of trees grown on local farms. Farmers are showing increased interest in growing trees, including indigenous species and fruit trees for fruit, income and sustainable management of the watershed. Tree selection is based on farmer preferences and recommendations on tropical fruits species suited to grow at specific elevations based on a literature review by ICRAF. We provided hundreds of kilos of durian, rambutan, lanzones and jackfruit seeds to farmer nurseries, and grafted seedlings Coffee was also a great demand among farmers.

Dissemination and Capacity-Building. Dissemination and capacity building was carried on along with our Landcare Program and by working directly with ATSAL. These two grassroots organizations are leading the way towards better natural resource management through adoption of simple conservation and agroforestry practices in the watershed. In this connection, we are also documenting their development process and will soon develop practical evaluation methods to measure the empirical evidence of grassroots initiatives in participatory watershed management. We also assisted with the development and production of the Landcare and ATSAL brochures for public awareness campaigns.

Impacts

Advances in Research

- ▶ Research publications and reports – see list of publications.

Advances in Capacity Building

- ▶ Reduced dependence on natural regenerants as planting material and forests for timber and wood; a diversified species base on farm and idle lands was utilized.
- ▶ Decentralized forest management approaches and skills enhanced.

- ▶ Improved living standards were achieved in rural communities.
- ▶ Heightened sense of conservation of soils, watersheds and natural forests was observed in the community of Lantapan?.

Advances in Scaling Up

- ▶ Hundreds of natural vegetative strips established and enriched.
- ▶ Hundreds of kilos of seeds properly collected, stored, and marketed; dozens of nurseries established and successfully managed.
- ▶ Hundreds of silvopastoral and honey production systems established and managed.
- ▶ Hundreds of thousands of seedlings produced in farmer-managed nurseries.
- ▶ Hundreds of small-scale woodlots established and successfully managed by smallholders.

Advances in Policies and Reality

- ▶ A recognized transformation of Manupali's landscape is gradually taking shape before our eyes. For example, before this project was implemented farmers within the confines of the watershed were almost exclusively harvesting or collecting wood and other resources from the national park (a protected forest) and other tree assemblages. Now, many farmers are cultivating their own trees. Few of the farmers who were engaged in tree farming before the project knew only how to propagate and cultivate tree species such as *Gmelina arborea* and *Eucalyptus robusta*. Now a diversity of both timber and fruit trees are propagated and planted on their farms. This transformation supports the ideals of biodiversity conservation and the protection of Manupali.
- ▶ Results of SANREM activities have become known and accepted by Philippine policy makers.

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- Koffa, Samuel and Dennis P. Garrity. What year? Grassroots Empowerment and Sustainability in the Management of Critical Natural Resources: The Agroforestry Tree seed ssociation of Lantapan. Pp. 197-217 In Ian Coxhead and Gladys Buenavista, eds., *Seeking Sustainability: Challenges of agricultural development and environmental management in a Philippine watershed*. Los Baños, Laguna, Philippines: PCARRD.
- Koffa, S.N. 2000. Translating challenges into opportunities for an ICRAF-DAR Landcare-driven partnership. Unpublished Manuscript

Work continues on various aspects of completing the following papers for submission to refereed and related journals:

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Weather Monitoring Using Automatic Weather Stations

Introduction

Weather monitoring activities at Lantapan, Philippines, were initiated in 1994 by SANREM CRSP in order to provide the necessary meteorological data for other work plan holders, particularly in its integrated watershed modeling and water quality monitoring projects. In a tropical watershed, rainfall is highly variable and the hydrologic characterization of the watershed requires the monitoring of rainfall quantities, intensities and its corresponding spatial and seasonal variations. For the purpose of natural resources management, other meteorological data such as air and soil temperature, humidity, solar radiation and wind data were required. This led to the establishment of an automatic weather station network at Lantapan.

Since the support of SANREM SEA Automatic Weather Station workplan extended only up to December 2000, efforts had to be initiated to institutionalize weather data gathering. Agencies with direct interest on weather data monitoring include the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), Department of Agriculture, and the Department of Environment and Natural Resources (DENR). Other stakeholders are the Lantapan Local Government Unit, the Provincial Office of Bukidnon, Central Mindanao University (CMU) and the Department of Agriculture.

Objective 1 (work plan)

This work plan was primarily established to furnish meteorological information to other SANREM work plan holders and to compile data, which could be useful to researchers, development planners, farmers and other potential users.

To institutionalize weather-gathering efforts at Lantapan in order to improve the statistical reliability of accumulated data.

Progress Toward Objective 1

To effect institutionalization process in the further operation of the automatic weather stations, a Memorandum of Agreement (MOA) was signed between and among PAGASA, PCARRD, DENR, DA, CMU, Lantapan Municipal Government, and Bukidnon Provincial Government. PAGASA will continue to operate and maintain the automatic weather stations, collect data and share these regularly to all the other partner institutions. The other institutions, on the other hand, will help in the upkeep and security of the weather stations. CMU thus transitioned the operation of the weather stations to PAGASA which has the institutional mandate to manage such stations over a longer period of time.

Objective 2 (added mid-year)

To continue weather monitoring activities at Lantapan using Automatic Weather Station at Kulasihan, Alanib and Bulogan.

Progress Toward Objective 2

Weekly inspection and maintenance of stations and premises

- ▶ Weekly downloading of data from the Automatic Weather Stations
- ▶ Processing of data using computer facilities at Central Mindanao University
- ▶ Compilation of monthly weather data
- ▶ Dissemination of compiled data
- ▶ Attend consultative and other meetings
- ▶ Submission of required reports

Results and Outcomes

Data for the following meteorological elements were compiled:

- ▶ air temperature
- ▶ relative humidity
- ▶ soil temperature
- ▶ solar radiation

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- ▶ wind speed/direction
- ▶ rainfall

There were problems encountered in the operation of our three Automatic Weather Stations. The program in the datalogger is not functioning well. This was first noticed during the last week of May, 2000. At Kulasihan Station, intermittent negative values of different sensors were generated, while at Alanib and Bulogan unpredictable program losses occurred. For these reasons, the frequency of data downloading from monthly to weekly was immediately implemented to minimize data losses.

Since the contract of the project with CMU terminated last December 31, 2000, the responsibility of data monitoring and all other operations was turned over to PAGASA on January 2001.

Impacts

1. The demand of weather data by the government, NGO's, researchers, etc. has continued. In fact, recently a group from Taiwan requested data from the work plan for their proposed rice production project at CMU.
2. Other corporate farms are still requesting data from the work plan.

Publications

No publications were produced during the period.

Other Issues

Since the automatic weather stations were turned over to PAGASA last January 2001, the CMU meteorologists involved may still provide technical assistance on an on-call basis. Training on instrument maintenance and repair will be provided by the Automatic Weather Station Unit of PAGASA.

Plans and Targets for CY 2001

Orient and train PAGASA personnel on field operations and data processing.



SANREM Andes: Project Overview

Introduction

The SANREM-Andes program conducts basic and adaptive research aimed at understanding and advancing sustainable agriculture and natural resource management in fragile mountainous regions. Globally embedded in the Inter-Agency network related to the United Nations Commission on Environment and Development's Agenda 21 (Chapter 13 on Sustainable Mountain Development), the Andean program pursues interdisciplinary and intersectoral scientific research in two research sites in Ecuador with outreach activities in Peru. At the international level, researchers are involved with international organizations and initiatives (e.g., Mountain Forum, United Nations Year of the Mountain, International Centre for Integrated Mountain Development), which helps guarantee broad application of lesson learned in the Andes.

The Andean program is made up of five integrated activities, each of which interlock with each other to form a single whole. The core activity (Sustainable Mountain Futures: AND 07) integrates, adapts and packages the data from the other activities to create future land-use scenarios useful for landscape planning by diverse stakeholder groups. In linking local people's perceptions of change with scientific findings, the program's integrated strategy traces the link between cultural and institutional factors (AND 02, AND 03) that drive changes in the landscape such as soils, biodiversity and water resource use (AND 05, AND 08). The data from these projects are integrated into a single database located at three linked nodes (University of Georgia-Athens, Catholic University-Quito, and in Jambi Mascaric-Cotacachi). The results of these research activities (e.g., multi-temporal land-use model, advocacy coalitions, water measurements) are translated into readily understandable community-level presentations so that stakeholders

have the opportunity to understand how their decisions affect land, water, and biodiversity through time and space. Scaling up and transferring lessons learned are coordinated by AND 01 (coordination and networking) and AND 09 (regional node for training).

Project Objective

The objective of the SANREM-Andes Program is to advance sustainable agriculture and natural resource management in fragile mountain or hill landscapes through basic and adaptive research on participatory multi-objective, multi-scale, and multiple stakeholder decision support methods that enhance sound and equitable long-term agro-ecological planning and policy.

Progress Toward Five-Year Indicators

1. *Scientific and Indigenous Multimedia Decision Support Platforms.* A planning tool based on diagnostic reports was pilot tested by the Iowa State institutions team (AND 03) in Cotacachi and Minnesota. Based on a successfully completed land-use change models and derived maps, photo-simulated panoramic past, present and future visions of the Nanegal landscape were developed as a tool for community-based planning and preliminarily tested on-site. Simultaneously, the derived rules of change from the Nanegal model were compared with story completion tests, which measure local understanding of the same time periods. This future visioning methodology was presented at two international meetings and published in two book chapters. Eighteen different scientific and indigenous images of the landscape were presented to different stakeholder groups in Nanegal and Cotacachi to measure understanding of perspective, relief, purpose, costs, and other variables. Forty-eight locally drawn maps were elicited from 24 informants disaggregated by gender, class, and ethnicity in each research site

(Nanegal and Cotacachi) and were analyzed. Gender proved to be the most significant variable in differential understanding of the environment. Based on the land-use change model, photo-simulations of the years 1950, 1966, 2000, and 2014 were developed for Palmitopamba, Nanegal Parish, and a preliminary test developed in the community (Photograph I). The multimedia database for Athens, Quito, and Cotacachi was enriched during the year through additions of maps, photographs, video footage, and software applications.

2. *Case Studies of Landscape Level Decision Support Tools and Experiences*. In March, 2001, the Spanish language book *Tendiendo Puentes Entre Los Paisajes Humanos y Naturales*, was published by Abya Yala Press, Quito. Five hundred copies are being distributed to researchers, organizations, libraries, and bookstores in Spanish-speaking countries. The book contains 18 chapters detailing research results conducted by SANREM-Andes in the Nanegal area between 1994-2000. An expanded English version of the same book is in press at Kendall/Hunt Publishers and due out in July, 2001. Another book *Experiences and Lessons from Integrated Conservation Development Programs in Tropical America: Linking People, Policies, and Programs* based on a 1999 joint international conference in Quito sponsored by SANREM-Andes, USAID-Ecuador, and CARE-Ecuador is with the publisher (Abya Yala Press). One book, twenty-four published articles, six reports, eighteen presentations, and one e-conference were produced in 2000-2001.

3 *Land Use Change/Hydrology Model*. A land-use change model (1966-2014) was developed for Nanegal and change rules derived from the study were tested against local perceptions (see Map I). For Cotacachi, model input parameters (climate, soils, land management) were collected for field scale modeling and input coverage (digital elevation model, land-use map, field management data) was generated for the GIS-watershed scale modeling (EPIC model). Two Ecuadorian scientists (Hernan Velásquez and Marcia Peñafiel) collected data for a multi-temporal (1963-1998) land-use change study for Cotacachi. Preliminary land-use change maps have been created based on these data. Eight biodiversity transects completed and species diversity inventoried.

4. *On-Site Databases Established*. During January and February 2001, Professor Monsarrath Mejia from Catholic University-Quito was trained in ArcView/ArcInfo and database management at University of Georgia. As the designated person in charge of the Ecuadorian database, she designed an integrated database format into which all SANREM activity data will be entered. The Cotacachi node remains fully functional with all field data stored on-site and available to the local communities. All students working in the field in 2000 provided reports and data for the archives in their respective locations. Backup

copies of data are made for each location and, upon request, distributed to SANREM researchers.

5. *Interactive Searchable Database Warehousing of SANREM-Andes Data*. During the year, responsibility for the SANREM-Andes website (<http://julian.dac.uga.edu/~sanrem>) was transferred into a central Web site at the Management Entity in Watkinsville, Georgia. Although the SANREM-Andes Web site remains online, it will be turned off later in 2001. As a move to conserve resources, the Management Entity will receive primary data from the SANREM-Andes program and make it available on the same server as the other SANREM regional sites. As a result, this indicator (and indicator #12 on the Web site) will become a joint venture with SANREM-Andes providing data and the ME inputting and managing information.

6. *Case Study on Ethno-Geomatics and Ethno-Ecological Methods*. Two case studies were written up, presented at professional meetings, and published in 2000: (1) an application of cognitive anthropology methods to land-use planning for Oglethorpe County, Georgia; (2). ethnoecology story completion tests for local perceptions of land-use change in Nanegal, Ecuador as a test of the scientific model's local relevance.

7. *NGO and Scientific Personnel Trained in Future Visioning Methodology*. Two students from Catholic University-Ibarra were field trained in Cotacachi. Four Ph.D. students from the U.S. were given research methods training through hands-on research in Ecuador. One professor from Catholic University-Quito was trained in GIS and other database management techniques at UGA. Three collaborators from Peru visited Cotacachi in December 2000 for onsite interaction and collaboration. During November 2000, Carnelio Orbes and Rafel Guitarra (representatives of UNORCAC) participated in the International Congress of Ethnobiology (Athens, GA) where they visited local projects and exchanged ideas.

8. *Community Training in Water Quality/Quantity*. During July and October 2000, basic training workshops were offered to 16 community volunteers. One UNORAC technician and one student from the Catholic University-Ibarra were trained in water monitoring techniques. They were further trained to enter data on the SANREM computer at Jambi Mascaric and send monthly files to Auburn University. In April 2001, certification workshops on "Water Quality Monitoring" was conducted in Quilicas, Peru.

9. *Training Manual on DSS Tools for Mountains*. Jointly with the International Centre for Integrated Mountain Development (ICIMOD), progress has been made on a methods module for ecoregional approaches in mountains. R. Rhoades and V. Nazarea participated in two weeks of research and workshops in January 2001 in Kathmandu. R.Rhoades is a Senior Advisor to the ICIMOD effort.

10. *Case Study of Future Visions Scenarios.*

- ▶ Case Study report “Oglethorpe County, Georgia: A Case Study of Desired Future Conditions” was prepared and distributed to local authorities, interested scientists, county planning commission, and board of commissioners.
- ▶ SANREM-Andes working document (AND 2000-1) entitled “The Sustainable Mountain Futures Methodology: An Ongoing Study of Visioning in Nanegal Parich” was published. The future visioning method was published by D. Stewart in the Spanish volume on Nanegal.
- ▶ A chapter entitled “Contrasting Scientific and Local Valuations of Land-use Change” by R. Rhoades, V. Nazarea-Rhoades, and M. Piniero was written for the forthcoming SANREM-ANDES book by Kendall/Hunt on Nanegal.

11. *Memory Banking Methodology.* Memory banking methodology (AND 02) continued to be widely adopted in Ecuador and internationally. As the 1999 Praxis Award winner in Anthropology, news of the method continues to be widely spread. In Ecuador, Jambi Mascaric has institutionalized the method in Cotacachi (Magdalena Furies) and Canton Cotacachi (Mayor Auki Tituana). More than 50 indigenous myths and legends about the environment were gathered and prepared for a children’s storybook collection as a method of ethnically significant environmental learning. Fifteen school children (funded partially by SANREM) collected landrace seeds and elders’ stories. Materials were grown in a successful *in situ* garden at Jambi Mascaric, which was also the focus of a women’s biodiversity fair in March 2001. Memory banking has been adopted by Native Seed Search in Arizona and recently became the basis of a new International Potato Center project in the Philippines. USDA-ARS has requested and received a proposal from the ethnocology project to implement memory banking among Vietnamese immigrants to the U.S.

12. *Bilingual Website (English/Spanish).* See indicator 5 above.

13. *UN Year of the Mountain.* The Mountain Forum, which is a key player in the interagency planning for the upcoming Year of the Mountain, elected R. Rhoades as a North American Board member to The inaugural event for Year of the Mountain will be held at United Nations Headquarters, New York, in December 2001, with participation of SANREM. In addition, plans are being developed to host one of the major International Year of the Mountain conferences in Ecuador in 2002.

Benefits to the U.S.

In four areas, the SANREM-Andes program has produced results applicable and beneficial to the United States. First, the memory banking methodology has been adopted by two regional seed saving

organizations (Native Seed Search and Southern Seed Legacy). This method helps conserve U.S. germplasm as well as the cultural heritage underlying its preservation. The National Seed Laboratory considers memory banking so useful that they have requested a proposal to collect germplasm and cultural information from recent immigrant groups, beginning in 2001 with the Vietnamese. Second, the water quality and water quantity citizen research and methods of Auburn University are widely used in Alabama and elsewhere in the Southeastern U.S. Third, the future visioning methodology has been successfully applied in land-use planning for Oglethorpe County, Georgia, and is relevant wherever there are planning conflicts over land-use. Similar efforts have been successful in Minnesota. Fourth, the mountain-specific methods developed by SANREM-Andes are being linked to US community planning efforts in Rocky Mountains and Appalachia.

Year 3 Impacts

Year 3 impacts can be measured at three levels: Local communities and landscape, ecoregional (Andean), and international or global.

Impacts at Local Level. In Ecuador, impacts include: increased environmental awareness and biodiversity enhancement of local varieties through memory banking application and Ancient Futures Farm experiments; knowledge-erosion reversed through collection of environmentally-related myths and legends; improved water quality and quantity; training of indigenous youth to use computer technology; and institutional strengthening of cantonal- and communal-based natural resource planning

Impacts at Ecoregional (Andean). Memory banking, future visioning, and water quality and quantity methods have been successfully transferred to Peru through the efforts of Iowa State University, Auburn University and The Mountain Institute. The ecoregional methodologies for assessing sustainable agricultural systems developed in the Himalayas (ICIMOD project) have stimulated interest in using the methods within the Andean region. Lessons learned in participatory watershed management in Phase I of SANREM have been applied by numerous NGOs in the Andean region.

International. Based on the distribution of 6,000 copies of a SANREM “lessons learned” article (Gatekeeper Series) in Asia, watershed management projects are more streamlined and efficient. The same article has guided and impacted project managers in Africa and Latin America. The efforts of SANREM-Andes in raising awareness of global mountain issues joins with other UN, national, and private organizations in improving the situation of mountain peoples globally.

AND 00-02

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

The ethnoecology activity, which incorporates user's perceptives into SANREM's interdisciplinary landscape research process, achieved all programmed goals for the year 2000. Among these accomplishments are: 1. Statistical analysis of 48 cognitive landscape maps disaggregated by gender, age, ethnicity and age completed and results presented in scholarly international meeting; 2. Protocol for groundtruthing the modelers' derived rules for landuse change in Nanegal (see AND 07) field tested on 15 individuals (male and female) and results written up and accepted for publication; 3. Forty students trained in the *in situ* memory banking method with 32 endangered traditional plants collected and preserved; 4. Three *in situ* biodiversity community gardens established and one women's biodiversity and seed exchange fair in Cotacachi sponsored; 5. Fifty environmentally relevant folktales and local sayings collected, analyzed, and stored for the cultural landscape component of future visioning; and 6. A Ph.D. dissertation research on women, development, and biodiversity management completed. Most significant finding of the cognitive research is that gender, more than other variables, shapes how the environment is perceived and acted upon. Most significant international impact in year 3 is continued adoption by international agencies and biodiversity conservation groups of the memory banking approach. Most significant local impact is the adoption by the municipal mayor of the memory banking method and its application throughout the Canton Cotacachi. The preservation of local culture and biodiversity is seen as culturally relevant and an attraction to the new tourism thrust of the area.

AND 00-03.

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

Coalitions and partnerships between state, civil society, and market institutions can both facilitate and detract from sustainable agriculture and natural resource management at the grassroots. Our initial research, carried out by a joint Ecuadorian-US. Team, identified natural resource conflicts and the coalitions involved, looking particularly at their desired futures for the area, their implicit and explicit causal models, and their rules of evidence. The second phase of the research involved an NGO and community leaders to assess the coalitions and potential coalitions around specific issues of sustainable agriculture and natural resource management. The third stage will work with NGOs and community-based teams to identify potential coalitions as a basis for community-based watershed management. The research and its

community implementation will serve as the basis of a workbook which can serve as a decision support tool for community groups seeking sustainable futures related to agriculture and natural resource management.

In addition, we analyzed the components of the institutional capacity of indigenous secondary organizations, identifying key aspects of capacity that related to the success of primary level organizations that they bring together. This methodology will be extended in order to identify levels of capacity and key interventions for capacity building with these SLOs across Ecuador.

AND-00-05

Water Resources Management and Environmental Education in Andean Watersheds

Water quality problems have implications for public health and stewardship of natural resources upon which livelihoods are dependent. The rationale for this work plan is to address problems of water quality through community-based, participatory research. Specifically, objectives of this work are to assist collection and analysis of baseline environmental parameters, develop human and institutional capacity to carry on the technical work of monitoring and data analysis, and equip local decision makers to utilize the data for natural resource management planning and policy formulation. Methods to accomplish these objectives include training community members and local leaders, promoting environmental education for school children, making appropriate information widely accessible, and helping to develop partnerships that will support the development process. Successful implementation of this work in Cotacachi is providing "scaling up" opportunities in Ecuador and the Andean region, and contributes to development of a global program and database for participatory research and community-based water quality monitoring.

AND 00-07

Sustainable Mountain Futures: Linking People and Information for Effective Landscape Decision-Making in the Andes

The **sustainable mountain futures** activity aims to systematically integrate interdisciplinary multiple scale and stakeholder research from SANREM-Andes into transportable community-based methodologies for sustainable landuse planning. This future visioning methodology, which links changes in the lifescape ("human drivers") with landscape (soils, biodiversity, and water), uses scientific modeling to create past and future scenarios of landuse change under different conditions and assumptions. These scientific models, and the modelers' rules, are groundtruthed with local people with the objective of creating user-friendly scenarios for landscape level planning and policy

formation. The target audience, in addition to Andean mountain communities, are international mountain research and development organizations working to advance sustainable development.

The 2000 achievements are: 1. Landuse change model for Nanegal completed involving thirty projections (1966-2014) and 4 major derived land-use change rules defined; 2. Landscape photo-simulations (1900, 1950, 2000, and 2030) based on the model and oral history workshops were completed; 3. Jointly with AND 02 (ethnoecology), the modelers rules were field tested in Nanegal; 4. 18 different images of the landscape collected and interpreted by different stakeholders groups to determine ease of use, cost, perspective, and value for planning; 5. A beta-version of the multi-temporal analysis of landuse (1963-1993) completed for Cotacachi along with the database framework completed; 6. Cotacachi biodiversity inventory (flora and fauna) completed and a monograph *Flora and Vegeacion de Cuichochoa* readied for publication; 7. Hydraulic resource systems in 8 Cotacachi communities of the Yanayacu watershed studied from the anthropological perspective; and 8. 54 farmers in 5 Cotacachi communities interviewed in terms of agricultural practices and results submitted for publication; 9. Synthesis book published in Spanish on the Nanegal landscape and 500 copies distributed in Latin America

AND 00-08

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

Low soil fertility, nutrient imbalance and soil erosion have been identified as major soil-related constraints to rainfed agricultural production in Latin America, the adverse effects of which are aggravated by land misuse, soil mismanagement and subsistence farming by resource-poor farmers. Members of the Cotacachi communities identified decreasing soil fertility as a major threat to their subsistence (UNORCAC, 1999).

In this activity, we propose the implementation of decision support tools for the Cotacachi area that will help local people evaluate the effects of their decisions on the future conditions of their soil and water resources. On a field scale, agricultural sustainability will be assessed using EPIC (Erosion Productivity Impact Calculator), by simulating long-term changes in soil fertility and crop productivity as affected by land use and land management practices in selected Cotacachi communities. On a watershed scale, soil erosion and sedimentation will be estimated and its impact on water quality will be evaluated using WaTEM (Water and Tillage Erosion Model), which allows for erosion prediction employing the Revised Universal Soil Loss Equation in a raster GIS environment, as well as for sediment routing.

During the first year of this activity, model input parameters (climate, soils, land management) were collected for the field scale modeling and input coverages (digital elevation model, land use map, soil erodibility map) were generated for the GIS-based watershed scale modeling. Over the next months, the data collection will be completed, and existing data will be refined. The models will be tested and different scenarios will be analyzed.

AND 00-09

Regional Node For Training And Upscaling of Community-Based Natural Resource Decision-Making

The regional node located in Jambi Mascaric (formerly "Doctors Without Borders"), UNORCAC, is the primary outreach and training center for dissemination of SANREM findings, technologies, methods, and information within the Andean region. Headed by SANREM-Andes primary collaborator, Councilwoman Magdalena Fueres, the node is strategically located geographically and institutionally within the larger Cotacachi area. Within the headquarters of Jambi Mascaric, SANREM has been allocated a databank and training room to house our computers, data, assistants, seeds, herbarium specimens, etc., as well as an area for interviewing and writing. The node is the central point for training, workshops, evaluations, biodiversity fairs, women's events, and other activities of the project.

The 2000 year accomplishments are: 1. Training node facility and computer equipment established and fully functional for SANREM researchers; 2. Data from projects for year 1 and 2 entered on computer; 3. weather station transferred from Nanegal and now functioning; 3. Two indigenous project assistants trained in computers and field techniques; 4. Two Cotacachi indigenous leaders traveled to the US to present papers on joint activity with SANREM; 5. One women's biodiversity fair sponsored with over 70 women in attendance; 6. Establishment on the Jambi Mascaric property a demonstration biodiversity garden; 7. Hosted the SANREM External Evaluation Panel Review of the Andean program; 8. Provided venue for numerous SANREM meetings and training sessions with scientists and local people during the year; 9. Linked with policy makers at higher levels in the dissemination of SANREM research.



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

Introduction

This project examines different stakeholders' perception (stratified by gender, ethnicity, and age) of and behavior toward the landscape. By addressing such sustainability issues as intergenerational equity and cultural indicators of sustainability, this research addresses critical gaps in knowledge. It seeks to illuminate the connection between objective, operational factors and representations in scientific models and maps — especially the proposed watershed model — and the equally important but often neglected representations and choices of local people. While policymakers need to be informed about alternatives based on the new, scientific maps and models, it is still the local population who will make, and live with, resource management decisions and practices. The activity complements the goal of “scaling up” by comparing various representations or landscape images by scale, cost, use, access, and understandability at two basic levels of disaggregation — the local versus the external (e.g. local maps and GIS maps) and along different dimensions of the local (e.g. by age, gender, class, and ethnicity).

Objectives

- ▶ To map local realities and stakeholder perceptions as input to “future scenarios” planning exercise.
- ▶ To “groundtruth” scientific models, rules, and predictions regarding land use change.
- ▶ To put Decision Support Information to use by supporting local initiatives in biodiversity conservation emphasizing the role of local youth and of women.

Methods and Approach

A variety of ethnoecology methods are used in this project. In addition to key

informant interviewing and ethnographic methods, special research tools for the cognitive research include: Thematic Apperceptions tests using culturally relevant photographs; free style, hand-drawn maps by different stakeholder groups; landscape maps partially georeferenced maps suitable for informant completion; story completion tests and folktale analysis for the future visioning exercise. For the biodiversity research the methods include memory banking, ethnobotanical collection and storage, and indigenous horticultural grow-out gardens. All data is subjected to appropriate form of statistical analysis, if possible, or content analysis to guarantee validity and representativeness. A comparative framework of sociocultural marginality, mainly focused on gender, ethnicity, class and age is used in the investigation of social networks, home gardens, and life histories. The approach of the project is completely participatory involving full prior informed consent and permission of local communities and individuals. The project assistants in Cotacachi are fluent in the Quichua language. All data are stored in the SANREM office in Jambi Mascaric and duplicated for the SANREM-Andes database at University of Georgia.

Results and Discussion

Cognitive Mapping

Community-based sustainable land use planning starts from an appreciation of how different landscape users conceptualize and engage space, time and space-time relationships. Over the past six months, ethnoecological research in Ecuador continued analysis of different groups's perception of their environment (disaggregated by gender, age, ethnicity, and class). The 48 cognitive maps of people's environments (24 each from Nanegal and

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Cotacachi) previously collected were systematically analyzed using SPSS. Regarding relative salience, the following findings are reported:

Representation. Fifty-three percent of informants used abstract representation whereas the remainder (47 percent) used pictorial representation in their cognitive maps. This is contrary to our expectation that a greater proportion would use pictorial representation instead of the abstract representation that formally trained cartographers would use. The only significant determinant was gender. Males tended to represent in the abstract at approximately a 2 to 1 ratio while 63 percent of females preferred pictorial representation.

Focus. A minority of informants (6 percent) concentrated on their community while the rest were approximately equally divided between those who focused on the center of the parish (49 percent) and those who mapped the whole canton (45 percent). Gender appears to be significant here. Males tend to draw the whole canton (9 of 14 cases) while females tend to focus on the smaller parish scale (16 to 9 cases). The effect of occupation was not significant but it is worth noting that subsistence farmers tended to focus on the finer scale (community or parish) while non-farm business operators tend to cover the whole canton.

Perspective. Slightly more informants (29 percent) mapped from the horizon (looking out or what geographers call a "perspective view") and slightly less (26 percent) mapped from a bird's eye view (top-down, flat view) as a cartographer would. A few informants (4 percent), particularly from Cotacachi, mapped in a hierarchical, almost mystical manner reflecting the Andean cosmovision. The rest (41 percent) did not utilize any apparent spatial perspective or mixed the different perspectives.

Gender is significant in analysis of perspective. A majority of both males and females frequently mapped using a mixed, non-spatial perspective. However, of the remaining, males tended to map with a cartographic perspective (4 of 9 cases). Females tend to map from the horizon looking out (11 of 4 cases).

Detail and Emphasis. Four percent of informants highlighted where they reside or their own community while 20 percent stressed familiar routes (e.g., to the farm or work), 33 percent emphasized important landmarks, and the remainder (43 percent) did not emphasize any one location or direction over others.

Gender is again significant but not as strongly as with representation, focus, and perspective. Among the informants who emphasized either familiar routes or important landmarks, males tended slightly to emphasize familiar routes while females were three times more likely to emphasize important landmarks.

Dominant Features. Dominant natural or human landscape features or structures most highly represented (20 percent) were community meeting places such as the church, the park, the basketball court,

and the soccer field. Roads (18 percent) came second and this is significant because "road" was not a lumped category. The third most highly represented places (16 percent), with more or less equal prominence, were natural resources, roads, and communities. Finally, 12 percent represented, again with more or less equal prominence, a combination of roads and communities. Based on these results, we can tentatively conclude that the degree of relative salience ranking is community meeting places>roads>natural resources. On the second tier of importance, three categories came up with equal frequency (8 percent): the park, combination of rivers and forest, and combination of channels of movement and sources of livelihood.

Ethnicity is significant here as *mestizos* emphasized community-meeting places, indigenous people paid more attention to natural resource features, roads, and community-meeting places (two-sided significance $P=0.058$). A noteworthy, though not significant, effect of occupation is that subsistence farmers emphasize roads whereas day laborers emphasize community-meeting places.

Ethnoecological Test of Modelers' Derived Rules

Land use change scenarios and change rules generated in AND 07 for the Nanegal area through a robust modeling exercise were tested against local perceptions during June and August 2000. Using ethnoecological methods, generate local people's envisioning by presenting the scientists' scenarios and rules in culturally acceptable ways (story or folk tale completion, photo-interpretation, and informal interviews) in order to elicit the local understanding of natural resource change. In the Palmitopamba test site, local folk tales about legendary figures were presented in terms of story completion that took the respondent 30 years into the past and encouraged him or her to envision changes in the forest, pasture, the cropland, the chaparral, and the people's priorities in land use change. The Spanish version of these stories were pre-tested on two respondents (male and female) and later given to 15 individuals (equally divided between male and female). The stories were recorded and later analyzed according to dominant themes, trends, and patterns emphasized by the local people.

Although the data is still being analyzed and is quite rich in detail, we can conclude that modelers tend to concentrate on factors that are easier to quantify (such as distance from road) whereas local people tend to concentrate on factors that are important to them, e.g. community and work. The connection between people and land transformation is implicit in the scientific model but explicit in indigenous frameworks. Scientists tend to compartmentalize while local people do this less often. The story completion tests revealed that local people have their own concept and time frame for ecological succession with chaparral occupying a

special nexus. Roads were prominent in the local framework, as these were the in the modeler's derived rules, but distance appeared to have more of a confounding rather than a direct role in land use conversion from the local point of view. Clearly, the focus of local people is on community progress (measured in loss of forest) whereas the scientific emphasis is on loss of forest (obviously in a negative sense) due to developments such as road building. Ethnoecological research using local folktales to capture people's interpretation of the environment is more advanced in Cotacachi. Fifty local folk tales, myths, and legends have been taped, transcribed, and translated into Spanish and Quichua. These are available in hard copy draft and stored in the SANREM-Andes training node in Cotacachi and at the University of Georgia.

Biodiversity and Memory Banking

In response to the priorities of both local people and the USAID-Ecuador office, one major thrust is to help buffer-zone communities recover and maintain their traditional varieties of food and medicinal crops. Using a method called "memory banking," the project links cultural knowledge with planting materials (especially seeds) and then looks for culturally acceptable ways to stimulate conservation of both. This past six months, 10 students (ages 9-12) in Nanegal, and 15 high school students (ages 13-15) and 15 young scholarship students or *becarios* (ages 6-10) in Cotacachi were trained to document the knowledge of their elders. Three *in situ* gene banks were established (Palmitopamba Elementary School, Ulpiano de la Torre High School, and Jamric Mascaric). Herbarium specimens were also preserved in the schools. Seed samples were collected and some were planted in school gardens while remaining portions were kept in Jambi Mascaric. A total of 32 seed specimens were collected and conserved. The Mayor of Cotacachi and his wife (a very influential woman in the Canton) have requested that the two UNORCAC facilitators working for SANREM provide training to the community at large on memory banking so that more local youth can participate. This latter part is independently funded of SANREM.

Results and Outcomes

- ▶ 48 cognitive maps analyzed and results integrated into future visioning method; Gender demonstrated to be most important shaping force in environmental perception
- ▶ Working Document completed on "future visioning methodology" (WD Andes SANREM 2000-1)
- ▶ Landscape change rules from modeling of Nanegal landscape tested through story completion in Palmitopamba community and differences

- ▶ between local and scientific perspective highlighted
- ▶ International Symposium on genetic resource use and indigenous rights organized at International Congress on Ethnobiology; joint authored paper completed.
- ▶ Fifty environmentally relevant folktales revealing how Cotacachinos perceive their environment collected, analyzed, and stored for land use planning in Cotacachi
- ▶ Forty students trained in memory banking methodology; three *in situ* gardens established; memory banking method adopted by the International Potato Center (CIP) for peri-urban garden research
- ▶ Biodiversity and memory banking research integrated into "Farm of the Ancestral Futures," an ecotourism and conservation initiative by the UNORCAC communities for income enhancement, conservation, and cultural enrichment.
- ▶ Ph.D. dissertation research on women, development, and biodiversity management completed; graduation expected in December, 2001 (Maricel Piniero, national of the Philippines)

Impacts

- ▶ Continued widespread regional and international adoption of the memory banking protocol. Mayor of Cotacachi using SANREM researchers to diffuse method in the canton; CIP using in its international program, and bilingual education collaborators in Cotacachi are promoting the folktale book products with the Ministry of Culture and Education; US equivalent in the form of Southern Seed Legacy becomes more entrenched and self-sustaining as it is transformed from a USDA funded research project to a membership sustained non-profit organization.
- ▶ Future visioning methodology, including adaptation of the TATs method, also applied in Oglethorpe County, Broad Rivers Watershed, by a graduate seminar (see AND 07)
- ▶ Institutional strengthening of Jamric Mascaric, a subunit of UNORCAC, through collaboration with Magedelana Fueres (Vice President of UNORCAC) who is promoting a very strong gender component in her development efforts.

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SANREM CRSP

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Collaborative Research Support Program
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Integrated Institutional Management:

Social Capital, Institutional Capacity and Environmental Capital in the Andes

Introduction

Institutional decisions that impact sustainable agriculture and natural resource management are often at cross-purposes, leading to environmental degradation, increasing social inequality and poverty. That situation is particularly true in indigenous areas of the Andes, including the selected sites of Cotacachi, Ecuador, and Quilcas, Peru. Decisions made by farmers and local institutions — the municipality and the indigenous community organization — are influenced by their desired future conditions for agricultural and natural resources and by decisions made by a variety of institutions — economic, governmental, and civil society — that enhance or limit local options. These institutions are local, municipal, provincial, national and international. As coalitions are made across sectors and across levels where there are similar desired futures and similar causal models, more sustainable development will take place.

Analysis of the desired futures and mental causal models of actors in different sectors and levels — from local to international — and the evidence they use to make decisions regarding the degree to which the present situation will result in desired future states, shows that local actors can form advocacy coalitions to influence decisions at the relevant institutional levels. Participatory techniques for identifying actual and potential advocacy coalitions and gathering data about the desired future conditions and rules of evidence of potential partners in an advocacy coalition empowers local groups to achieve more sustainable agriculture and natural resource management.

Objectives

1. Identify and analyze Sustainable Natural Resource Management (SNRM) issues and decision points within local regional, national and international context.
2. Develop Decision Support tools for encouraging sustainable natural resource management (SNRM) that are appropriate for different institutional levels and different institutional actors.
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.

Methods and Approach

The following efforts contribute towards objective 1:

Cotacachi, Ecuador

- ▶ Seven additional focus groups included in the study
- ▶ Conducted eight additional institutional interviews (19 conducted previous year)
- ▶ Coded all data for analysis
- ▶ Initiated text analysis
- ▶ Wrote and presented three papers for International Farming Systems Association meeting in Chile (Nov. 27 to 29, 2000)
- ▶ Submitted two papers on advocacy coalitions for publication
- ▶ Presented study results to UNORCAC.
- ▶ Linked results of the international interviews to national and local levels.
- ▶ Presented the advocacy coalition approach to Ecuadorian NGOs in an invitational workshop.

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Peru

- ▶ Team of NGO and community members completed nine institutional interviews
- ▶ Interviews coded using text analysis software (coding at Iowa State University)
- ▶ María Fernández (Grupo Yanapai and National Agrarian University at La Molina) spent 6 weeks at Iowa State University as a Visiting Scholar
- ▶ Submitted six proposals or pre-proposals to various funding agencies for continuation of natural resource management work in Quilcas highlands
- ▶ Developed four short pre-proposals for cooperation between Iowa State University in areas of sustainable agriculture, distance education, undergraduate exchanges and farmer exchanges.
- ▶ Arranged for three Peruvians to attend SANREM External Evaluation Panel meeting in Ecuador and to exchange knowledge with Ecuadoran collaborators
- ▶ Discussed funding for National Agrarian University at La Molina -Iowa State University collaboration with Iowa State University Foundation personnel
- ▶ Worked on four papers with Edith Fernández-Baca, Cornelia Flora and Jan Flora
- ▶ Visit to Iowa State University of Ing. Hugo Nava, Vice-Rector for Academic Affairs, National Agrarian University at La Molina, Peru from October 30 to Nov. 1, 2000. Signed a Memorandum of Agreement with the College of Agriculture at Iowa State University, and more importantly carried on discussions of specifics of future collaboration.
- ▶ Led visit of ISU sustainable agriculture faculty to Peru in order to begin collaborative research, in conjunction with La Molina and Grupo Yanapai (ISU-supported)
- ▶ Results of the participatory studies of advocacy coalitions and land use changes presented to community assemblies.

The decision support tool development referred to in objective 2 will be the main activities of Years 4 and 5, and is closely linked to the future scenario methodology. It will involve bringing together the various components of SANREM's Andean regional effort in order to conduct the future scenarios. In the meantime, we have progressed in developing ancillary decision support tools, to wit:

- ▶ We have refined a planning approach that incorporates analysis of diagnostic reports carried out by others. UNORCAC, the Union of Peasant Organizations of Cotacachi, was used as a pilot effort. Some half-dozen evaluation reports were synthesized with feedback offered to the organization. A publication in Spanish resulted

from the effort and was distributed to UNORCAC and other organizations and agencies in the region. Informal feedback has been offered to UNORCAC leaders individually and formal presentation of the results will be made at an appropriate time.

- ▶ A similar exercise was carried out with several Regional Rural Sustainability Partnerships, which are based on agroecological zones of Minnesota and funded by the Minnesota Legislature. In these cases, we took previous visioning efforts they had carried out, divided their proposed efforts into activities, outputs, and outcomes. Then step-by-step, we helped their steering committees move from outcomes (desired future states) to outputs (intermediate goals) and then to activities that needed to be undertaken to achieve, first, outputs, and ultimately, outcomes, encouraging them to modify outputs and activities that were inconsistent with the desired futures they had set for themselves.
- ▶ We collaborated with Tom Carroll and Tony Bebbington on the measurement and analysis of social capital and organizational capacity for peasant secondary-level organizations (SLOs). Most of the analysis involved four SLOs in Ecuador. , Once we write up that work, a simplified instrument can be developed that SLOs can use as a self-diagnosis tool. (The initial instrument was very long and laborious; factor analysis and regression techniques should allow us to pare the variables down.)
- ▶ We have completed the interviews for three decision nodes or issues in Ecuador — water quantity and quality, bio-reserve management, and the question of whether there will be large-scale mining in Intag (the semi-tropical part of Cotacachi canton). Analysis of the interviews, focus groups and documents is completed for Ecuador, allowing the team to begin discourse analysis.
- ▶ In Peru, the initial interview process is complete for the municipality of Quilcas, near Huancayo in the Mantaro Valley. Some dozen interviews have been carried out with the participation of community members from the Colpar Annex or rural neighborhood; persons from other parts of the municipality may be involved later on. As a result of implementing the advocacy coalition approach, agreement has been reached on boundaries among neighborhoods and communities in the municipality, which is an important prerequisite for future collaborative efforts. In fact, the project convinced the community of Quilcas to join a coalition concerned about mining on communal properties. When a mining executive failed to show up for a meeting with the coalition, they called upon the “people’s advocate” (government ombudsman), with whom

they made initial contact in one of their advocacy coalition interviews. His gentle pressure was enough to assure that the mining executive kept a second appointment with the anti-mining coalition, which has generated discussions between the two sides about their differing interests.

- ▶ The Andean Institutions group (in collaboration with the Centro de Datos para la Conservación, a SANREM institution from Phase I) has conducted analysis that links land use changes based on remote sensing data and a census of small holders to social capital and organizational capacity for the four communities near Nanegal, the site for SANREM's Phase I. Bob Rhoades is incorporating the community-level changes in land use into the pilot phase in which the future scenarios approach is being tested.

The institutional group is examining advocacy coalitions related to water use in the highlands of Cotacachi. Control and use of water is closely linked to land use issues. We believe that the advocacy coalition approach will be relevant to policy development in this area and should dovetail with Auburn's work on water monitoring and with the land use-erosion work being carried out by the University of Georgia.

As part of our progress toward objective 3, the three teams? have set a date to work together in Peru in July to develop a workbook for community organizations and NGOs on implementing the advocacy coalition methodology. Training in decision support analysis has been initiated. The involvement of community people in the advocacy coalition research involves on-the-job training.

Results and Outcomes

Groups are now meeting around the three issues identified in Cotacachi, based on the analysis of the written materials and key informant interviews. The results are being used to form alternative advocacy coalitions, particularly around water and management of the bio-reserve.

Outcomes have been achieved through the research process. Interviews and focus groups have provided a space for reflection on controversial issues. As a result, the different advocacy coalitions around management of the bio-reserve have asked our Ecuadorian colleagues to facilitate a focus group between the two coalitions, based on the analysis of the desired future conditions, mental causal models, and rules of evidence present in each coalition. In Peru, the local community is using the results of the participatory research on advocacy coalitions to stop the degradation of pastureland.

Many of the institutional actors interviewed found that the interview questions and the focus groups based on the advocacy coalitions identified through

the focus groups increased their understanding of the importance of shared desired future conditions and mental causal models of how to get there.

We have used this methodology in work that we are doing with funding from the U.S. Environmental Protection Agency (EPA) and also with collaborations for IATP (Institute for Agriculture and Trade Policy) and the Land Stewardship Project in Minnesota in two different watersheds. The methodology has been helpful for generating the basis for creating alternative future scenarios and for developing policies that help achieve the more desired future conditions.

Methodologies for issue identification and data gathering are clearly specified. The research approach has shifted from an expert-led model to a participatory research model, which is serving as the basis for a workbook aimed at community-based groups and NGOs.

Impacts

Negotiations for alternatives to mining are underway in Cotacachi in order to create a more sustainable agriculture and natural resource base. In communities in the Montaro Valley, the formation of advocacy coalitions around pasture sustainability has resulted in inter-community coalitions addressing the issue.

Due to implementing the participatory advocacy coalition methodology in Peru, in combination with a participatory study on changing land use, agreement has been reached on boundaries among neighborhoods and communities in the municipality, an important prerequisite for future collaborative efforts.

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Other Issues

We are now at the stage where all the projects in the Andean team are doing a lot of writing. We need to feel freer to exchange drafts. Perhaps posting them on the secured portion of the SANREM-Andes web page would be a good way of increasing that exchange. The project management techniques that we use require constant writing of papers to share results.



Water Resources and Environmental Education in Two Andean Watersheds

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Introduction

A global water crisis is growing, with indications that much of the world's population does not have access to good quality water. At SANREM research sites in Ecuador, public health and safety of drinking water are issues of concern to community members. Most public water supply systems depend upon conveyance of mountain spring water to community taps or homes, with intermittent or no treatment. As a result, communities have reported increasing incidence of waterborne diseases. Negative changes in water quality and quantity are perceived to have occurred in the last few decades. This rapid rate of change is cause for alarm among communities.

Many changes in water quality and quantity result from increasing population and problems of waste disposal. Inadequate wastewater treatment and land-use changes also are affecting water quality. Pesticide use on agricultural and horticultural crops with the appearance of these chemicals in public water supplies is another concern for local residents and researchers. Mining activities near Cotacachi threaten water quality and integrity of the watershed by altering stream flows and contaminating surface waters with metals and acid. Other industrial activities are introducing toxins to water.

Lack of understanding of biophysical alterations of water is as much a problem as contamination itself. Public awareness and participation in the process of environmental management is required for lasting, positive impact. This activity emphasizes the need for public education and involvement in water resource management in order to find solutions for

environmental problems and optimize livelihood activities and environmental quality.

Objectives

1. Provide technical support to citizen monitoring groups for collection of data on water quantity and quality at Nanegal (phase out after this year) and Cotacachi sites.

- ▶ Bacteriological monitoring: This component has highest priority in participating communities, and will continue on a quarterly basis.

- ▶ Water chemistry monitoring: Sites will be identified for monthly monitoring of chemical parameters.

- ▶ Stream discharge and total suspended solids: These parameters are low priorities in participating communities, but may be initiated where there are opportunities.

- ▶ Develop a quality assurance protocol: A Spanish language manual will be prepared, including formats for collection of data.

- ▶ Continue to improve water quality database: Work with community monitoring organizations to improve database management, and develop protocols for sharing the data with other SANREM activities.

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

- ▶ Conduct two joint workshops with local leaders and institutions on technical aspects of water quality monitoring.

- ▶ Conduct one training-of-trainer workshop for experienced monitors to become trainers of other community members.

- ▶ Conduct one workshop in Ecuador for potential participants from other Andean countries.

► Work with local institutions to support community monitors.

3. Assist Andean project leader with project coordination by assigning Auburn graduate student at 0.5 FTE.

4. Write monograph, including the Andean Experience, on developing community capacity for bacteriological assessment of water, and protection and restoration of aquatic resources.

Methods

Methods used in Ecuador (as in the Philippines) are modeled after those developed for Alabama Water Watch, a citizen, water quality monitoring program in the U.S. Sampling sites are identified according to local needs and physical-chemical monitoring is conducted monthly. Six chemical parameters are tested using a specially designed LaMotte field test kit. Tests are based on colorimetric techniques allowing ordinary citizens to measure, with credible accuracy, air and water temperatures, pH, hardness, alkalinity, dissolved oxygen and turbidity. Water quality and quantity data are analyzed, summarized and presented in appropriate formats for use by citizen groups, educators and local decision-makers. The data is made available to other Andean SANREM researchers for incorporation into models and for generating future scenarios.

Bacteriological monitoring of surface water and water for human consumption in participating communities is conducted quarterly. The Coliscan Easygel method for coliform and fecal coliform testing is used, as approved for Alabama Water Watch by the U.S. Environmental Protection Agency. It is a new technique for quantifying *E.coli* and other coliform bacteria. No incubators, sterilizers or glassware are needed for this technique and supplies (about \$1.50 per test) are easily transported. Test results are reported to the community.

Strengthening institutional partnerships and linkages was done through joint activities, including training, workshops, technical support, and database development.

Results

Auburn University personnel completed five trips to the Andean Region. Sergio S. Ruiz-Córdova visited Ecuador and Peru. Drinking water systems of several communities received physical, chemical and bacteriological tests. Mr. Ruiz Cordova conducted four bacteriological surveys of surface and drinking water with members of UNORCAC communities in Cotacachi Canton. Sampling was conducted with the help of technicians Horacio Narváez and Nicolas Gomez.

Almost 1700 bacterial tests were done from 187 sites in 46 communities affiliated with UNORCAC in Canton Cotacachi, and the cities of Imantag, Quiroga and Cotacachi. Testing of 152 sites indicated the presence of coliforms, 88 with *E. coli*. Coliform counts ranged from 1 to 100,000 per 100 mL, far above safe levels. Analyses of water from 35 sites indicated no coliforms, including the cities of Quiroga and Cotacachi. Two hundred and seventy records of physical-chemical data from 83 sites were collected from June 2000 to May 2001. Forty-three percent of these records come from streams, 24 percent from springs, 13 percent from irrigation canals and 20 percent from reservoirs, Lake Cuicocha and other surface sources. Most physical-chemical analyses were within desired limits. Bacterial and physical-chemical data were entered into the computer database at PUCE-Q and the SANREM computer at Jambi Mascaric in Cotacachi.

Two certification Workshops on Water Quality Monitoring were conducted: one in Ecuador and one in Peru, with participation of 27 volunteers. Environmental education presentations were conducted at elementary schools in UNORCAC communities.

Results of physical-chemical testing in Peru were comparable to those found naturally, with the exception of the watering canal. Alkalinity and hardness were high, validating local suspicions about contamination. Canal water is taken from the river that carries sewage from a mining operation upstream. Locals from Quilcas have concerns about the kind of contamination in this canal that irrigates most of the valley. Yanapai Group leaders asked for testing for heavy metal pollutants. In Ancash, members of Water Forever Project are starting water monitoring across the Quebrada Honda watershed. Intensive mining activity has prompted local concern about pollutants going into streams and into their agricultural fields.

Substantial progress has been made developing a Global Water Quality database that will link Ecuador, Philippines, Alabama Water Watch, and other developing community-based water quality monitoring projects.

Sr. Cornelio Orbes, UNORCAC president, traveled to the U.S. in October 2000 accompanied by Sr. Ruiz-Cordova. He visited Alabama Water Watch headquarters at Auburn University, field sites, citizen monitoring groups and a monitor training session. Sr. Ruiz-Cordova also accompanied Sr. Orbes to the Inter-American Foundation headquarters to negotiate funding for UNORCAC.

A Spanish-language quality assurance protocol manual, and a monograph on developing community capacity for bacteriological assessment of water, and protection and restoration of aquatic resources, are scheduled for completion in year 4.

Impacts

- ▶ Bacteriological 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
- ▶ The SANREM water quality activity has influenced decision making of community leaders in Cotacachi. Their stance on water quality issues was a positive factor in the election of several UNORCAC members as municipal leaders in their communities.
- ▶ Conflict over water resources has moderated as knowledge about water quality issues and interest in citizen monitoring has increased in municipal and indigenous organizations in Cotacachi.
- ▶ SANREM personnel doing water quality monitoring in communities have introduced people and communities to water resources management. With leadership of Sr. Nicolas Gomez, sixteen new monitors, including eleven women, were recruited, trained and certified this year.
- ▶ UNORCAC communities in the Intag River Watershed (outside of Canton Cotacachi) have expressed interest and have requested training and assistance in establishing water-monitoring groups.
- ▶ SANREM collaborators have been asked to participate in the search for water supplies for new irrigation systems to benefit communities in the high altitude areas of Cotacachi.
- ▶ Water monitoring data from the communities of El Batan and Turuco in 1998 and 1999 showed coliform contamination. Community members were shocked by comparisons of their drinking water with bottled water and drinking water from other communities. As a result they made improvements in their systems. Monitoring conducted between June 2000 and May 2001 showed that coliforms were either not present or significantly reduced.

Visits to Peru established possibilities for water monitoring activities in Quilcas and Ancash where water quality is affected by mining. Some monitoring is being done in Ancash by the Water Forever Project. Side-by-side testing of their techniques with SANREM's improved techniques have moved Water Forever Project to adopt the SANREM water testing kit. They have requested cooperation with SANREM to assist them to find easy-to-use and inexpensive tests for pollutants not routinely tested for by SANREM.

¹ Cotacachi and Quiroga are cities not included among the 43 affiliated to UNORCAC.

² Cfu = colony forming units.



Sustainable Mountain Futures

Linking People and Information for Effective Landscape Decision Making in the Andes

Introduction

Since mountain ecosystems achieved Agenda 21 chapter status at the Earth Summit in 1992, there has been an explosion of interest and activity on the part of international agencies, national organizations, and NGOs in the development of multiple use, multi-stakeholder, and multi-scale (e.g., catchments, landscape, watersheds, river basins) research, management tools, methodologies, and information processes. While it is assumed that effective decision-making for sustainability can be improved through a participatory linking of primary stakeholder groups with scientists and their products (research, information, technologies), the reality is that all too often there is a discrepancy between local stakeholder realities (needs, perceptions, experiences, time and space frames, and capabilities) vis-à-vis those of scientists and planners. The purpose of this project is to develop an interdisciplinary future visioning methodology that involves both basic and applied research inspired by a growing literature on the ecoregional approach to sustainability. The methodology is useful wherever scientists and local people wish to combine their respective knowledge and expertise to explore alternatives.

Objectives

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)
2. Test and refine the participatory future scenario modeling exercise with a hierarchy of decision-makers (internal and external)

connected with the landscape around Cotacachi and Nanegal.

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

Methods or Approach

- ▶ Identify multiple decision-makers' (internal/external) scales, objectives, and record their diverse (and often conflicting) visions of derived future conditions, emphasizing land-use change, water quality, and biodiversity as impacted by landscape system drivers of economics, institutions, and culture.
- ▶ Utilize extant simulation models and other modern and traditional decision support tools (GIS, maps, remote sensing, indigenous mapping, etc.) to create *in situ* scenarios of future conditions based on both quantifiable and qualitative variables (80 to 100 year time span). Both scientific and indigenous conceptions and values are incorporated.
- ▶ Present the alternative scenarios and future visions in various media forms (visual, oral, written) as an interactive, user-friendly platform for stakeholder debate, priority setting, planning, policy and technology generation.
- ▶ Create databases that remain with partner communities but are linked outward whenever possible to other testing sites through the Internet;
- ▶ Collaborate with a tropical mountain network aimed at co-testing and adapting this methodology of facilitating fit between science and local knowledge;
- ▶ Disseminate relevant decision support tools, methodologies, and lessons learned through training, publications, and teaching to other mountainous areas and projects.

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Results and Discussion

Objective 1

A combined data-visual database has been set up in the Sustainable Human Ecosystems Laboratory, in Quito at the Catholic University, and in Cotacachi, Ecuador. This database currently includes GIS-based soil, topographic, and political boundary maps of the Cotacachi Canton — linked to general socio-economic government data. Hernan Valasquez (Ministry of Agriculture) has completed initial interpretation of 1963, 1978, and 1998 satellite Landsat images. This information will link with the multi-temporal analysis (30 year period) of land-use change, a key process in future scenarios. Ten Transects by Marcia and 4 students from Catholic University added data on current plant and animal biodiversity which, in turn, can be compared to benchmark data she collected 10 years ago from the nearby Laguna de Cuicocha in the Cotacachi Cayapas Reserve.

EPIC and USLE are two biophysical models for erosion and the effects of land-use being run by members of the soils team (AND 08) and the future visioning team (AND 07). Two meteorological stations were moved to Cotacachi communities Morochos and Topo Grande and installed. Aurelio Vicuña (PUCE-Quito) has collected data on production strategies in three specific sites in the SANREM study area in Cotacachi as a part of this thesis that involves development of the USLE model. Calibration of this model will take place during the coming months (January-May, 2000). Mika Cohen (UGA) has collected field data on land use in irrigated versus non-irrigated areas and in high versus low altitude communities (8 communities). Along with agricultural production in these areas, she has also collected accompanying information on demographics (household size and migration patterns) and on local perceptions and beliefs regarding hydraulic resources in the area. Finally, a database has been created and pre-tested in FoxPro that will link UNORCAC (44 communities with a population of 20,000) census information at the community level with the digital maps.

For the Nanegal site, a full synthesis book, covering 18 chapters, of all SANREM work to date has been published in Spanish by Abya Yala Press. Three hundred copies will be marketed by the press in Quito and the SANREM project will have 200 copies to distribute to authors, donors, communities, libraries, reviewers and other interested persons.

Objective 2

The “future visioning” protocol described above has been tested in two settings over past six months: Nanegal (Palmitopamba) and the Broad River watershed, Oglethorpe County, Georgia. Based on the

modeling exercise mentioned above, maps reflecting land-use in 1966, 1990, and 2104 were carried in August to Palmitopamba, one of the 4 Nanegal communities studies by SANREM. These images became part of a complex of 17 different landscape images (e.g., topographic, hillside, aerial photo, 3-D diorama, etc.) for eliciting people’s mental causal model rules for land-use change (see SANREM Andes Working Document 2000-3). Each image was examined by different stakeholders in terms of perception of scale, theme, perspective, relief, purpose, costs, geo-referenceability, understandability. During August 2000, the ethnoecology team also “tested” the modelers rules (deforestation and road building) against local perceptions and values (see AND 02 for more details).

In response to the Board of County Commissioners and the Planning Commission for Oglethorpe County, Georgia, a graduate seminar under the direction of Robert Rhoades carried out a study of “desired future conditions” for the county. As in the SANREM Ecuador effort, this study is considered pioneering and preliminary. The seminar devised a new research protocol combined the strengths of Thematic Apperception Tests (TATs) and Visual Preference Surveys (VPS). The final test asked people to pile sort, rank, and carry out a proximity test with a series of photographs representative of development in the county. This technique was shown to be useful in determining people’s values about the future as well as some conflict in choices. To supplement this research, a phone survey (randomized phone number selection within census block tracts) on 266 individuals (approximately 8% of the population) was carried out. This information has been prepared in a report (Sustainable Human Ecosystems Laboratory 2000) and presented to the local newspaper, the Planning Commission, and the Board of Commissioners.

Objective 3

Although extrapolation of the future scenario work is not to begin until year 3 of Phase II, some activity in that direction has started. First, a \$5000 contract has been developed with a Peruvian NGO (Yanapai) to carry out a duplicate land-use and future scenarios project in the community of Quilcas, Mantaro Valley, Junin, Peru. This work is just underway, although the Yanapai team participated in the EEP evaluation in Ecuador. Second, discussions have opened with the Mountain Forum and Dr. Jane Pratt, CEO of the Mountain Institute in West Virginia to share methods and ideas about this kind of methodology for mountainous communities in Asia, Africa, Latin America, and North America.

To encourage more local participation in the SANREM-Andes project in Cotacachi, the team has designed a local initiative called “Finca de los Futuros Ancestrales” (Farm of the Ancestral Futures). This grows from an expressed local demand that they wish

to recover passing traditions and crops, as well as link these traditions to future survival. This project is highly inter-sectoral involving UNORCAC, Catholic U.-Ibarra, CIP, CISP-Heifer, Fundacion Interamericana, and others. Beginning in June 2000, research began on the concept of an “Ancestral Future Farm” as an entry into communities and as a mechanism to revolutionize agriculture extension in the area. Three students from Catholic-Ibarra under Kaia Ambrose (extension specialist) are writing their undergraduate thesis on sustainable agriculture, emphasizing the lost cultivars of the region. Simultaneously, a number of controlled agronomic experiments were undertaken in three ecological zones to better understand how local varieties would do after extensive periods of high external input agriculture. The “Granja Integral” (Integrated Farm) of Catholic-Ibarra — a conventional extension farm — has been re-designed under this experience. Three field days were conducted involving local farmers and information was distributed regarding organic quinoa (a traditional Andean crop) growing and marketing. Five Cotacachi “leader” farmers also were taken to a CIP field day on alternative and organic methods for potato cultivation.

Results and Outcomes

- ▶ Database and knowledge base established at three nodes (UGA, Quito, and Cotacachi)
- ▶ Spatial analysis materials gathered and initial multi-temporal analysis complete (40 years)
- ▶ Biodiversity transects and analysis for Cotacachi zone advanced
- ▶ USLE model data collected and linked with EPIC modeling efforts of AND 08.
- ▶ Initial field research completed on socioeconomic of irrigation and potable water systems of Cotacachi
- ▶ Database and protocol created and pre-tested in FoxPro for participatory census of Cotacachi
- ▶ Synthesis of all Nanegal research to date published in 2000 in Spanish (“Tendiendo puentes entre paisajes humanos y ecologicos” by Abya-Yala Press: Quito). Presented to communities in December 2000.
- ▶ Final editing of publication of “*Flora y Vegetacion de la Laguna de Cuicocha*” by Marcia Peñafiel completed; book to appear in January 2001, also by Abya Yala Press.
- ▶ Land-use model and future scenarios developed for Nanegal (maps and photo-interpretation) along with “landscape change rules”.
- ▶ 17 images of the landscape analyzed and compared by different stakeholder groups
- ▶ Future visioning protocol tested in Broad River Watershed, Georgia, and information fed into land-use planning commission of the county.
- ▶ Background research and experimental plots for a “Farm of the Ancestral Futures” conducted in

conjunction with Catholic University-Ibarra

- ▶ Twelve Ecuadorian students trained and three local technicians trained

Impacts

- ▶ Capacity building for the study and management of natural resources in Ecuadorian universities, NGOs, government, and indigenous organizations
- ▶ Input into the first land-use zoning laws of Oglethorpe County, Ga.
- ▶ Publication of first interdisciplinary study of a landscape in Ecuador
- ▶ Training in research skills at university and local level in Ecuador

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- Chapter 2: *Alexandra Martínez y Robert E. Rhoades*. La historia medioambiental del área de Nanegal durante los primeros cincuenta años del siglo XX. Pp. 55-69.
- Chapter 4: *Alexandra Martínez, Robert E. y Eric C. Jones*. Rhoades Migración y el paisaje de Nanegal. Pp 71-103.
- Chapter 18: *Robert E. Rhoades y Galo Ramón Valarezo*. Reflexiones y pautas para la investigación del desarrollo sustentable. Pp. 395-416.
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Scenarios of Land Use Change in Palmitopamba: 1950-2030



1956



2000



2030: Future Scenario I



2030: Future Scenario II



SANREM CRSP

Sustainable Agriculture and Natural Resource Management
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Effects of Land Use Change on Long-Term Soil Fertility, Crop Productivity and Water Quality in Cotacachi

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Introduction

Cotacachi is a unique region in the temperate inter-Andean valley of northern Ecuador at an elevation of above 2,500 m.a.s.l. just north of the equator. Indigenous populations have lived in this area for thousands of years and have employed farming practices well suited to the climate and topography of the region during much of that time. Spanish colonization and suppression of the old social order produced changes in the agricultural context, and with the recent breakup of the hacienda system, new problems of soil erosion and declining soil fertility have emerged.

In Ecuador, many local indigenous organizations are accepting responsibility for managing their own natural resources. UNORCAC is the organization through which indigenous farmers in the Cotacachi region have expressed their concerns about decreasing productivity of their soils and their desire for a clean, reliable water supply. Over the past years, SANREM-Andes has developed a good working relationship with UNORCAC. The SANREM research initiatives have focused on ethnoecology and water quality and started last year with a new activity (AND-08) to specifically address the issues of soil fertility and erosion.

Objectives

1. Select a representative first-order watershed to which the model developed in this activity will be implemented
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)

3. Scale up the field-scale modeling outputs to the watershed level using raster GIS
4. Route sediment and runoff through the landscape and evaluate nutrient export and water quality changes
5. Show local people how to interpret and use the model results as a decision support tool

Activities and Methods

Objective 1

Various first-order watersheds within the Cotacachi area were visited during Summer 2000. The specific topography of the study area – streams deeply incised 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 km²; 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

General model input parameters, such as topographic information, elevations, field sizes, etc. were collected during Summer 2000.

Historical weather data from existing weather stations in Cotacachi, Otavalo, and Ibarra, were collected. To obtain more site-specific data including rainfall intensities

and to assess climatic variabilities within the study area, two *Campbell Scientific* weather stations were installed in the communities of Morochos and Topo Grande, and a participatory weather monitoring activity was initiated in nine communities around the Cotacachi volcano, with nine rain gauges and three thermometers installed at the homes of participants, who have been recording rainfall as well as minimum and maximum air temperature on a daily basis.

In cooperation with Dr. Larry West, major soil types within the study area were identified and example soil profiles were described. Soils were sampled according to genetic horizons from cultivated fields, pastures, and forests throughout the study area, equally representing the different parent materials, climatic zones, and land management strategies encountered. All sampling sites were geo-referenced, and the specific land management history was recorded. In addition, detailed grid sampling was conducted prior to establishing field plots for model validation in three fields in Morochos, Chilcapamba, and Iltaquí, and terraced and un-terraced fields in Iltaquí and Topo Grande were sampled in detail to analyze soil differences due to the effects of terraces in retaining soil against erosion. In total, about 400 soil samples were taken throughout the study area. Basic parameters, such as pH, electrolytic conductivity, and saturated hydraulic conductivity, were measured in-country during the summer months of 2000. One hundred soil samples were analyzed for routine fertility parameters by a soil laboratory in Quito and 300 soil samples were shipped back to the Department of Crop and Soil Sciences at the University of Georgia (UGA), where further analyses are being conducted. These include particle size distribution, plant available water, organic carbon, nitrogen, and phosphorus, labile phosphorus, cation exchange capacity, base saturation, phosphorus sorption ratio, as well as soil mineralogical parameters.

In cooperation with Brian Campbell (Ph.D. student of Dr. Robert Rhoades), farmer surveys were conducted to document cropping practices and rotations used in the study area.

A rainfall simulator borrowed from the Engineering faculty at the Escuela Politécnica Nacional in Quito is being used during Summer 2001 to measure erosion from a variety of soils within the study area. Erodibility factors thus determined are basic inputs for erosion models used to estimate soil and sediment loss from the watershed area under study.

In three communities (Morochos, Chilcapamba, and Iltaquí), plot experiments were conducted to assess factors limiting to crop growth. Various rates of chemical and organic fertilizers were applied to maize plants in these fields, resulting in 31 different fertility regimes at each site. The field experiments are being

harvested and analyzed in Summer 2001, and the EPIC model will be validated by comparing predicted with measured crop yields in these plots. Similar experiments are planned for the coming growing season to obtain further insight into limiting factors and to provide additional data for model validation.

First trial model runs have been conducted with EPIC using parameters thus far available. As the acquisition of input parameters are completed over the next months and the results of the validation plots become available, the model will be validated, and a various scenarios will be analyzed involving and use types (cropland, pasture, and forest) and a variety of land management practices, as well as soil types and slope gradients encountered in the study area.

Objective 3

During Summer 2000, complete soil descriptions were collected for representative soils in the Cotacachi area, and soil sampling was carried out in order to prepare a level two soil survey with mapping units relevant to both the Soil Taxonomy system and to local soil management schemes. Additional soil surveying is being conducted during Summer 2001, based on which existing soil maps will be refined.

Objective 4

GIS input coverages necessary to predict erosion and sediment transport with WaTEM (Water and Tillage Erosion Model) were generated over the past year. These include a digital elevation model (DEM), a land use map, and a soil erodibility map of the study area. In order to obtain higher resolution, these maps will be refined over the next year using photogrammetry and photo interpretation, as well as additional soil surveying.

In Summer 2000, sediment monitoring stations were installed at five locations in the Río Yanayacu, which are being monitored to validate the model outputs over the next two years.

Objective 5

Many contacts were made in local communities and the planned efforts were presented and discussed with community members individually and in community meetings.

Results and Discussion

Weather data

Average monthly rainfall and the corresponding standard deviation of 25 years from the Cotacachi station are presented in Table 1. The mean annual precipitation in the study area is about 1,350 mm. The climate is relatively mild with warm days and cool nights, and is characterized by an expressed seasonality with a dry season from June to August,

and 90 percent of the annual precipitation occurring from September to May. The relatively high standard deviations of the 25-year average monthly precipitations (Table 1) indicate high variability of rainfall from one year to another. The data show that draught is a potential hazard to crop growth, and that in dry years the availability of irrigation water may be crucial to agricultural production.

Soil data

An example profile description is given in Table 2. Formed on highly variable, fairly recent, sandy and silty volcanic deposits, the soils in the study area are relatively weakly developed. The recent deposits overlay an older, more developed surface, which may still play an agronomic role in areas where the recent soil has been eroded, as observed in Iltaquí and Topo Grande.

Physical and chemical characteristics of selected representative topsoil samples of the five communities are presented in Table 3.

The parent materials of the soils are andesitic and dacitic volcanic materials, resulting in soil pHs of around 6 and appreciable amounts of available cations. Water holding capacity is generally low; however, organic matter in surface soil accumulates with increasing altitude.

Depending on the location within the study area, various factors may be limiting to crop growth. The most obvious factor is the low water holding capacity of the sandy soils, which may cause water stress in dry years. At higher elevations, the slow decomposition of organic matter and therefore slow release of nutrients may cause deficiency of nitrogen and other plant nutrients. In areas with considerable amounts of amorphous volcanic minerals, high anion fixation may cause phosphorus deficiency. Mineralogical data indicate that in the study area such minerals are abundant only above 3,000 meters, thus affecting only the higher lying fields near the paramo. Further analyses will be conducted to specifically identify the limiting factors in the different zones and to study the processes involved.

Management data

Most of the interviewed farmers owned less than 2 ha of arable land and had no or very little livestock. Due to the lack of resources and the desire to produce organically, the use of chemical fertilizers and pesticides is rather uncommon. Manure application rates are generally low and many farmers don't fertilize their land at all for years. Depending on the size and location of fields, as well as on farmers' resources, the land is tilled by hand, with yoked oxen, or with a tractor. Due to the limited amount of land,

only half of the interviewed farmers include fallows in their crop rotations. Very few farmers have access to irrigation water.

Impacts

Since this activity has been initiated in Year 3 and has been in the phase of data collection during its first year, its impacts at the farm level and at the level of local governments and institutions are expected to be seen in subsequent years.



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

Introduction

The long-term impacts of SANREM-Andes will be found in the use of appropriate methodologies, case studies, and sustainable land use systems and technologies in mountainous or slope land regions of the world. In preparation for the eventual end to the SANREM-Andes project, it is necessary to create mechanisms and trained personnel who can carry forth in different contexts the lessons learned from SANREM in Phase I and Phase II. While significant information can be perpetuated by individuals (farmers or other stakeholders), a more long-lasting transfer occurs when the recipient is a well-established community or organization that represents the interests of stakeholders over the long-term.

The node is located strategically to the Cotacachi landscape, which includes small producers, large haciendas, agro-business, and a nature reserve, and will contain an information center, hands-on opportunity with projects in the area, and the case study information for instruction based on SANREM research. The node is the central point for training, workshops, evaluations, biodiversity fairs, women's events, and other activities of the project. The node is equipped with a computer, printers, scanner, cameras, recorders, map files, and field equipment. The node provides transportation, space, support services, telephone, fax, and other amenities for training and workshop activities of SANREM. All students and U.S.-based scientists coordinate with Magdalena Fueres for field facilitation and permits. Upscaling workshops and short courses will target trainees from other indigenous or peasant communities in the Andes, decision-makers from the NGO and state

organizations, and from institutions of the North.

The issue of scaling up or the extension of findings over a larger area (both spatially and hierarchically) needs to be addressed in a project like SANREM. How can the valuable lessons learned be transferred or extrapolated to other interested parties? In one way, SANREM-Andes is linking with the global mountain research and development community to transfer lessons learned. In addition, through the Iowa State project, case studies are being carried out in other Andean regions (e.g., Mantaro Valley of Peru). However, there is considerable advantage of bringing participants to a viable SANREM site where research has been ongoing, where information is available, the future scenario exercise has been carried out, and where other local stakeholders and communities can be a part of the transfer process.

Our partners at UNORCAC have expressed interest in this approach. One of the former leaders of UNORCAC, Segundo Arrango, is presently the Executive of PRODEPINE (Proyecto de Desarrollo de Los Pueblos Indigenos y Negros de Ecuador), a project representing a hundred communities in the Ecuadorian Andes as well as indigenous communities of the Amazon and Northwest coastal area. Within Ecuador alone, there is wide scope for transfer, but when expanded to other Andean regions (e.g., Peru, Bolivian, and Colombia), a wider net can be cast. The possibility for "Mountain-to-Mountain" exchanges will be enhanced if there is a node for training and institutional capacity building in the SANREM site.

Objectives

- ▶ Establish a training and up-scaling node within Jambi Mascaric

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

- ▶ Establish a functional data center at Jambi Mascaric 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.
- ▶ 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.

Methods or Approach

Since this is a training and outreach project and not a scientific project, the methods used are those of communication and capacity building. The type of training varies from individual on-site training (e.g., independent study students, graduate students) to interactive workshops to field participatory exercises. The local NGOs with special skills in training have been complementary to the scientific efforts of SANREM. The training on database management and computers at UNORCAC and Catholic University has been one-on-one capacity enhancement of individuals.

Results and Discussion

1. Agreement reached with to establish a training and scaling up center in Jambi Mascaric (UNORCAC) and computer, filing cabinet, and furniture acquired and installed;
2. All available data for Cotacachi entered in the computer and a "hard copy" filing system completed and inventoried;
3. Field support (e.g, transportation, Quichua translation, community contacts, prior studies) provided to all SANREM researcher;
4. Meeting venue to present SANREM research to communities and leaders for wider dissemination (at least 10 such meeting held in 2000);
5. Two indigenous leaders travelled to US to present SANREM research in international conference;
6. A women's biodiversity fair sponsored (with AND 02) in which 70 women participated;
7. Provided venue for the EEP review of the Andes program, including contact with Peruvian participants;
8. Magdalena Fueres (co-PI of this project) is a Canton Councilwoman and jointly with the Mayor have inputted SANREM ideas into environmental planning on issues such as co-management of the

Cotacachi-Cayapas Ecological Reserve, a watershed management plan, and many other activities in the area.

Impacts

Primary impact is the building of capacity within an indigenous development organization (UNORCAC).

Publications

- Campbell, B. 2000. Applied Historical Ecology in Cotacachi, Ecuador. Working Document 2000-4.
- Rhoades, R., E. Jones, and M. Cohen. 2000. Comparative Images of the Landscape. Working Document 2000-3.
- Rhoades, R., D. J. Stewart, V. Nazarea, and M. Piniero. 2000. The Sustainable Mountain Futures Methodology: An Ongoing Study of Visioning in Nanegal Parish. Working Document 2000-1. SANREM-Andes Program.
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SANREM West Africa

Project Overview

Introduction

The collaborative research program developed by the SANREM West Africa Project (SANREM-WA's) seeks to improve natural resource management (NRM) and conflict management practices in agro-pastoral systems in West Africa's arid and semi-arid regions. The program builds on lessons learned from the first phase of the SANREM CRSP and began Phase II with a new mandate, a new regional strategy and a new site in Mali located in Madiama Commune.

Madiama is located about 25 kilometers southeast of the historical city of Djenné. The climate is very dry, with an average annual rainfall that is low (482 mm in the years 1970-200) and falling (636 mm from 1950 to 69). On the other hand, the commune is located in the delta region of the Niger River, giving it the benefit of annual floods that make possible both a unique wetland pasture, called *bourgou*, and the cultivation of rice. Only a portion of the commune's area is flooded. Dryland crops such as sorghum and millet are crucial to the local diet and much of the pastureland is severely degraded.

Ten villages make up the commune. They are populated by a variety of ethnic groups that specialize in crop farming or herding to varying degrees. As population has increased and rainfall has declined, the pressure on resources has grown, threatening crop yields and livestock production and increasing the potential for conflict over resource use. In recent years, the Malian government has improved the ability of local populations to deal with these issues by decentralized decision making power. The commune itself is a new political unit and it is at this level that the SANREM-WA program has begun its work. From here, the results of the program will be scaled up and out.

The SANREM-WA program was developed following a Participatory Landscape-Lifescape Appraisal (PLLA) conducted in early 1999 with its collaborators. A key element of the program is the establishment of NRM Advisory Committees at the commune and village levels whose memberships are drawn from the local populations. Six activities make up the current program: WAF 01, coordination and management; WAF 05, a regional workshop on conflict and natural resource management; WAF 06, creation and support of NRM advisory committees; WAF 07 development of methods and tools for evaluation and decision making; WAF 08, farmers' decision making for

improved soil fertility management; and WAF 09, community decision making aids for improved pasture lands.

Project Objectives

Good progress is being made in all activity areas of SANREM WA. Although it is still early to assess project impact, the SANREM WA project is on track for achieving the following objectives during the expected life of project:

Objective 1

A multi-year database established for modeling the dynamic interactions between the local populations, their NRM technologies and practices at the enterprise or local government landscape/lifescape scale (Target: local, national, and regional researchers).

Progress Toward Objective 1

This past year biophysical data was collected on weather, main soil types, main crop varieties and existing crop management practices at 59 sites (32 sites for Years 2 with 3 and 27 additional sites during Year 3). Based on a soil survey and cartography, we produced a soil map at a scale of 1/40,000 showing the general geomorpho-pedology of the commune. An agro-climatic assessment of the commune has been completed that analyzes long-term rainfall variability and reliability as well as the length of growing period. A database for different management schemes, the weather, and the main soils and crops was created. Major land types and soil types have also been described and their distribution and areas determined.

Objective 2

Bio-physical and socio-economic models developed that provide cost-effective decision-maker aids for the local government assessment of potential NRM technologies and practices that may be applied at the enterprise or local government landscape/lifescape scale (Target: decision makers and researchers at all local levels).

Progress Toward Objective 2

Preliminary simulations are being tested for model calibration and sensitivity analysis for cowpea, sorghum, and millet but not rice. Integration of the CropSyst model with GIS programs is in process. These tools are being developed with Malian partners and

the necessary technical knowledge transferred to them. The economic viability of current and alternative crop and range practices is also being determined. Social Analysis Matrix (SAM) analyses have allowed for distributive effects to be taken into account to determine whether interventions are likely to exacerbate or diminish conflicts between the various occupational groups in the commune.

Objective 3

Participatory NRM model developed at the local (Commune) level in the context of West African decentralization and interacting and competing agricultural and pastoral systems (Target: local and national governments and researchers and NGOs).

Progress Toward Objective 3

NRMAC members have drafted their own by-laws and regulations necessary for official recognition, prepared an institutional development plan, and concluded an agreement with the Commune Council and Mayor to provide advice on communal natural resource management issues. They have also initiated discussion among villagers concerning improved management of *bourgou*, a wetland forage grass that is a valued but diminishing resource. The committee has also been reinforced with four additional women representatives, raising women's membership from 14 to 33 percent.

Objective 4

Local government capacity reinforced and local officials able to effectively manage their natural resources through the development of a prototype NRM plan at the Commune level (Target: local, national governments, NGOs).

Progress Toward Objective 4

Three training workshops in Holistic Management (HM) consensus building have been completed for local leaders, the Natural Resource Management Advisory Committee (NRMAC), and technical assistance providers in the Commune of Madiama. This year these groups began monitoring soil and pasture resources applying the Holistic Management model. Work on the development of the commune level NRM plan based on HM principles will begin next year.

Objective 5

Local capacity building through the identification and application of NRM conflict mitigation strategies (Target: local to regional GOs, NGOs, and communities).

Progress Toward Objective 5

Two training workshops in HM conflict prevention and mitigation strategies have been completed for local leaders and technical assistance providers. Committee

members have achieved improved inter-village communications over sensitive resource issues.

Objective 6

Information on NRM models, conflict management methods and associated decision-making tools disseminated throughout the West African Sahel (Target: national and regional researchers and the development community).

Progress Toward Objective 6

The SANREM CRSP-West Africa Annotated Bibliography is being augmented with additional research materials on NRM and conflict management in the West African Sahel and a Web page has been established that contains a Working Papers Series (in French and English) documenting project accomplishments. SANREM CRSP progress was reported at the Regional Workshop on Research in Sylvopastoralism in the Arid Zone of West Africa in Dakar.

Progress Toward Five-Year Indicators

To facilitate reporting and help focus our project, SANREM WA has adopted the practice of directly linking our project objectives to our Five-Year performance evaluation indicators (i.e. objective 1 is also performance indicator 1). The project is on track to achieve these impacts. The NRMAC model for participatory NRM is still in the early phases of its organizational development (Indicator 3). Nevertheless, the Committee has, made good progress toward developing its institutional capacity to plan and manage the Commune's natural resources (Indicator 4). Improved inter-village communication has been reported by NRMAC members (Indicator 5). Coordinating the interests of all stakeholders (both within and outside of the Commune) around the sustainable regeneration of a *bourgoutière*, or wetland pasture, is on the agenda for the next few months. The biophysical and socio-economic databases (Indicator 1) and models (Indicator 2) to inform natural resource management decision-making have been established and are in the process of refinement. Information on NRM models, conflict management methods and associated decision making tools are beginning to be disseminated (Indicator 6) are beginning to be disseminated (Indicator 6).

Benefits to the US

There are several benefits to the US from this project. Most generally, the increase in nutrition and income levels and the reduction in conflict that this project is designed ultimately to bring about will do its part in contributing to a more prosperous and peaceful world that will benefit every nation, the US

not least among them. Working with local populations to raise their level of initiative and assertiveness in dealing with their local, regional and national governments is a central part of this project and one that is very much in line with US democratic principles. As the known benefactor in this instance, the US specifically will benefit from the goodwill earned.

More directly, the Holistic Management and conflict management trainers who work in West Africa also work toward the same ends here in the United States, among ranchers and Native Americans, for example. There are important common elements in natural resource and conflict management around the world, and as the trainers refine their techniques in the work in Mali, they also become more effective in the US.

Professionally, the US based researchers on the project, both faculty and students, are learning about another part of the world, its environmental conditions and how people respond to them. This is significantly improving their understanding, not only of the technical problems they have to deal with both in the US and elsewhere, but also of global economic and social conditions and their political implications. The broader result is that they are better informed citizens themselves and better able to educate others back home. The more specific outcome is that the researchers' technical knowledge and experience is stronger when applied to solving problems not only in the US but also elsewhere, helping to maintain the high level of professional capacity for which US universities are known. This is especially the case in the Mali program, where the environment is unusually harsh. Such areas cover wide areas in the United States and every continent in the world, and anything that is learned regarding how to make them more productive is worthwhile. Part of this improved productivity is in the form of increased carbon sequestration, that is, the absorption of carbon dioxide and reduction in the tendency toward global warming. SANREM West Africa has applied what it has learned in Mali to obtaining a grant from NASA to investigate this kind of benefit more thoroughly.

Year 3 Impact

The environmental conditions and the resulting conflicts that this project is addressing have been building up over decades. The two years of the project's life so far have not been long enough for widespread or profound impact. However, if the project disappeared today, there are probably two areas where its contribution would last. One is in the sense of responsibility created among the Madiama population and resulting from the establishment of the MRM Advisory Committee. The self-confidence that the members are gaining from their training would likely encourage them to continue to improve the

management of the Commune's resources. By their own account, this would especially be so where conflict avoidance and conflict management are concerned and, especially again, where these techniques are applied to the management of their *bourgou*, or wetland pasture. The other area of as yet modest but still lasting impact is that the local population has seen from the tests in soil fertility and pasture management that improvements are possible – a significant point given that what they have had to witness hitherto is a predominant tendency toward deterioration. Both these gains are very tenuous at this stage, but will become clearer and more firmly established with time.

WAF 00-05

Workshop on Conflict and NRM: Emerging Lessons and Directions from West Africa

The Project participates annually in this regional workshop, which treats natural resource management and related themes. It provides an appropriate forum for researchers, development practitioners, and the donor community interested in conflict and NRM in agro-pastoral systems to present and discuss program directions, strategies, results, and impacts of collaborative research in these overlapping domains. It also presents an outstanding opportunity for SANREM WA to scale up and disseminate project results, tools and technologies. This year the SANREM West Africa Manager and the Mali National Coordinator participated in the Regional Workshop on Research in Sylvopastoralism in the Arid Zone of West Africa. The three-day workshop took place in May 2001 in Dakar, Senegal. It was organized by the Institute of the Sahel (INSAH) and CORAF (Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles) with support from CIRAD (Centre de Coopération Internationale en Recherche Agronomique pour le Développement) and PPZS (Pole Pastorale de Zone Sèche in Senegal).

WAF 00-06

Creation and Support of a Commune-Level NRM Advisory Committee

The primary goal of support for the NRMAC has been to establish the socio-institutional conditions necessary for communal leadership leading to increased and sustainable natural resource-based productivity in the Commune of Madiama. Committee members must become community leaders with the skills necessary for not only managing natural resources, but also to manage the conflicts such management entails. For this leadership to be viable, skills in functional literacy and numeracy, as well as skills in financial management and strategic planning are required. Consequently, committee members have been subject to considerable training efforts: in Holistic Management, Conflict Resolution, Democratization/Decentralization, and literacy, etc. In addition, the committee itself must be recognized as a legitimate leader within the commune. This has two dimensions, one legal and the other moral. Committee members have drafted their own by-laws and regulations necessary for official recognition, and concluded an agreement with the Commune Council and Mayor to provide advice on communal natural resource management issues. They have also initiated discussion among villagers concerning improved management of a valued, but diminishing, resource: *bourgou* (*Echinochloa stignina*, a wetlands grass highly valued as fodder for cattle and small ruminants). The primary result of these activities has been a growing awareness on the

part of NRMAC members about their roles and obligations with respect to the management of natural resources within the commune of Madiama. SANREM researchers continue to work with the NRMAC to document institutional growth and impact.

WAF 00-07

Development of Methods and Tools for Evaluation and Decision Making

This activity uses a participatory research process to develop tools for sustainable agriculture and natural resource management (NRM) decision-making. It seeks to model and evaluate existing and alternative NRM technologies, thereby increasing options available to farmers in Madiama for improving their food security and income generating capacity. Accomplishments for this past year include collection of biophysical data on weather, main soil types, main crop varieties and existing crop management practices at 59 sites (32 sites for 2 years and 27 more sites for one year). Based on a soil survey and cartography we produced a soil map at a scale of 1/40,000 showing the geomorpho-pedology of the commune. An agro-climatic assessment of the commune has been completed that analyzes long-term rainfall variability and reliability as well as the Length of Growing Period. A database was created showing different management schemes, weather, and main soils and crops (1 cowpea, 2 sorghum, 2 rice and 4 millet cultivars). Preliminary simulations are being tested for model calibration and sensitivity analysis for all but the rice cultivars. Integration of the CropSyst model with GIS programs is in process. We will relate scientific terminology and model results to local knowledge of soils, and produce digital maps of land cover and uses, surface and ground water, and soil and land suitability. Malian partners help adapt the tools, and the necessary technical knowledge is transferred to them. We will discuss our results and their implications with the Natural Resources Management Advisory Committee (NRMAC) in Madiama.

WAF 00-08

Farmers' Decision Making Aides for Improved Soil Fertility Management

The nutrient cycle is the key pillar of the ecosystem targeted by this activity. Degraded soils were cited as one of the major natural resource constraints in every village of Madiama, Mali. Crop residues are increasingly being collected for domestic use and animal feed. Cereal yields have decreased steadily and more fields have been opened up to cropping, further reducing the practice of fallowing. In order to address this problem, SANREM CRSP-WA researchers are collaboratively testing various soil fertility improving practices with farmers under the aegis of Madiama's Natural Resource Management Advisory Committee

(NRMAC). The use of legumes in the rotation or in association with small grain crops to improve soil fertility and yields is one of the key methods used to reduce the need for the importation of mineral fertilizers. Soybeans were tested in the first year, but deemed unsuitable. Now work is focusing on rotations or intercropping cowpeas and millet. Soil amendments with rock phosphate (PNT, a nationally available resource) and with manure also are being examined. Results from the first year do not demonstrate statistical differences in productivity. However, comparative economic analyses suggest that the association of millet and cowpeas is substantially more profitable than farmer practice. Collaborating farmers and NRMAC members are beginning to develop more discerning practices with respect to the evaluation of the field tests.

WAF 00-09

Community Decision Making Aides for Improved Pasture Lands

Using the Holistic Management diagnostic process, the NRMAC and collaborating researchers have identified management practices that are the probable cause of a generalized regression of plant communities to the level of annual grasses and other species of low forage quality that severely limits the potential for the community to achieve the quality of life it desires. The present low level of succession represents a severe botanical shift. The first priority is to concentrate on changing management practices so that natural succession can revegetate and restore these resources. Setting realistic expectations for this process and evaluating progress toward their fulfillment requires understanding of the native vegetation (legumes/grasses) that existed previously. Work began this year with four demonstration exclosures (10 x 10 meters), two in the village of Sidagourou and two in the village of Nérékoro. A net predominance of grasses over the legumes in all pastures was observed. The same plants were present in both degraded and non-degraded sites (grazed and ungrazed sites). Plant cover is only 40% in Siragourou and 60% in Nérékoro on the degraded (grazed) sites. Forage biomass production was higher at the Nérékoro site (2110 kg/ha, ungrazed; and 880 kg/ha, grazed) than at the Siragourou site (1015 kg/ha, ungrazed; and 665 kg/ha, grazed). Work on the communal management of *bourgoutière* began. The NRMAC led discussions with all bourgou stakeholders in order to develop a management plan for the regenerated *bourgoutière* in three villages (see WAF-06).



Workshop on Conflict and Natural Resource Management: Emerging Lessons and Directions From West Africa

Introduction

Each year SANREM WA plans to participate in an appropriate workshop that brings together SANREM stakeholders and other interested parties from around the region and the world to review and discuss emerging strategies to manage conflict and natural resources. This recurrent regional workshop opportunity provides a forum for researchers, development practitioners, and the donor community interested in conflict and NRM in agro-pastoral systems to present and discuss results, strategies, program directions, and impacts of collaborative research in these overlapping domains. This year the SANREM West Africa Manager and the Mali National Coordinator participated in the Regional Workshop on Research in Sylvopastoralism in the Arid Zone of West Africa. The three-day workshop was organized by INSAH and CORAF with support from CIRAD and PPZS. SANREM participation was invited by INSAH, our principal West African regional partner. Forty-one participants from 11 countries and 24 entities dealing with degrading pastoral rangeland issues in West Africa attended.

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.

Progress Toward Objective 1

SANREM WA presented the project approach and progress at the workshop. Mike Bertelsen presented the draft "Briefing Paper" that summarizes the Madiama program and the SAM (Social Accounting

Matrix) that describes the sources and distribution of income from the economic activities of different groups in the commune. Salmana Cissé presented a paper on the challenges involved in undertaking Holistic Management in Madiama. Both presentations were very well received. In the case of the SAM, it was apparent that SANREM WA was the only project represented that has a significant socioeconomic content relevant to pastoralists, a theme that was stressed in plenary discussion sessions following the presentations. The SAM methodology and results elicited a lot of comments and interest. The representative of the PPZS project seemed very taken with the SAM and promised to contact SANREM WA shortly to suggest collaboration. In the case of Holistic Management, many participants were familiar with the previous and, in the case of much of the Sahel, failed Holistic Management experiment supported by the World Bank. The participants appeared to be very interested in and supportive of our efforts.

The SANREM participants learned that although there is a lot of pastoralist thematic work going on in the region, virtually none of it is coordinated to provide regional value added. CORAF will assume leadership to try to address this problem in the follow-on e-mail conference that will run through August of this year. An additional problem is the near universal lack of multidisciplinary approaches to research on pastoral issues. Through this workshop, the SANREM project provided fellow pastoral researchers with an alternative research model.

Results

IER was assigned partial responsibility in the follow-up e-mail conference for

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animating the priority research issue “Increasing Productivity of Pastoral Resources”. The e-mail conference will be an additional opportunity for SANREM WA PIs to continue the Holistic Management dialogue with pastoral research partners in the region.

Impacts

Regional stakeholders were informed of the SANREM WA project and progress. Potential future regional partners for SANREM were identified.

Publications and Presentations

Bertelsen, Michael. 2001. SANREM Trip Report: Dakar, Senegal, 27 May – 1 June 2001. OIRD/Virginia Tech.

Cissé, Salmana. 2001. La gestion holistique des pâturages dans la commune de Madiama, Cercle de Djenné: les défis. Presented at the Regional Workshop on Research in Sylvopastoralism in the Arid Zone of West Africa. Dakar, Senegal. May 2001.

SANREM CRSP – West Africa. 2001. A Briefing paper for Expanding Decentralized Participatory Natural Resource Management Decision Making. Presented at the Regional Workshop on Research in Sylvopastoralism in the Arid Zone of West Africa. Dakar, Senegal. May 2001.



Reinforcement of the Organizational Capacity of the Natural Resource Management Advisory Committee

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Introduction

Since inception of the NRMAC in October 1999, members have received training in Holistic Management and Conflict Management and in techniques and skills for institutional strengthening. The committee's focus has been on identifying priority natural resource management problems at the community level and planning for their resolution in a holistic and sustainable fashion in collaboration with researchers. A major objective for the formation of such a committee was to investigate the extent to which the NRMAC could assist commune-level decision-makers to better manage natural resources at this recently decentralized local government level. The committee has worked closely with researchers from Virginia Tech, Washington State, and the CRRRA/Mopti to identify and test suitable technologies, and develop mechanisms for their dissemination throughout the commune. In May 2000, CARE/Djenné joined the SANREM team and began providing assistance for the institutional strengthening of the committee. During the course of this past year, CARE/Djenné has replaced CRRRA/Mopti in the role of human resource development and institutional facilitation for the committee. This transition has allowed researchers to focus more explicitly on technical NRM issues and measuring the growth and impact of institutional development. The essential elements of the SANREM team and partnerships have now been established.

Approach

During this past year, the primary focus has been on developing the institutional capacity of the NRMAC. Training and skills development in Holistic Management and Conflict Resolution are being reinforced by

building the committee's human and institutional capacity. CARE/Djenné began by assisting the NRMAC in conducting an institutional diagnosis of its strengths and weaknesses. Taking into account the identified weaknesses, the NRMAC developed an five-year Institutional Development Plan (PDI). The plan's first step involved elaboration and adoption of statutory documents. The NRMAC's statutes and by-laws were adopted by the General Assembly of the ten villages of the commune. These documents open the way for the official recognition of the NRMAC. Official recognition must be achieved in order to establish formal partnerships with other structures.

The Fall training session in Holistic Management for NRMAC members and local technicians began with a review of the research trials on soil fertility and pasture management. Visits to farmer field sites facilitated discussion. The principal focus of the workshop was a description of the Chadian experience in improved pasture management and HM evaluative tests. Substantial discussion followed the presentations. Rotational grazing had already begun to be considered independently by committee members. Small group exercises reinforced the HM themes and the application of tools and management techniques. The NRMAC also analyzed the conditions for *bourgou* management including aspects such as identifying stakeholders and their perspectives, and technical issues of *bourgou* restoration. An action plan leading up to establishment of next year's work plan was elaborated.

In order to raise the rate of literacy within the committee, a training course was initiated for the benefit of the 18 members of the NRMAC. This 15-day session made

it possible for NRMAC members to better assimilate the concepts of democratic governance through CARE's integrative literacy training method. This method uses topics related to democratic governance (self-government, management, civic action and lobbying, partnerships, the mobilization of resources) and to decentralization as training materials for reading and writing. With an aim of sustaining these accomplishments, a woman was designated by the committee and trained by CARE as a literacy trainer. Additional training in financial management and accounting focused on management and accounting concepts, expense documentation, inventories, amortization, provisional budgets, financial control, and financial reports.

Initiating the PDI has necessitated the development of a strategic plan. To this end training in strategic planning was provided. During this training session, participants were introduced to the process of strategic planning, and in a very participative way, they carried out both internal and external analyses of the Committee. These analyses focused on the strengths and weaknesses of the Committee, its opportunities and challenges, the needs of beneficiaries, the strategic problems and critical questions. A proposal for a triennial strategic plan for the Committee including the mission, the vision and the objectives of the NRMAC was drafted.

The Committee has also initiated dialogues with selected villages for regeneration of *bourgou* in certain seasonal ponds in the commune of Madiama. Stakeholder negotiations took place in four villages: Téguégné (December 1 2000), Nouna (December 8 2000), Torokoro (December 15 2000), and Bangassi (January 5 2001). Due to a lack of consensus in the village of Nouna, only the three other villages were retained for the *bourgou* regeneration program. At present in each selected village, negotiations are ongoing with neighboring villages and other *bourgou* users in order to establish local conventions governing the sustainable exploitation of this wetlands resource. These dialogues proceed under the aegis of the NRMAC and the Mayor of Madiama with the assistance of CARE and CRRA/Mopti.

Objective 1

Reinforcement of the institutional capacity of the NRMAC through training in functional literacy, numeracy, financial management, and strategic planning.

Progress Toward Objective 1

The Natural Resource Management Advisory Committee (NRMAC) has been meeting routinely (despite difficulties meeting during the growing season). Its first achievement has been to conduct a

diagnostic analysis of its institutional strengths and weaknesses. As a consequence of this analysis, the Committee drafted a plan for institutional development and a set of organizational by-laws. The internal organization of the committee has been revised and four additional women members added, raising women's representation from 14 to 33 percent. Training in literacy (focusing on notions of democratic governance), financial management, and strategic planning has been completed. The literacy rate among NRMAC members increased from 55 to 76 percent this year.

Objective 2

Reinforcement of the NRMAC capacities in Holistic Management of natural resources.

Progress Toward Objective 2

The third training workshop in Holistic Resource Management focused on use of common pasture resources, both wetland and dryland. Two specific themes were discussed: organizing a system of rotational grazing on communal pastureland and an action plan for sustainable regeneration of a *bourgoutière*. Three villages have been identified, negotiations among stakeholders initiated to develop a convention for the sustainable exploitation of these *bourgoutières*, and the *bourgoutières* have been seeded. HM tools also have been used to examine soil fertility enhancement through rock phosphate application, and millet/cowpea rotations and intercropping (WAF 00-08) in several farmers' fields, as well as a set of exclosures to demonstrate pasture regeneration (WAF 00-09) in two villages.

Objective 3

Increasing member's capacities to manage conflict situations involving natural resources.

Progress Toward Objective 3

Committee members report having applied their newly learned conflict management skills to improving inter-village communication over sensitive resource issues. The committee has initiated dialogues with selected villages for regeneration of *bourgou* in certain seasonal ponds in the commune of Madiama. In selected the villages, negotiations are ongoing with neighboring villages and other *bourgou* users in order to establish local conventions governing the sustainable exploitation of this wetland resource. Parallel to the village dialogues, negotiations were initiated to establish a formal partnership between the NRMAC and the Communal Council of Madiama. The negotiations led to the development of a protocol of partnership that is currently in the process of amendment and validation. The signing of this

document will make it possible for the NRMAC to be viewed by the population as a credible actor in the resolution of conflicts associated with natural resources.

Results

The primary result of this activity has been the growing awareness on the part of NRMAC members concerning their roles and obligations with respect to natural resource management within the commune of Madiama. The re-organization of the committee to include more women indicates this broadened perspective. The increasing capacity of individual members as they learn new skills (from literacy to financial management and strategic planning) has led to a growing confidence of the committee as a whole that they can make a difference in the management of natural resources at the commune level. The committee has also adopted the principle of maintaining written records of their meetings and those of the general assembly. Drafts of organizational by-laws and plans for institutional development have been completed. All of this points to a growing respect among committee members for the principles of democratic governance.

Impacts

It is still early for the NRMAC to have achieved any substantial impacts on NRM in the Commune of Madiama. However, the committee members were highly satisfied with the consensus building and conflict resolution training they received during the previous workshops and are applying their new skills to improve inter-village cooperation. Lessons from Holistic Management are being applied as Committee members develop a plan for a rotational grazing system in the commune. Last year researchers established a Knowledge, Attitudes, and Practices (KAP) baseline that will assist future evaluation of impact.

Publications and Presentations

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Development of Methods and Tools for Evaluation and Decision Making

Principal Investigator

Introduction

The tools complement the soil fertility and pasture improvement tests in activities WAF 08 and 09. There are two sets: biophysical and economic/socio-institutional. Through simulation modeling, both will allow us to extrapolate the results of tests in farmers' fields to different rainfall and soil conditions, taking account of socioeconomic circumstances. They will also make possible the evaluation of current NRM technologies and their comparison with potential alternatives.

From among the many crop simulation models available (see References) we adapted the most appropriate. CropSys is a multi-year, multi-crop, daily time step, crop growth simulator developed by Claudio Stockle and a team at WSU. It has a friendly (Windows) interface and is linked to GIS software (ARC INFO) and a weather generator (CLIMGEN). It simulates crop growth in response to soil, weather and management, and estimates water erosion, residue decomposition, tillage and other effects. Many data requirements are similar to models used by the SANREM DSS project, enabling the two projects to share information.

The economic viability of current and alternative crop and range practices will also be analyzed. The Social Accounting Matrix (SAM) shows distributive effects, helping determine whether interventions are likely to exacerbate or diminish conflicts between the various occupational groups in the commune.

Objectives, Methods and Results

The overall objective is to adapt and apply methods and tools to evaluate alternative cropping and pastoral systems, assisting decisions by farmers, herders and those who advise them.

Objective 1

Establish a multi-year database for crops, soils, weather and management technologies for modeling and evaluating the impact of NRM practices on productivity and environmental sustainability.

IER and WSU are creating a multi-year database in Access and Excel to show biophysical data on weather, main soil types, main crop varieties and existing cropping management practices. Data were collected at 32 sites for Years 2 and 3 and at an additional 27 additional for Year 3.

Results

The database covers four millet local cultivars, two sorghum cultivars and two rice cultivars. For each of these crops, and for niébé (cowpeas) in field tests this year, the phenological stages from planting to maturity have been characterized. Heat units, component biomass (roots, stems, leaves, fruits) and total yield have been calculated.

The soil database contains initial chemical test results (pH, organic matter, total N and phosphorus), the soil water balance from the 32 fields and the soil samples from the 190 soil survey sites. Baseline values show very low values for total nitrogen (less than 0.1 percent in all soils), organic carbon (0.08 to 0.5 percent) and phosphorus (2.5 to 8 ppm). The soils range from strongly acid (pH 4.2) in the clayey rice fields to slightly acid (pH 6.2) in the loamy millet fields. Soil bulk density and soil texture are also recorded.

A report written this year analyzes daily weather data (solar radiation, rainfall, minimum and maximum temperature) from 1953 to 1999 for Mopti, Djenné and Sofara. The automatic weather station installed last year collected data for the

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entire growing season. A network of 10 rain gauges covers all 10 villages of the commune.

Total rainfall in 2000 from the 10 villages of the commune was highly variable from place to place, ranging from 359 mm for 23 rainy days at Tatia to 629 mm for 41 rainy days at Torokoro. From the recently completed agro-climatic assessment study of the commune, the long-term (50-year) rainfall average is 544 mm compared to a 482 mm average for the 30 years since 1970. Rainfall pattern is monomodal, with rains in July and August representing about 58% of the total. As is typical of the Sahel, rainfall is highly variable from year to year with a coefficient of variation of about 29%. Total length of growing period permitted by rainfall alone in Madiama is about 84 days with a coefficient of variation of 30 percent. If it is assumed, following an FAO study, that another 100 mm of moisture is available from water stored in the soil, the growing period can be extended by 18 days to 102. The soil data bank mentioned above will be used to evaluate this assumption and permit a more exact estimation of the total growing period.

The following table shows data for 1999 (when rainfall was 545 mm, above the 30-year average of 482 mm, and the growing period about 118 days).

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.

As a cost effective alternative to the classic intensive soil survey, the method combines computer-based Remote Sensing (RS) analysis and GIS technologies with ground truthing to classify and map soil types, vegetative cover and agricultural uses.

Results

Landsat and soil maps at scale 1/40000 have been developed from a soil survey conducted in June 2000. The map is being refined and GIS layers created for linkage to CropSyst. A technical report on the soil survey study has been drafted.

The commune, with a total land area of 16,970 hectares, has eight major soil units that are identified and described according to landform, pedogenesis, hydrology and land use.

Objective 3

Develop and apply biophysical modeling techniques to monitor and evaluate the biophysical performance of existing and alternative natural resource management technologies and practices.

CropSyst, an existing biophysical modeling package that simulates alternative crops and management practices, is being adapted to West African conditions.

Results

Progress includes model calibration and preliminary model integration, sensitivity analysis and simulation. CropSyst database and parameter files were created for different management schemes, weather, the main soils identified in the commune, and crops (millet, sorghum and cowpea). Yields levels for 1999 and 2000 were used to adjust the crop parameters and improve yield simulation. Weather records were obtained and modified for input. Soil data input files were prepared. Models were calibrated for millet, sorghum and cowpeas. Preliminary simulations results presented at the February 2001 workshop in Mali. Integration of the CropSyst model with GIS (Arc View and Arc Info) is in process. Modeling will take place both in the US and in Mali.

Objective 4

Develop tools to monitor and evaluate the social and economic viability of current and alternative soil and pasture management practices.

Simple budget models will allow the economic viability of current and alternative NRM technologies to be assessed. The social accounting matrix (SAM) already developed shows economic linkages among activities and social groups within the commune and links to the outside. It will be used to assess the distributional impact of changes in alternative NRM technologies.

Results

Economic data on crop production were collected last year as part of the activity to construct a social accounting matrix for the Commune. Once output from the CropSyst model is available, the economic data can be applied to assess economic viability of the practices modeled.

Objective 5

Transfer evaluation tools including models, methods and skills to IER and other regional partners.

Modeling tools, methods and skills will be transferred to regional partners through a regional training workshop organized in West Africa. There will also be mutual sharing of model results with Texas A&M.

Results

Application of the methodologies and tools mentioned in this report, including data collection, is going ahead in collaboration with IER and the local population. Sessions for technical training of researchers and evaluation of results in collaboration with the Madiama NRMAC, IER researchers, CARE partners and appropriate government officials are included in the Work Plan for Year 4.

Impact

The technical understanding of biophysical conditions in Madiama commune has been much improved. Productive collaboration has been established leading to an exchange of skills in field monitoring and database development for biophysical and socio-economic variables used in describing and simulating systems. As yet there is no impact in terms of improvements in natural resource management practices among farmers and herders in Madiama.

by Jim Williams, USDA/ARS at Temple, Texas; and CropSyst (Stockle *et al.*, 1993) developed by our team at Washington State University.

Publications and Presentations

In May/June 2000 a base-map at a scale 1/40000 was produced from Landsat 7 image taken in November 1999 and from aerial photographs (1973 and 1991). A *soil map* at a scale of 1/40000 has been produced as a result of the soil survey conducted in June 2000. Major land types and soil types are described and their distribution and areas determined.

Thematic maps on yields and erosion risks in Madiama commune were produced from the preliminary simulation modeling and presented at the February 2001 planning workshop in Mali.

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Many crop models have been developed over the past two decades (Stockle, 1989). Examples of these models are the CERES models (wheat, corn, sorghum), developed by Joe Ritchie (Michigan State University) and coworkers (e.d., Jones and Kiniry, 1986); SoyGro (Jones *et al.*, 1989); PutGro (Boote *et al.*, 1989), and BeanGro (Hoogenboom *et al.*, 1991); SUCROS and other models developed by researchers from Wageningen in the Netherlands (for references see Kropff and van Laar, 1993); EPIC (Sharpley and Williams, 1990) developed



Farmers' Decision Making Aides for Improved Soil Fertility Management

Introduction

An assessment conducted in the villages of Madiama, Nérékoro and Tombonkan of Madiama Commune identified severe degradation in soil fertility and forest resources (Participatory Landscape Lifescape Appraisal or PLLA, February 1999). In November 1999, community leaders and key Natural Management Advisory Committee (NRMAC) members were introduced to the Holistic Management (HM) methodology and began to diagnose the soil fertility problems throughout the commune. Among the priorities in every village, degraded soils were cited as one of the major natural resource constraints (NRMAC, February 2000). Committee members have targeted the nutrient cycle as the key HM pillar of the ecosystem to address. Sahelian soils are characterized in large part by their poverty in nitrogen and phosphorus because continuous cropping and reduced applications of manure have not allowed for adequate replacement of soil nutrients. Increasingly, crop residues are collected for domestic use and animal feed instead of leaving the residues in the field. Cereal yields have decreased steadily and more fields have been opened up to cropping, further reducing the practice of fallowing.

The use of legumes in the rotation or in association with small grain crops to improve soil fertility and yields is one of the key methods used to reduce the need for the importation of mineral fertilizers. Recent studies (Gakale and Clegg, 1987; Fahad et al., 1982; Mannering et al. 1968; and Cook, 1984) have shown that these cropping systems improve physical and chemical soil properties, control erosion and reduce pathogenic agents. Earlier tests involved soybeans. However, it was determined that soybeans were extremely difficult to bring to full growth given the erratic rainfall patterns. Cowpeas, a well-

known and appreciated legume in the Mopti region, could be introduced into these rotations or in association with millet in order to improve soil fertility and crop yields. Farmers collaborating in the NRMAC-CRRA/Mopti field trials tested this improved management practice in their fields. Soil amendments with rock phosphate (PNT, a nationally available resource) and with manure also are being examined.

Other lessons will be learned as the ongoing biophysical characterization of agricultural ecosystems provides information on local soil management practices and farmers' participation in the design, testing and evaluation of other soil management technologies proceeds. Long term improvement of soil quality and a positive nutrient cycling path in farmers' fields of Madiama Commune will require changes in NRM technologies brought about through direct community involvement in the choice, implementation and evaluation of soil management practices. Previously we had learned that farmers are much more likely to adopt new NRM practices when they are directly involved in the selection and use of the practices.

Methods

Two series of tests were conducted in the 10 villages of the Commune of Madiama. The first test involved nine farmers (each from a different village) who tested the association of millet and cowpeas. This involved four treatments in a randomized bloc design in an area of 600 square meters; each farmer was a repetition. The four treatments were: (1) millet/cowpea associations with rock phosphate; (2) millet/cowpea association without rock phosphate; (3) farmer (mono-culture) practice with rock phosphate; and (4) farmer practice without rock phosphate.

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The second test involved 16 farmers (maximum of two from each of the ten villages) who tested the rotation of millet or sorghum with cowpeas. The experiment was set up as a split-plot design with 16 repetitions. The primary factor was two levels of rock phosphate application (0 and 300 kilograms/hectare), and the secondary factor was two cropping systems, farmer practice and establishment of the rotation of cereal with cowpeas. For each of the tests, harvesting of three meter-square samples across the diagonal of the parcels was conducted to determine (after threshing and drying) yields of straw, hay and grain.

This activity used a participatory and collaborative research process built around the emerging understanding and use of the Holistic Management model to identify and test soil fertility and water management improvement technologies with the aim of increasing the decision-making alternatives available to farmers in Madiama Commune. Collaboration was structured through the active participation of the NRMAC and related village committees. The field trials include socioeconomic evaluation, biophysical monitoring and modeling (see WAF 00-07).

Objectives and Progress Toward Objectives

Objective 1

- ▶ Document the state of the art concerning existing and newly introduced cultural practices.

A bibliographic synthesis of soil and water conservation technologies has been drafted but is not yet completed.

Objective 2

- ▶ Development of improved technologies for improvement of soil fertility.

The field trials involved only rock phosphate (PNT) as a fertilization additive, manure was not included this year. Some farmers found that the plots with the PNT responded better than those without it. Results of the statistical analysis did not demonstrate a significant difference at the 5 percent significance level. Nevertheless, it was unlikely much response to PNT will be measured this year since (due to late arrival of funds and identification of farmer cooperators) it was not applied until late August, well after the onset of the rainy season. However, an economic analysis comparing farmer practice with and without PNT and the association with and without PNT suggest that the association of millet and cowpeas is substantially more profitable than current farmer practice.

Objective 3

- ▶ Reinforce local capacity to apply the Holistic Management model in the monitoring and evaluation of soil fertility improving technologies.

Collaborating farmers are beginning to describe their experience with the cereal and cowpea association or rotation using the HM conceptual approach. Some of the farmers were satisfied with the technique of associating millet and cowpeas, particularly during short rainy seasons. The cowpea association also was beneficial in combating striga infestations. More interesting, however, is that in conducting these experiments on barren (degraded) land that had been abandoned for some time, farmers have come to see that rest, even on barren land, does make a difference. They had not expected much crop growth at all. Some farmers are considering plowing and planting other barren parcels that have been left abandoned. A new understanding of degraded land may be emerging.

Results and Outcomes

These trials were established on two farmer fields in each of ten villages in conjunction with each village user group (Village NRM Committee). This has allowed for a potentially higher than expected level of participation by community members. However, not all plots were successfully managed by the farmer collaborators. Committee members will need to consider the quality of farmer participation in the next season of trials. Nevertheless, these trials have provided a focus for addressing issues of increasing soil fertility within the Commune.

Impacts

It is still too early to discuss impacts of these field tests.

Publications and Presentations

None as yet.



Community Decision Making Aides for Improved Pasture Lands

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Introduction

Madiama community members and researchers at IER, Virginia Tech and Washington State have conducted participatory diagnostic analysis of the pastureland resources in the Commune of Madiama (PLLA, February 1999, and the Holistic Management Training Sessions, November 1999). In preparation for communal research planning in February, the Natural Resource Management Advisory Committee (NRMAC) of Madiama prepared village level lists of research concerns. Among the priorities in every village, the poor quality of pastureland was cited as one of the major natural resource constraints (NRMAC, February 2000).

According to Ba *et al.* (1995), desertification and drought have reduced crop and pastureland in the Sahel at a rate of 80,000 hectares a year. In the Mopti Region (including Madiama Commune), the lack of pasture and forage resources has been a growing problem. Demographic growth, extension of field cropping, increasing herd size, high levels of exploitation of ligneous resources, and rainfall fluctuations have all contributed to serious losses of biodiversity within the zone. In addition, access to pastureland resources has become a major flashpoint for conflict among stakeholders.

Using the Holistic Management diagnostic process, the NRMAC and collaborating researchers have identified management practices that are the probable cause of a generalized regression of plant communities to the level of annual grasses and other species of low forage quality that severely limits the potential for the community to achieve the quality of life it desires. During the rainy season, livestock seek out pastures in communally controlled dryland areas. The forage resources of these pastures have become nearly non-existent

and only a few perennial grasses can be found in Madiama. Transhumant practices also are increasingly limited, particularly in traditionally utilized areas in the communes of Timissa and Tominian. Furthermore, the *bourgoutières* in the region have been poorly managed.

Approach

The present low level of succession represents a severe botanical shift. The first priority is to concentrate on changing management practices so that natural succession can revegetate and restore these resources. Setting realistic expectations for this process and evaluating progress toward their fulfillment requires understanding of the native vegetation (legumes, grasses) that existed previously. The research questions can be divided into short-term (needing immediate attention, i.e. the identification, rehabilitation and productivity of existing vegetation) and long-term (i.e., increase and maintain production through economically, socially, and environmentally sound practices).

1. Is the soil at its current status able to support the growth and productivity of commonly grown perennial grasses? If the answer is no, what can be done to improve the soil fertility? If the soil problem is beyond improvement or repair what can be established or grown on the existing soils? Can management practices such as cutting frequencies, grazing, allowing reseeds of the annual grasses be used as viable alternative?
2. Does a potential seed source still exist in these degraded environment? If so, how can it be recovered?
3. What management practices will promote different expressions of natural succession? The commune is worried not only about the loss of perennial grasses, but also about

certain woody plants and trees and many medicinal herbs.

4. Long-term improvement in the potential for succession to more diverse and productive plant communities in pastoral areas will require that additional issues be researched including:
 - ▶ the current management practices of herd owners within the commune as well as their transhumant practices,
 - ▶ the potential for community organization of pasture access and use,
 - ▶ the quality of pasture and forage resources, and
 - ▶ how pasture practices and resources can be modified to increase productivity, improve pasture management and help prevent conflicts involving those resources.

This work began this year with four demonstration exclosures (10x10 meters), two in the village of Sidagourou and two in the village of Nérékoro. One exclosure in each village was sited on barren pastureland; the other in a depression. Vegetative response in these exclosures was noted and discussed by the villagers. Although some members of the NRMAC were interested in expanding the exclosures to much larger areas, the demonstration purposes of the exclosures have been served.

Objectives and Progress Toward Objectives

Objective 1

- ▶ Determine the quantity and quality of forage resources in the Commune of Madiama.

At the demonstration sites in Siragourou and Nérékoro, a net predominance of grasses over the legumes in all pastures was observed. The same plants were present in both degraded and non-degraded sites (grazed and ungrazed sites). The difference is in the plant cover, which is only 40% in Siragourou and 60% in Nérékoro on the degraded (grazed) sites. Forage biomass production was higher at the Nérékoro site (2110 kg/ha, ungrazed; and 880 kg/ha, grazed) than at the Siragourou site (1015 kg/ha, ungrazed; and 665 kg/ha, grazed).

In addition, geo-referenced photographs have been obtained for the classification of pastoral resources indicated on the November 1999 and October 2000 LandSat images.

Objective 2

- ▶ Describe and analyze the socio-economic characteristics of pastoral and agro-pastoral systems of the commune.

A recent survey was conducted but data analysis is yet to be completed.

Objective 3

- ▶ Develop mechanisms for community-based

management of Madiama's pastoral resources using the Holistic Management Model.

Holistic Management training in October focused on the evaluation of exclosure demonstration sites and on how to sustainably expand the area of pastureland allowed to rest through implementing a rotational grazing program. A key issue addressed was the identification of all stakeholders and the necessity for their involvement in a formal convention governing pasture use.

Work in the *bourgoutière* began with NRMAC holding discussions with all *bourgou* stakeholders in order to develop a management plan for the regenerated *bourgoutière* in three villages (see WAF-06).

Results

Limited results have been achieved up to this time. Efforts of IER researchers and NRMAC members have been focused on largely on establishing *bourgoutière* regeneration activities as reported in WAF-06.

Impacts

There are no impacts to report at this early stage.

Publications and Presentations

None.

Global Impacts & Information Exchange

Project Overview

The Global Impacts and Information Exchange (GIIE) Project serves several important purposes within the overall SANREM program. These include research, information exchange and assessing decision support opportunities. These are each designed to integrate, augment and serve the regional projects and the program as a whole.

The project includes two separate but mutually reinforcing activities that support SANREM regional and global projects. The activities, managed through the Management Entity of the SANREM CRSP, are listed below.

(1) *The identification of critical and recurring agriculture and natural resource management decisions and issues through an assessment of decision-making processes (GLO-31).*

This research activity aims at better understanding how natural resource management decisions are actually made; the needs, priorities and values involved in natural resource decision-making (local and national government, private sector, NGOs); the methods, data and information sources that decision-makers use; and the processes whereby decisions are made, reinforced and/or changed over time. The goal of this research is to provide information to enhance the relevance of sustainable agriculture and natural resource decision support methods and approaches developed by SANREM researchers. In Year 3 the foundations have been established for an understanding of natural resource management decision-making processes in general, in the context of four pilots surveys (Ecuador, Mali, Philippines and Southeastern US). In Year 4, this research will narrow the focus to concentrate on the priorities of and opportunities afforded by NGOs and Local Government Units (LGUs).

(2) *Facilitation of communications and information exchange among regional and global projects, decision-makers, and agencies and institutions involved in similar work (GLO-11).*

The goal of this activity is to ensure that information generated by the SANREM projects is documented, shared with and used by citizen groups, development practitioners, local government units and policy makers and researchers, as appropriate, to enhance sustainable agriculture and natural resource management. Additionally, this activity serves to support institutionalization efforts in the program. This activity involves communications and information exchange within SANREM, but it is also designed for information exchange among a broader network of institutions that may use the program

outputs. The vehicles used for communication and information exchange include research reports, policy briefs, case studies, newsletters, videos and tools. All of these methods are available via SANREM's Web site. In Year 4, these activities will also focus on coordination of cross-project synthesis research reports, as well as on documentation of program impact.

Project Objectives

- ▶ Identify priority needs of local, national, regional and global decision-makers
- ▶ Facilitate communications and exchange of information among SANREM regional projects and between SANREM and other institutions, organizations, and agencies.
- ▶ Improve the capability to make informed decisions and to assess the impact of decisions related to consequences of adopting specific agricultural and natural resources management technology, practices, and policy at landscape, provincial, national, regional and global levels.

Progress Toward Five-Year Indicators

Progress made by the SANREM Global Impacts and Information Exchange Project for the period June 1, 2000 to May 31, 2001 is reported in this section. The indicators for the Global Project, as defined in the Global Project Work plan for 2000-2001 are stated and the progress is indicated below each statement.

Outputs supporting local-to-provincial (landscape) level decision-makers

Methods developed to assess the priorities and needs of local-to-provincial (landscape) level agricultural and natural resource decision-makers and at least three documented cases of their application.

A methodological protocol has been developed and tested in Mali, the Philippines, Ecuador and the Southeastern United States. A synthesis across sites in the form of a methods paper has been written.

SANREM published a book entitled *Cultivating Community Capital for Sustainable Natural Resource Management: Experiences from the SANREM CRSP* that includes papers presented as part of a special session of the International Farming Systems Association in Chile during November 2000. This book documents six cases of SANREM experiences dealing with the needs of local-to-provincial level agricultural and natural resource decision-makers.

Outputs supporting national-to-global level decision-makers

Methods created to assess the priorities and needs of national-to-global level agricultural and natural resources decision-makers and at least three documented case studies of their application.

A draft methodology has been written that synthesizes results from the Assessments of Decision Maker Priorities surveys (ADMP) conducted in Mali, the Philippines, Ecuador and the Southern Piedmont Region of the United States.

The set of Guidelines entitled "Broadening the Research Horizon: Integrating Food Security Dimensions into the NARS Agenda" is being published by FAO. Several SANREM Colleagues provided interventions to the conference as well as case examples for the guidelines.

SANREM in collaboration with the International Partners for Sustainable Agriculture and the Food and Agriculture Organization designed and implemented a discussion board and electronic conference for stakeholder input into the Rio+10 process and the FAO Committee on Agriculture's 16th session. These e-events in conjunction with a face-to-face major stakeholder dialogue established the priorities of major groups (farmers, trade unions, indigenous peoples, business and industry and NGOs) related to sustainable agriculture.

SANREM was well represented at an international workshop on carbon sequestration as it relates to agriculture and land use held in Geneva, Switzerland in 2000. Building on this activity, the SANREM CRSP and the Soils CRSP joined forces with USDA-ARS to develop a proposal for NASA funding to better understand the potential for carbon sequestration through community land management practices in the Sahel.

Outputs supporting information exchange

Access to knowledge and tools generated by the SANREM program provided to a broad range of decision-makers through development of online resources including an electronic library, technical and non-technical presentations of information, and databases (searchable database for publications, documents, and human resource expertise).

Technical findings, papers, conference proceedings, and other SANREM products now can be posted easily on the redesigned SANREM web site. New features added to a protected area allow authorized users to upload files, submit trip reports, obtain addresses and other information for those associated with SANREM. Southeast Asia and West Africa projects also updated their Web sites to provide a more consistent, seamless look overall and greater access to their publications. The Andes project Web site is being redesigned. An Access database was established that contains

citations of all SANREM publications. The SANREM Web site was added to the Earth Day Network and became a member of the Sustainable Development Web ring, where it was a featured new member for a month. For more, see www.sanrem.uga.edu.

Benefits to the United States

The GIIE project brought benefits to the U.S. in the form of proposal development for domestic activities based on SANREM international work, requests and distribution of SANREM documents to domestic institutions, interaction with the USDA-ARS on domestic projects on sustainable agriculture and watershed management, co-development of a global database for water quality monitoring, and the development of an environmental education activity for school children.

Year 3 Impacts

New formats of communication including the e-mailed SANREM news, the display, posters and brochures are enhancing the SANREM corporate image and have increased SANREM visibility and credibility. The SANREM communications activities have increased access to research results to a much broader audience (for example the web site alone is getting 1000 hits per month). The participatory processes (e-events), which SANREM has designed and facilitated, have been utilized by FAO to enhance stakeholder involvement in development of guidelines and in their reporting efforts.

The Assessment of Decision Maker Priorities methodology serves as a useful tool for government agencies, NGOs, and scientists in planning and implementing research and development activities from local to national levels.

ME-PRO 00-61**SANREM Year 2000 Conference in Chile**

SANREM led a symposium entitled Cultivating Community Capital: The experiences of the SANREM CRSP at the International Farming Systems Association (IFSA) meetings that took place from November 27 to 29, 2000 in Santiago, Chile. This meeting brought together PIs from the SANREM CRSP to provide 5 presentations from activities in Ecuador, Mali, and the Philippines. The papers were also drafted into a book that was distributed during the symposium. The SANREM symposium was dedicated to the late Dr. Robert D. Hart in honor of his work in SANREM and with IFSA.

GLO 00-11**Communications and Information Exchange**

The Communications and Information Exchange Activity takes the lead in coordinating communications with external audiences about SANREM projects, by disseminating general and technical information to those interested in sustainable agriculture and natural resource management, and by providing leadership for internal communications within the SANREM CRSP. Communications objectives are being achieved by revision, update and promotion of the SANREM Web site; co-sponsoring and/or participating in electronic and face to face conferences; developing publications, brochures, posters and other communications products to enhance awareness of SANREM; maintaining a physical and electronic library containing SANREM publications; and by bringing SANREM lessons home.

GLO 00-31**Assessment of Decision-Maker and Decision Support Opportunities**

Within the context of providing support to natural resource management decision makers, the Assessment of Decision Maker Priorities (ADMP) project is geared to understand the desired outcomes, issues and difficult decisions of natural resource managers. Identifying and understanding these issues is being undertaken in order to ensure that the support designed to help decision-makers actually corresponds to the needs and demands particularly in setting where national governments are yielding decision-making authority to local branches and citizen society organizations. Based on assessments made in the Philippines, Ecuador, and Mali, an overall synthesis of lessons learned relative to the methodology and results was compiled. The Year 4 activities will include targeting the protocol for NGOs and LGUs to fit current and future decision support tools to these clients. Additionally, a monitoring and evaluation framework component will be added to the protocol.



SANREM CRSP

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

June 2001
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SANREM Year 2000 Conference in Chile

Introduction

In the 1998-2003 Implementation Plan for Phase II, SANREM identified a Year 2000 Conference for global information exchange. In the December 1999 SANREM joint meeting, the Board of Directors and Technical Committee agreed that the 2000 conference could be held in conjunction with the 16th Symposium of the International Farming Systems Association (IFSA). This meeting took place from November 27 to 29, 2000 in Santiago, Chile. SANREM sponsored a special symposium within the Theme on *Institutional Development and Natural Resource Management*. This meeting brought together PIs from the SANREM CRSP research regions as well as non-SANREM researchers for a half-day symposium. The SANREM symposium was dedicated to the late Dr. Robert D. Hart in honor of his work in SANREM and with IFSA.

Objective

To enhance exchange between SANREM and non-SANREM researchers on the topic of Institutional Development.

Methods and Approach

The Management Entity of the SANREM CRSP in concert with the Regional Program Managers identified key individuals and topics related to natural resources management at the local level for presentation at the International Farming Systems Association meetings. All papers presented were published in book-form and approximately 100 copies were distributed at the meeting.

Five presentations were given during the symposium. Two 1.5 hour-long sessions were held on November 28. SANREM Deputy Director Constance Neely and SANREM Director Carlos Perez moderated both sessions.

In the sessions, SANREM investigators presented 5 papers from the regional projects in West Africa, Southeast Asia and the Andes:

- ▶ William Deutsch (Auburn University) discussed water quality monitoring efforts in the Philippines
- ▶ Agustin Mercado (ICRAF) discussed the Landcare approach in the Philippines
- ▶ Michael Bertelsen (Virginia Polytechnic and State University) discussed holistic management in West Africa
- ▶ Cornelia Flora (Iowa State University) discussed the advocacy coalition framework that is being used to study policy change in Ecuador
- ▶ Jan Flora (Iowa State University) discussed social capital and advocacy coalitions in Ecuador.
- ▶ A sixth paper was published but not presented due to illness. That paper by Robert Rhoades was about future visioning work in Ecuador.

Results and Discussion

This meeting provided an opportunity for SANREM partners to share their findings on community based natural resource management with each other as well as to solicit feedback from key scientists from around the world. SANREM research results were shared with a much broader audience during the conference and SANREM's network of individuals and institutions doing similar work will be expanded. There was an association-wide tribute to Dr. Bob Hart.

SANREM was well received at the conference and Drs. Constance Neely and Cornelia Flora were asked to serve as co-presidents for the 17th Symposium of the International Farming Systems Association (IFSA) to be held in Florida in 2002.

In addition, the book was distributed at the Convention to Combat Desertification in Bonn, Germany in December 2000. Of the 500 books printed, approximately 250 have been distributed based on requests.

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Impacts

A most important impact of this work was the synergistic effect of SANREM's story being told to a wide audience of researchers and development professionals and the resulting networks formed.

Publications and Presentations

Cason, Kathleen (ed). 2000. Cultivating Community Capital for Natural Resource Management: Experiences from the SANREM CRSP. Athens, Ga.: SANREM CRSP. 62 pp.

Presentations made at the IFSA meetings, Santiago, Chile:

Deutsch, W. G. and J. Orprecio. 2001. Formation, Potential and Challenges of a Citizen Volunteer Water Quality Monitoring Group in Mindanao, Philippines.

Mercado, A. R. and D.P. Garrity. 2001. The Landcare Approach: Enhancing Community Participation in Sustainable Agriculture and Natural Resource Management in the Uplands.

Bertelsen, M. K. 2001. Holistic Management in West Africa: A new approach to community based natural resource management decision making and institutional development at the decentralized commune level.

Flora, C.B, J. L. Flora, F. Campana, and E. Fernandez-Baca. 2001. The Advocacy Coalition Framework: A theoretical frame for SANREM to address policy change and learning.

Flora, J. L., C. B. Flora, F. Campana, M. G. Bravo, and E. Fernandez-Baca. 2001. Social Capital and Advocacy Coalitions: Examples from Ecuador.



SANREM CRSP

Sustainable Agriculture and Natural Resource Management
Collaborative Research Support Program
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Communications and Information Exchange

Introduction

While publication of journal articles is an essential component of any research program, access to research results in that venue is limited to a narrow, scientific audience. Recasting research results for other audiences can expand their impact. SANREM Phase II now is at a point where a sufficient body of information is available and ready to be broadcast, in coordination with the regional projects.

The activities undertaken during Year 3 strengthened ongoing communications efforts, facilitated access to SANREM research results, and helped generate awareness of the SANREM program in general. The Global Project took a lead role for these activities by coordinating communications with external audiences about SANREM projects, by disseminating general and technical information to those interested in sustainable agriculture and natural resource management, and by providing leadership for internal communications within the SANREM CRSP.

These activities support SANREM's five-year goals by making knowledge accessible to decision-makers and researchers. The focus of Year 3 activities was further development of an information system and communication of research results to a variety of audiences.

Objectives

- ▶ Collect and facilitate access to knowledge generated by SANREM regional and global projects.
- ▶ Generate awareness of SANREM research and activities and promote understanding of sustainable agriculture and natural resources management issues, in particular as undertaken by SANREM.
- ▶ 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.

Methods or Approach

Communications objectives are being achieved by:

- ▶ Revision, update and promotion of the SANREM Web site;
- ▶ Co-sponsoring and/or participating in electronic and face to face conferences;
- ▶ Developing publications, brochures, posters and other communications products to enhance awareness of SANREM;
- ▶ Maintaining a physical and electronic library containing SANREM publications; and
- ▶ Bringing SANREM lessons home.

Revise, update and promote SANREM Web site

A redesign of the SANREM Web site was implemented. Technical findings, papers, conference proceedings, and other SANREM products now can be posted easily. New features added to a protected area allow authorized users to upload files, submit trip reports, and obtain addresses and other information for those associated with SANREM. The SANREM Web site joined the Earth Day Network and became a member of the Sustainable Development Web ring, where it was a featured new member for a month.

For more, see www.sanrem.uga.edu.

Electronic and Face-To-Face Conferences

- An electronic conference on *Integrating Sustainable Food Security Dimensions into the Research Agenda of the National Agricultural Research Systems* (June 5 to July 14, 2000) was led by the United Nations' Food and Agriculture Organization (FAO) in cooperation with Global Forum on Agricultural Research (GFAR) and SANREM at the University of Georgia. More than 400 participants from 50 countries participated. Constance

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Neely of SANREM led the e-conference team and served as conference moderator. A set of guidelines, entitled "Broadening the Research Agenda: Integrating Sustainable Food Security Dimensions into the NARS Agenda" were developed based on the electronic-conference and will be published in time for the World Food Summit in November 2001.

- *Looking Forward to Rio+10: Reporting Progress on Land and Agriculture* (March 5 to 23, 2001): During this e-conference, different perspectives on progress made toward sustainable agriculture and rural development (SARD) and land since the 1992 "Earth Summit" in Rio de Janeiro were examined in an effort to spur further achievements. E-event outcomes were incorporated into the U.N. report on Land and Agriculture covering Chapters 10, 12, and 14 of Agenda 21. Conference hosts were Food and Agriculture Organization of the United Nations (FAO) in collaboration with the United Nations Environment Programme (UNEP), and in partnership with SANREM at the University of Georgia.
- *Forum on Sustainable Agriculture and Rural Development* (March 2001): Building upon an electronic discussion and the e-conference mentioned above, members of five of the major groups of Agenda 21 met in Rome to discuss how collaboration can improve between groups such as governments, the private sector and civil society so that sustainable development goals can be advanced. The group also discussed how to attract institutional and financial support for agriculture and rural development. Representatives from indigenous groups, trade unions, farm workers, non-governmental organizations, private sector and governments discussed these topics in front of governments during the Committee on Agriculture (CoAg) Meeting. Recommendations formulated by participants were shared at the May meeting of the U.N. Commission on Sustainable Development and will be provided at the World Summit on Sustainable Development (Rio+10) to be held in South Africa in 2002.
- *Impact Assessment Workshop*: Constance Neely and Kathleen Cason attended an Impact Assessment Workshop held in Washington, D.C. from July 19 to 21. Various researchers from the CRSPs, CGIAR and World Bank plus all of the CRSP directors attended the workshop. The purpose of the workshop was to review and discuss ways to assess actual and potential impacts of agricultural research. The SANREM CRSP prepared a summary document.
- *Carbon Sequestration*: Three SANREM representatives attended an international workshop on carbon sequestration as it relates to agriculture and land use. More than 60 scientists and development

practitioners examined these issues in Geneva, Switzerland from August 30 to September 1, 2000. As a result of the workshop, SANREM, the Soils CRSP, and USDA-ARS developed a proposal that was funded by NASA. The proposed research aims to explore the potential for carbon sequestration through community land management practices in the Sahel.

Publications, Brochures, Posters and Other Communications Products

- A traveling exhibit on SANREM and SANREM fact sheets were unveiled at the Sustaining Upland Development in Southeast Asia conference in Manila sponsored by the Southeast Asia project. This exhibit is available for SANREM partners' use.
- A new SANREM brochure was produced.
- Listservs were established to facilitate communication for the CRSP Council and collaborators in a grant proposal on Carbon Sequestration (Soils CRSP and others).
- Electronic news messages were distributed to SANREM partners, CRSP directors, and others providing information on upcoming events, opportunities for funding, deadlines, and SANREM news. For more efficiency and to increase the number of recipients we can reach, a listserv has been established to distribute e-news.
- Support was provided to regional projects (e.g. an html flier and program cover was designed for the SEA conference on *Sustainable Upland Development in Southeast Asia*, editorial support was provided for various documents)
- Support was provided for e-conferences, face-to-face meetings and CRSP council activities (fliers, posters, etc.)

Physical and Digital Archive of SANREM CRSP Research

An Access database was established that contains citations of all SANREM publications from Phase I and Phase II based on annual reports, semi-annual reports, the Phase I Impact Document and Web sites (old SANREM Andes and Southeast Asia). Approximately 580 items have been identified including the following: 46 refereed journal articles, 9 books, 40 chapters, 8 manuals, 90 presentations, 96 reports, 2 videos, 3 annotated bibliographies, 18 theses or dissertations, 7 brochures, 1 database, 21 working papers, 1 monograph, 47 proceedings, and 203 unknown or other types of documents. Copies of 228 of these items are available from the Management Entity either in hard copy or electronic versions. Nearly one half of the publications housed at the ME are from Phase II.

Bringing SANREM Lessons Home

- SANREM initiated proposal development in response to the 2001 call for proposals by

Integrated Future Agriculture and Food Systems (IFAFS) in collaboration with the Center for Holistic Management, USDA-ARS, the University of Georgia and others. The proposed research would bring together land users, community members, government agencies, non-governmental organizations and local governing bodies to assist small to mid-size private land managers and their communities in the Piedmont region of the Southeastern United States and would help them to identify and seize profitable, land-based economic opportunities while protecting the environment and enhancing rural community life.

- A news release about SANREM participation in CSD-8 was distributed to various media outlets. Two articles were published in local newspapers. The University of Georgia's Terry College of Business magazine wrote a spin off article about a student that SANREM helped get appointed to be part of the CSD-8 delegation for the U.S.
- SANREM prepared an exhibit for Ag at the Zoo Day at the Atlanta Zoo. The University of Georgia's College of Agricultural and Environmental Sciences sponsors this event. The SANREM exhibit consisted of a game to stimulate awareness of our ecological footprint. More than 7,500 people visited the zoo that day.

Results and Discussion

Awareness of the SANREM program activities is broadened by participating in activities with organizations such as FAO, IFSA, and the CRSP Council. As a result of the Impact Assessment Workshop, representatives from the CRSP Council, World Bank and CGIAR learned about SANREM activities. The supporting documents that SANREM prepared as a result of these interactions furthers awareness of SANREM as well.

The newly designed Web site provides greater access to SANREM research publications and news and is easier to navigate. Combined with recently updated Southeast Asia and West Africa project Web sites, the new Web site has a more consistent, seamless look overall and greater access to publications. The Andes project Web site is being redesigned next. Linking to other Web sites and joining Web rings increases SANREM's visibility and potential impact of research results.

Impacts

The SANREM communications activities have increased access to research results to a broader audience (for example the web site alone is getting 1000 hits per month). New formats of communication including the e-mailed SANREM news, the display, posters and brochures are enhancing the SANREM

corporate image and have increased SANREM visibility and credibility. The participatory processes (e-events), which SANREM has designed and facilitated, have been utilized by FAO to enhance stakeholder involvement in development of guidelines and in their reporting efforts.

Publications and Presentations

- Neely, Constance. 2000. Participatory Monitoring and Evaluation of Capacity Building Efforts. Panelist at Impact Assessment Workshop, Washington, D.C. July 19 to 20. [presentation]
- Neely, Constance L., M. Carla Roncoli, Julia A. Earl, Thomas L. Price, and Abubaker Maddur (editors). 2001. Broadening the Research Agenda: Integrating Sustainable Food Security Dimensions into the NARS Research Agenda. FAO. 45 pp. [in press]
- SANREM CRSP. 2001. Proceedings of the Impact Assessment Workshop: A workshop organized by the Office of Agriculture and Food Security U.S. Agency for International Development (USAID). July 19-21, 2000. Washington, DC [draft]

News Stories

- Bingham, Sam. 2001. Holistic Management in West Africa. <http://www.sanrem.uga.edu/news>
- Cason, Kathleen. 2001. Andes Research Helps Georgians Envision the Future. <http://www.sanrem.uga.edu/news>
- Cason, Kathleen. 2001. New publications from the Southeast Asia project. <http://www.sanrem.uga.edu/news>
- Cason, Kathleen. 2001. Old Problems in an Old Nation. <http://www.sanrem.uga.edu/news>
- Cason, Kathleen. 2001. Sustaining upland development in Southeast Asia. <http://www.sanrem.uga.edu/news>
- Neely, Constance and Kathleen Cason. 2001. SANREM Colleagues in the News. <http://www.sanrem.uga.edu/news>
- Neely, Constance. 2001. Rio +10: E-conference update. <http://www.sanrem.uga.edu/news>
- Williams, Phil. 2001. SANREM researcher provides leadership for the International Year of the Mountain. <http://www.sanrem.uga.edu/news>



Development of Decision-Maker Priorities and Decision Support Opportunities

Introduction

The five-year strategy is based on collaboration with SANREM's regional projects and other global projects. Having devoted the previous year to developing a methodology and conducting participatory appraisals of decision-makers' needs and priorities in the Philippines, Ecuador and Mali, this year's emphasis was on validating, compiling, and disseminating the results. A participatory methodology has been developed and is being fine-tuned with input by an expert panel. Preliminary participatory appraisals have been undertaken in each of the SANREM sites and in one additional region in the U.S. to identify critical decisions related to natural resource management, relevant issues, major constraints that shape those decisions, and desired outcomes as perceived by decision-makers. From the local to regional level, the project has identified decision support priorities, including some initial insights as to tools, information, and capacity building needs.

In Year 4, we will further refine our understanding of decision making processes however we will move from "theory" to the design and client testing of selected decision support "tools" and participatory fine-tuning of those. Key to this will be targeting decision making and narrowing the scope to a few decision support options. Simultaneously we plan to focus efforts on two specific audiences – Non governmental organizations (NGOs) and Municipal Mayors or Local Government Units (LGUs).

Objectives

- ▶ To fine-tune the methodology for identification and understanding of natural resource decision-making priorities and constraints.
- ▶ To synthesize and prioritize decision-

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

- ▶ To compare and validate the demand for tools, information, and capacity building support to improve natural resource management decisions in the regions and globally.
- ▶ To integrate findings into a participatory monitoring and evaluation framework to assess how research activities are progressing towards addressing decision-maker priorities

Methods and Approach

To ensure a degree of consistency across sites and interviewers, an interview protocol was developed (see attached). Elements of this protocol included: information on the stakeholders being interviewed; key issues their institutions were facing; other actors related to the issue; enabling, constraining and resolving forces and actors; relevant policy-implications; the importance of decentralization and privatization; decision support tools used or identified as useful; and perceived future issues. Decision makers in this context include all individuals, groups and institutions that make decisions both directly or indirectly over agriculture and natural resources. This includes civil society, state (public) and market (private) sectors. The assessments included interviews of individuals and focus groups of decision makers from different sectors and from multiple levels of the decision-making hierarchy from the local to national level and in some cases international levels.

The assessment was conducted in three sites where the SANREM CSRP is currently working – Mali, the Philippines, and Ecuador. Preliminary activities were also undertaken in the Southeastern U.S. In

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conjunction with the assessments, an annotated bibliography was developed on the topic and within each site relevant gray literature was examined. The assessments were done over a period of time that allowed for methodological lessons learned in one site to shape the assessment in the next site to be undertaken. This is an important point as, traditionally in cross-cultural research, the research provides the same stimulus so that the responses can be compared. Our approach was to shape the stimulus to the site to ensure respondent understanding and so that similar types of information would be gleaned. Details of the applications of the assessment protocol and lessons learned in implementing the protocol for particular countries are described in the methodology papers.

Results and Discussion

A methodology paper has been written that synthesizes the lessons learned from the protocol and initial findings from assessments in Mali, the Philippines, and Ecuador. When this work was initiated, it was anticipated that a methodology to assess decision maker priorities and decision support opportunities would lead toward two outcomes. The first was to gain an understanding of the diversity of natural-resource management issues that decision makers at all levels and sectors in three countries in different world regions were grappling with as well as to gain insights into the relationships among decision makers within and among levels. A second outcome was to be the development of a methodology that would assist in better matching decision support to the priorities of real decisions. Using the interview protocol developed and fine-tuning it in an iterative manner has allowed us to move to address these. Based on the different techniques used to adjust the methodology, it is felt that the interview protocol (both in groups and with individuals) is highly useful for understanding a specific issue as it is viewed from the local to national level and beyond by different sectors and the potential solutions that each of these stakeholders or "influencing bodies" might envision. This can then be used to design or identify research- and development-oriented decision-support mechanisms. Adding the component related to advocacy coalitions provides a mechanism for the stakeholders to actually view their relationships in light of the desired future conditions and subsequently fast track the thinking to mutually agreed upon decision support options.

Issues treated in the three studies were quite variable. In Mali, the focus was primarily on farming and pastoralism and secondarily on natural resource management. Specific issues treated included conflicts between farmers and herders, environmental implications of expansion of cotton production, and

jurisdictional conflicts between resource ministries. In Ecuador, the issues treated were more broadly related to natural resource management—of water, an ecological reserve, and alternative futures based on mining versus diversified agriculture and tourism. The Philippines assessment focused on institutional issues around management of natural resources: land use planning, political and legal inconsistencies among government institutions at different levels in the resource decision-making hierarchy, and local government-NGO relations under conditions of devolution. Common threads in all three studies are certain institutional questions: interaction of market, state, and civil society in agricultural and natural resource decision making; implications of government decentralization (and privatization as a derivative element) for natural-resource decision making, and conflicts and disconnects among different levels, from local to regional to national.

Research regarding participatory monitoring and evaluation frameworks was undertaken during this reporting period. The result of the research was the compilation of a paper, "Creating a Continuous Learning System: Participation and Evaluation in Agriculture Development Projects" that was subsequently presented at an international conference on Evaluation of International Cooperation Projects: Centering on Development of Human Resources in the Field of Agriculture in Nagoya, Japan. Full-fledged development of the monitoring and evaluation framework is foreseen to take place during the 2001-2002 of the project.

Impacts

The development of this methodology serves as a very useful tool for planning and implementing research and development activities that span local to national level decision makers.

Publications

Under Review

Neely, C. L., C. Flora, J. Flora, G. Buenavista, and J. Earl. 2001. Assessing Decision Maker Priorities and Decisions Support Opportunities: A Protocol for Planning Natural Resources Management.

Moseley, W.G., J.A. Earl and L. Diarra. (nd). L'Échelle des Moyens d'Existence et la Gestion Communautaire des Ressources Naturelles: La Décentralisation et les Conflits Agro-Pastoraux dans le Delta Intérieur du Niger au Mali. Under review for inclusion in *Les Actes du Séminaire International sur La Gestion des Ressources Naturelles en Zones Inondables Tropicales, Bamako, 20-23 Juin*. Institut de Recherche pour le Développement. Paris, France. (forthcoming in fall, 2001)

Moseley, W.G., J.A. Earl and L. Diarra. (nd). Livelihood System Scale and Local Natural Resource Management: Decentralization and Farmer-Herder Conflicts in Mali's Inner Niger Delta. Under review at *Natural Resources Forum*. (Submitted 11/6/00)

Conference Presentations

Moseley, W.G., J.A. Earl and L. Diarra. 2000. L'Échelle des Moyens d'Existence et la Gestion Communautaire des Ressources Naturelles: La Décentralisation et les Conflits Agro-Pastoraux dans le Delta Intérieur du Niger au Mali. Paper presented at the International Seminar on Integrated Natural Resources Management in Tropical Wetlands. June. Bamako, Mali.

Flora, Cornelia Butler, Jan L. Flora, Florencia Campana and Edith Fernández-Baca. 2000. The Advocacy Coalition Framework: A Theoretical Frame for SANREM to Address Policy Change and Learning. Paper presented at a Special Session of the 16th Symposium of the International Farming Systems Association and the 4th Latin American Farming Systems Research and Extension Symposium. November. Santiago, Chile.

Neely, C.L., E.T. Kanemasu and J. Earl. 2000. Creating a Continuous Learning System: Participation and Evaluation in Agriculture Development Projects. Paper presented at the 2nd International Cooperation Center for Agricultural Education (ICCAE) Open Forum: Evaluation of International Cooperation Projects: Centering on Development of Human Resources in the Field of Agriculture. December. Nagoya, Japan.

Decision Support System

Project Overview

Introduction

A suite of geo-referenced economic, environmental and biophysical models is being developed and linked to holistically assess the impact of changes in technology or policy on food, agriculture and use of natural resources in developing countries. Kenya and Mali are pilot countries, and East and West Africa are pilot regions for this research, which will generate products intended for more general application. The resulting Decision Support System (DSS) also will include critical foundation data for spatially explicit analyses and will provide access to other models and sources of relevant information through global networking. DSS is being developed and adapted for use at levels of scale from farm to global. A participatory approach is used whereby methods are developed and refined in collaboration with ultimate decision-makers and national scientists, extension personnel, and NGOs. Relevant real-world assessments are used as development-demonstration platforms and contribute useful case studies that address contemporary issues. This approach produces methods tailored to needs of specific users who participate in their development.

Project Objectives

- ▶ Develop improved capability to make informed decisions relating to the consequences of adopting specific agricultural and natural resource management technology, practices, and policy on sustainable agricultural development with a focus on integration at landscape/lifescape levels.
- ▶ Develop the capability to assess the impact of policy and management decisions related to the general area of food, sustainable agriculture, and natural resources management at levels of government ranging from provincial to global.

The DSS Project contributes to all three SANREM Program Objectives. The project addresses the more specific objectives related to development and use of assessment tools to determine the impact of policy and technology options in the context of broader program objectives.

Progress Toward Five Year Indicators

Outputs supporting local-to-provincial (landscape) decision-makers

Field studies were completed in the Rift Valley of Kenya and the Sikasso region of Mali. Analysis of current data and development of integrated models at the household, district and regional levels is ongoing. This provides new tools and data for evaluating the impact of technology and policy options to enhance food security at local levels. The output of national sector models serves as input to household or district models with regard to prices and quantities produced.

Outputs supporting national to global level decision-makers

National level economic and biophysical models were improved and are being used in case studies to address the most pressing problems identified by high-level decision-makers in Mali and Kenya. Ongoing engagement with decision-makers and collaboration with national and regional scientists are creating ownership of the DSS and are providing ongoing feedback to improve its utility. Long-term training for Malian and Kenyan scientists is providing national and regional expertise for training and continuing research. Ongoing training for analysts in key ministries of government is providing capacity to use the DSS in support of decisions on food security and sustainable use of natural resources.

Outputs supporting information exchange

The new strategies for INSAH include plans for evaluation and application of the DSS at regional levels in West Africa. As a result of ongoing collaboration with FAO's World Agricultural Information Center and other departments in the Organization, a global network of models and databases is being developed to assess options that enhance food security through sustainable use of natural resources. Methods for extrapolating research results from one location to another provide new approaches to evaluate technology options across countries. Models are being repackaged to make them more user friendly. For example, an Excel spreadsheet approach was developed to allow use of the Mali Agricultural Sector Model by non-expert analysts. Methods to evaluate and link the assessment of options for technology and policy at

varying levels of scale are progressing, providing decision-makers with the ability to assess the implications of national decisions at local levels and vice versa.

Benefits to the U.S.

The methods for acquiring and using spatially explicit information, and the further development of models and their linkages are applicable to the use of the DSS in domestic analyses in the U.S. What makes the DSS site specific are questions asked in case studies and the input data that drives the models. The updating of biophysical and environmental models will have immediate utility in U.S. analyses. The continuing linkage across the suite of models also is immediately useful for domestic analysis. The ability to define areas of geographic equivalence for extrapolation of research results from one location to another will provide an important planning and extension tool. USAID interest in providing these models to the CRSPs and the international agricultural research centers (IARCs) for USAID's R4 process further shows their use in the U.S.

continue toward the goal of incorporating the DSS into country level planning activities to achieve the goals of the World Food Summit – with interest in such linkages in both Mali and Kenya. The collaboration with FAO's WAICENT is creating an awareness and interest in the establishment of a global network of models and databases for use as decision tools in both developed and developing countries. The involvement of CMDT and the Saskawa Global 2000 project in Mali and the linkages between KARI, the Ministry of Rural Development and the Office of the Presidency in Kenya all point toward an active use of the DSS at household levels as well as at national levels. The DSS is being included as a planning tool in the new CILSS strategic plan, where there will be applications of the system to specific planning scenarios for multi-national engagement and for issues affecting the overall region.

Year 3 Impacts

Approach to Ensure Effective Impact

The DSS is expected to enhance the capacity of decision-makers in developing countries at multiple levels of scale as they consider impacts and trade-offs for policy options and as they plan and use technology to enhance the sustainable production of food. Success will be measured by the ability to increase the quantity of food (availability) and generate new economic activity from agriculture (reduce poverty and create access to food). For enhanced production of food to be sustainable, those considering new policy and technology must deal with the combination of food production and the sustainable use of natural resources. The DSS provides decision-makers with the capability to make rational and balanced decisions.

Status of Technology Transfer

Since research is still underway, it would not be expected that the DSS has been fully put into practice. In years 4 and 5, the emphasis will shift toward the technology transfer process, helping to ensure that the goals of application are achieved. For the present, there is good evidence of interest in the application of DSS by country level decision-makers in the pilot countries of Mali and Kenya. Training of analysts in various ministries and in the national research institutes is underway with active interest of participants. Negotiations are underway with FAO to apply the models to ongoing studies dealing with integrated production systems and the Special Programme for Food Security. FAO is providing support for the pilot studies. Collaboration with the FAO FIVIMS Secretariat

GLO 00-21

Global Level Analysis

Global economic models are used to assess the impact of international trade on national markets and to examine the effects of global climate change on developing countries. Satellite imagery is coupled with biophysical models to assess multinational impacts of drought, disease and other factors affecting the status of food security. In year 3, the global Agricultural Sector Model (ASM) has been used to assess the impact of climate change and climate change mitigation on agricultural productivity in developing countries (including African countries). Efforts are now underway to develop paired country and global assessments on climate change and carbon sequestration initially headquartered in Mali, but later in Kenya, Senegal and Uganda.

The model also has been used in the COP-6 round of Kyoto negotiations. Methods were developed and used to employ NOAA rainfall estimates for modeling forage availability in southern Kenya. Cold cloud duration, relative humidity and other weather station data were combined with NDVI data in the PHYGROW forage model to generate an interpolated surface map of forage production. A time series of maps shows the progression of drought and resulting loss of plant biomass.

GLO 00-22

Development of Economic Models

Economic models are being developed and used to assess economic and natural resource impact of policy and technology alternatives relevant to food security and the sustainable use of natural resources. Agricultural sector models (ASM) for Kenya and Mali simulate crop and livestock production activities in the major agricultural areas of the country and can be used to assess the impact of changes in population growth, technological improvement, and policy regimes on parameters of interest such as prices, consumption, production, trade, producers income, and benefits to consumers and the society as a whole. This year, the model was updated by incorporating additional crop and livestock production inputs and by adding additional post-harvest components. Farm level studies involving both economic and biophysical components of the DSS development were initiated in the Sikasso region of Mali and the Rift Valley of Kenya. A spatially explicit analysis provided a sample frame for an intensive farm level survey in these areas. Farm surveys were completed and the ASM is being revised and extended in both countries. This provides databases and ASMs for the two countries. These surveys provide input data for farm, regional, and national models in the DSS.

Experience with African colleagues and users showed that further development of farm level

assessment was needed to meet the needs of farmers and others decision-makers at sub-regional levels of scale. The recent farm surveys and a second generation of farm level models resulting from studies done as a thesis project by Dr. Jeff Vitale, who joined the Group in 2001, are being used to refine and make our farm level assessments more meaningful and better connected to the overall suite of models in the DSS.

GLO 00-23

Development of Biophysical and Environmental Models

To further develop the methods for integration of models in the DSS and to acquire additional data for modeling at sub-national and national levels in Mali and Kenya, two major field studies were initiated in the Sikasso region of Mali and the Rift Valley of Kenya. Within these regions, zones with similar geographic and biophysical characteristics were defined using spatially explicit analysis. These zones helped define the sampling frame for the field studies. Crop, forage, and livestock models are being run for each of these zones to simulate the performance of regional agriculture. Based on a stratified rapid rural appraisal of more than 100 farms in each region, a subset of these farms was selected for intensive survey. The surveys provide information on farming practices, commodities, cost of production, yields, prices and household consumption. These surveys are completed and biophysical and related economic characterization are underway. Biophysical models were enhanced by: improving functionality of the forage model called PHYGROW to better accommodate tree-dominated rangelands; developing a new interface for EPIC called Soil, Water, Air and Nutrient System (SWAN) to improve user-friendliness and environmental assessment; including a new French version of the livestock nutrition model (NUTBAL PRO) to allow livestock production assessment; and improvement of new technologies to allow Web linkages with the models used in the impact assessment process including the PHYTHON language links to NUTBAL and JAVA- based common modeling environment (CME) links to PHYGROW.

GLO 00-24

Spatially Explicit Analysis

The Spatial Characterization Tool (SCT) and Almanac Characterization Tool (ACT) are being developed to provide interconnecting linkages or information flows through which detailed simulation models can be effectively interfaced with spatial data and the outputs delivered to less detailed simulations (i.e. other models in the GDSS). These tools serve as both an output visualization device and an internal database input organizer. SCT is a GIS application tool that accesses gridded environmental data, point data and vector-

based information. The tool provides a suite of querying capabilities aimed at the characterization of agricultural and agroecological environments. It operates with Arc Info and Arc View as GIS engines. The ACT is a spatially related information and analysis tool prepared at country level and capable of being used at all levels of scale from national to household. SCT/ACT are part of the suite of interactive models and generate input to sector and farm level models. Previously, a number of SCT and ACT have been developed with separate funding for applications for several countries in East Africa. The DSS links these tools to other models and uses it as a mechanism for organizing and accessing databases and other information in a spatially coherent manner.

The SCT and ACT are being extended for use at the onset of DSS analyses to spatially define the problem and define inputs to other models. They also function to link and facilitate iterative interactions between models in the suite and finally to interpret the spatial projections of outputs from one level of scale to another. The ACT was developed and expanded and is now being used as part of the total interactive DSS.

Three concurrent activities have been underway in this activity over the past year: 1) the creation of the sample frame for farm level surveys conducted in the Sikasso region of Mali and collaboration in defining the farmer sampling procedures, 2) the creation of an appropriate sample frame for the counterpart farm level surveys in the Rift Valley of Kenya, and 3) the delivery of version 3.0 of the Almanac Characterization Tool.

The principal investigator of this project entered the private sector on June 1, 2001. The co-principal investigator, Dr. Raghaven Srinivasan, who has been a member of the DSS team since the inception of this project, will continue the studies under this activity. In addition to its previous scope, it will be the focal point for acquiring and using NASA and NOAA weather data for impact assessment at varying levels of scale.

GLO 00-25

National And Regional Applications of Decision Support Systems

Specific case studies conducted in East and West Africa are involved in developing and evaluating the various elements of the DSS. Through ongoing consultation with senior decision-makers and scientific collaborators in Mali, Kenya, and related regional associations, there is active collaboration with the Food Insecurity and Vulnerability Mapping System (World Food Summit) to develop applications of the DSS that provide decision-makers in developing countries with methods to evaluate options that enhance food security. The studies are aimed at developing sustainable means of increasing food security. In the past year, research

has been done to assess the impact of alternative strategies to maintain current food prices and levels of nutrition in Mali and Kenya with population projections out to the year 2015. Options that were assessed include intensification and extensification of production. The consequences of using today's technology to meet tomorrow's needs were estimated. Task forces of potential users in Kenya and Mali and at corresponding regional levels are evaluating applications of the DSS for food security analysis. FAO and the U.S. CRSPs are evaluating the DSS for applications related to assessing options for improving integrated production systems and for evaluation of impact of previous research.

GLO 00-26

Delivery Systems and Capacity Building

In year 3, we conducted multiple workshops and seminars that are described in GLO 00-025. In addition, long-term training in use of the DSS is underway at Texas A&M for two Malian scientists, one economist and one biologist. The Mali and Kenya Almanac Characterization Tools were delivered in those countries and training sessions held on their use. Databases acquired in field studies and simulations were made available for scientists and others to use. Task forces of interested users from the research and analysis communities are being given hands-on experience with the models. This will be expanded when scientists now engaged in long-term training return to Mali. Software to facilitate access to models and databases on a global scale was modified to be useful in FAO's World Agriculture Information Center.



Global Level Analysis

Principal Investigator

Introduction

USAID, FAO and other donor development agencies have ongoing and emerging programs that assess the global status of hunger, trends in food insecurity and vulnerability, and the capacity to produce food, fiber, and forest products in a sustainable manner. Information to support these programs comes from sources that range from local through national to global (e.g., satellite imagery). USAID also needs methods that can be used by their collaborators to assess the impact of research investments in both *ex ante* and *ex post* analyses. The Decision Support System (DSS) methods being developed by the SANREM team at Texas A&M provide tools for these assessments at multinational and global levels. The tools are being used to conduct specific case studies relevant to the concerns of development agencies that think at the global level.

The DSS development involves collaboration with three FAO global programs to develop methods to extend the breadth and depth of analysis at the global level. These include the Food Insecurity and Vulnerability Mapping Information System (FIVIMS), the Global Terrestrial Observing System (GTOS) and the World Agriculture Information Center (WAICENT). Methods are being developed to assess the current status and trends of food security, the factors that determine this status, and the impact of alternative strategies, policies, or use of new technology to improve the availability of and access to food using sustainable production methods. We are working with those entities having the mandate for global assessments to develop or extend the assessment at national and regional as well as global levels.

The Global Agricultural Sector Model simulates US agriculture and its interaction with foreign markets such as China and clusters of African countries. It is being used in the US for assessment activities related

to the COP-6 negotiations dealing with climate change as it regards the agricultural response. Interpretations of satellite imagery and mapping this in relation to ground based information on food and natural resources is being undertaken to provide a global perspective for the DSS.

Objectives

- ▶ Expand and apply Global Agricultural Sector Model (GASM) to development of national and regional impact assessment methods linking economic and natural resource management goals.
- ▶ Use GDSS methods to expand the ability to interpret satellite imagery for decision-making at national, regional and global levels.
- ▶ 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.

Methods or Approach

Expand and Apply Global Agricultural Sector Model

Attention has partly turned to the application of the GASM to national and regional impact assessment issues involving linked economic and natural resource management goals and the incorporation of GAMS features into a 100 year Forestry and Agriculture Model as well as the inclusion of greenhouse gas mitigation features into GASM. The resultant models have been used in this and associated projects to project the impact of change principally in terms of climate, El Nino Southern Oscillation events and climate change mitigation on forest behavior, food availability and cost in the U.S. and other parts of the world.

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Investigations were also done on carbon sequestration issues regarding permanence, leakage, and developing country carbon program implications. Some non-GASM efforts were also pursued in the climate change arena examining sustainability issues with respect to climate change and pests, climate variability and environmental protection. Efforts are now underway to develop paired country and global assessments on climate change and carbon sequestration initially headquartered in Mali but later in Kenya, Senegal and Uganda.

Predicting Forage Availability Using Satellite Imagery

The normalized difference vegetation index (NDVI), which is derived from satellite imagery, and rainfall estimates were used to determine the extent to which satellite derived information can be used to project simulated forage production using the PHYGROW model during specific intervals of varying rainfall. A geostatistical method called co-kriging was used for this analysis. It involves using the weighted linear average of the sampled points along with the spatially rich satellite data to estimate forage production in unsampled areas. For this to work efficiently, the satellite data has to be correlated with the forage at the sample points.

Acquisition of Global Database on Climate Surfaces

In collaboration with the International Maize and Wheat Improvement Center (CIMMYT), we recently acquired a global database of monthly climate surfaces. These surfaces, produced by the Climate Research Unit of Norwich University (UK) under contract from International Water Management Institute (IWMI), offer a low-resolution look at the entire globe. The climate surface models can be exercised over the whole of these global databases providing the Impact Assessment Group with a first look at global extrapolation zones. Two global soils databases also have been recently acquired. These databases will provide a representative soil pedon for all terrestrial areas on the planet. These foundation databases will be available and useful for all subsequent model development efforts.

Results and Discussion

Global ASM and Climate Change

GASM has been used to examine the impacts of climate and climate change mitigation induced changes in agricultural productivity in developing countries on U.S. agriculture. Specifically, GASM played a substantial role in developing the United States Global Climate Research Program's U.S. national assessment, the development of agricultural and forestry sink information and the COP-6 round of the Kyoto negotiations, and in illuminating total agricultural response involving sink sequestration, biofuels,

ruminants, manure, and fertilization responses. It also played a role in analyzing ENSO proactive decision-making alternatives and their consequences for world trade.

Predicting Forage Availability Using Satellite Imagery

The PHYGROW simulation model was used to derive the total forage available for cattle at each of 30 simulation points in Southern Kenya. Rainfall data used in the simulations were extracted from the NOAA daily rainfall estimate archive (http://ftp.ncep.noaa.gov/pub/cpc/fews/archive_daily_est/) for each simulation point. The NOAA rainfall estimates are derived daily for a large portion of Africa using an algorithm that combines METEOSAT 7 cold cloud duration data, weather station data, relative humidity and wind data (Herman et al. 1998). The total forage available output was then co-kringed with NDVI data to generate an interpolated surface map of forage production. The resulting interpolated surface did a good job of predicting total forage available for the simulation points. The cross-validation regression showed a reasonable correspondence between estimated total forage available and the simulated total forage available for the household points ($r^2=0.87$, SE prediction=249 kg/ha). Co-kriging using NDVI shows promise in creating mapped surfaces of available forage for regions where limited numbers of points can be simulated due to economic and computing constraints. A time series of these maps clearly shows areas that may be susceptible to low forage conditions due to drought and spatially defines states of nature relative to grazing land capacity. For the Southern Zone of Kenya, the drought of 2000 entered the zone in May 2000 and progressed from the northwest, pushing southward and eastward through the zone. There was little evidence of pockets of drought other than in the extreme western portion of the zone. These maps tracked what was observed in the region.

Linkages with EROS Data Center

Communications have continued with EROS on using land use and land cover data to help develop virtual landscape modeling environments based on NDVI and LANDSAT 7 data. To date, our principal efforts have been on linking point-based models of forage production and diet quality based on fecal samples in order to extrapolate responses across regions. We have also made linkages with key personnel at the NOAA Climate Prediction Center to create our FEWS NET weather data server.

Ghana NDVI and Near-Infrared Spectrometry (NIRS) Fecal Profiling

For the past 11 months, a Ph.D. student has been collecting geo-referenced fecal samples from a stratified set of pastoral and agro-pastoral households

throughout the rangeland regions of the northern two-thirds of Ghana, in a zone similar to the Sikasso region in Mali. In December 2000, he completed collection of 2000 fecal samples. Data obtained from those samples will be used to explore the use of NDVI data to extrapolate diet quality across broad regions. If this endeavor is successful, we will have a method to allow nutritional profiling across virtual landscapes in areas similar to Sikasso and a source of nutritional profiles for animal production models to serve the economic component of the GDSS.

Impact

GASM and associated forestry models were directly used by U.S. negotiators in the formulation of the U.S. negotiating position for the November meeting of the U.N. Convention Framework on Climate Change and will be used again in the upcoming July meeting. GASM also has been used in assessing the value of multinational satellite-based ocean observing systems. When the project is completed, we will use the GASM as an input to the DSS suite of models to evaluate the effect of global markets on national systems in developing countries and for assessment of the impact of climate change on food security in these countries.

The use of satellite imagery and related use of biophysical models to assess options for agricultural development on a large geographic (regional to global) scale will be a component part of the total package made available to decision-makers, including both investors in development and in developing countries.

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(See also GLO 00-23)

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Development of Economic Models

Introduction

The Agricultural Sector Model (ASM), which provides interaction among commodities and otherwise reflects the total agricultural sector in a given country, is a key component of the suite of models being developed in the DSS. Methods to streamline the development of these models to facilitate multinational impact assessment are being developed. Other economic models include rural household and farm models derived from the Farm Level Income and Policy Simulation Model (FLIPSIM), which simulate the economic performance of individual farms in response to changes in policy or technology. These models predict changes in probability of economic survival, changes in debt, and capital liquidity in response to introduction of new technology or policy. Other household level models used in previous studies provide outputs, including an index of vulnerability, net food surplus, index of mobility, equilibrium values for resource allocation, and household production to maximize profit and minimize cost. In year -three, increased emphasis was placed on linking economic and natural resource management models in order to determine optimal estimates of the tradeoffs between meeting short-term food needs and long-term sustainable production. The Global ASM provides inputs on markets and prices of traded commodities to national ASMs. The national ASMs provide inputs on prices to the suite of farm models. ASMs also account for various natural resource constraints that limit the adoption of new technology or policy at the several levels of scale.

Objectives

- ▶ Adapt, extend, or create economic models to be linked with the biophysical and environmental models in the GDSS to provide quantitative estimates of the impact of alternative

policy options or technology introductions in the agriculture of developing countries

- ▶ Develop linkages between economic models at varying levels of scale to improve the ability to forecast impact of technology from household to global levels
- ▶ Continue to add the risk dimension to economic models at varying levels of scale to assist decision-makers in the evaluation of the policy and technology options
- ▶ Evaluate the trade-offs between sophistication and quality of output versus simplicity and ease of use of economic models in the developing world
- ▶ 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

Methods and Approaches

National ASM economic models have been developed for Mali and Kenya that include regional delineations for the major (provincial or regional) political administrative regions of each country. Major food crops, cash crops and livestock commodities are included in each country's ASM. To better evaluate food security issues at a smaller resolution, the ASM was extended to district level production activities in the Sikasso region of Mali. Field studies of households in the Sikasso region were conducted to provide a current baseline model of economic and environmental factors affecting the enterprise and the adoption of new technology. The results of these studies were used to provide farm budgets for three zones of Sikasso, North (Koutiala and Yorosso), Central (Sikasso and Kadiolo), and West (Bougouni, Kolondjeba and Yanfolila).

Our experience with Malian researchers and users showed that the

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FLIPSIM model did not adequately fulfill their needs, especially in evaluating the impacts of alternative technologies on risk and poverty reduction. We deliberated with the Malian researchers on the nature of a farm level economic model that may better fulfill the needs of Africa and is linked with ASM and other biophysical models such as EPIC and NutBal. The new farm level economic model will reflect natural resource impacts of farming practices with and without technological change. The model will primarily focus on farm level food production strategies that (1) are risk minimizing for a targeted level of production required for sustenance of farm families, (2) meet cash expense outlays, and (3) maximize net income for the farm.

Results and Discussion

There is growing interest in the application of the economic components of the DSS by regional and national users in developing countries and agencies monitoring progress on international conventions such as the World Food Summit, the Convention to Combat Desertification, and the United Nations Framework Convention on Climate Change. To improve linkages between farm, sub-national, national, and regional impact assessments, methods are being provided by ongoing research. In this regard, the major accomplishments of this activity in this year include the following:

To obtain primary data, household surveys were conducted in Mali and Kenya. The data were used to update existing ASM budgets. To reflect greater production detail in Sikasso region of Mali ASM, the region was divided into three zones, each comprising two to three districts in the region. The data provided by the household survey conducted in Mali are providing input to these stratified models. A similar stratification has been done in the Rift Valley of Kenya with similar results. These studies have improved the linkages between household, sub-national, and national economic models and provide a better integration with biophysical and environmental models in the DSS.

An Excel-based interface was developed for the ASM so that scientists from different disciplines can use it more easily. This makes the ASM available and useful to users with less in-depth exposure to the ASM per se. The interface allows use of the ASM but does not allow modification of the model. Such modifications can, however, be made by those with more in-depth experience with the model, including researchers in Mali and Kenya who have participated in its development and use. A training manual was prepared that the Malian researchers will use for training West African scientists.

Foundations were laid for a new farm level model

in consultation with collaborating Malian researchers. This model will be geared to facilitate linkages with ASM and other biophysical models and will serve as the critical tool for farm level natural resource, food security and income impacts of improved technology.

The Food Insecurity and Vulnerability Mapping Information System (FIVIMS) is a product of the World Food Summit (WFS) intended to monitor progress towards achieving the goal of reducing hunger by 50 percent in the year 2015. Through a memorandum of understanding with FAO, the GDSS is being developed to provide analytic capacity to assess options to achieve WFS goals. The FIVIMS Pilot Studies in Mali and Kenya used the Mali ASM and the Kenya ASM to examine generic technology and policy interventions to attain food affordability and food availability in 2015. Projections were made of food quantities, prices, and costs associated with projected 2015 populations and various interventions. Interventions included policies to achieve full adoption of new sorghum and millet production technologies, intensification of current land use, introduction of other new technologies to increase crop and livestock productivity, extensification of land use by bringing additional marginal croplands into production, and import/export policies for food commodities and industrial inputs. Model outputs included prices and quantities of food commodities produced and consumed domestically, imports of food commodities, and the productivity increases needed to maintain near-current real food prices in Mali and Kenya. The results provided the basis for discussion in a major workshop held in Mali (Bamako, July 2000) and in Kenya (Nairobi, September 2000) with key decision-makers in the governments of each country to plan more detailed studies in line with the Sikasso Region of Mali and the lower Rift Valley Region of Kenya on food security options.

Climate change and Carbon Sequestration are two important research areas. The current research identifies Africa as a region vulnerable to climate change, and at the same time, a potential contributor to global efforts on carbon sequestration by modifying activities in the agriculture sector. Planning was initiated for a study that will evaluate economic impact of climate change and carbon sequestration options in Mali. The tools developed in this study will be readily usable in other African countries as well.

Impact

The DSS, including its economic modeling components, are still under development and their capabilities for decision making are being enhanced to better suit the needs of the end users in the developing countries and elsewhere. There is growing interest and commitment by research institutions and decision-makers in Mali and Kenya and at the regional level

through CILSS and Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) for the use of these models. Plans to use the DSS in FAO are being actively developed. Under GLO 00-26, we describe the capacity building and networking efforts that are underway to improve the probability of adoption of the system. The further development of economic models in year 3 enhances the capacity of decision-makers in the developing countries at multiple levels of scale as they consider impacts and trade-offs for policy options and the planning and use of technology to enhance the sustainable production of food. The linkage of economic models with the biophysical, and environmental models, will provide decision-makers with the capability to make decisions whose consequences spread beyond the target area of concern.

With the cost of obtaining enterprise level data increasing at a much higher rate than the cost of obtaining similar information through modern information technologies, the benefits of switching to spatially- based analysis continues to rise. Spatially-based analysis requires only a minimal amount of field data to provide ground-truthing, and can provide policy makers with decision support information that encompasses a much larger proportion of their population than would be possible with conventional research methods that have been applied in the past.

Publications

See GLO 00-21



Development of Biophysical and Environmental Models

Introduction

Biophysical models are used to predict the performance of crops or livestock based on historical data, surveys, and expert opinions. When such models reasonably replicate historical data, they may be used to estimate the biological impact of the introduction of new technology or policy options in advance of detailed experimental or practical experience. They may also be used to identify areas of similar geographic potential through geographic analysis. These models generate the performance data that are needed as input to both farm level and agricultural sector economic models. Biophysical models form a key bridge between economic models at varying levels of scale and environmental models that estimate the impacts of new technology or policy options on natural resources.

Objectives

- ▶ Develop and demonstrate the utility of biophysical models to estimate performance of crop and livestock species under developing country conditions.
- ▶ Further develop and apply watershed models to assessment of environmental and economic impact of alternative policies and technologies.
- ▶ Develop and use improved indicators of land and water degradation as a function of agricultural practices involving intensification and extensification of production

Methods or Approach

Two studies in the Sikasso region of Mali and the Central Rift Valley of Kenya were initiated to further develop methods of integrating biophysical models with economic and environmental models. Biophysical data from both study sites were stratified using themes of climatic

clusters, soil association, distance to market and rural population density to define unique simulation environments. To establish a basis of biophysical representation of the farming/livestock systems, a rapid rural appraisal was conducted on approximately 100 farms in each location. Farms were randomly selected within the simulation zones. In Sikasso, the village was the point of reference for farm selection while in the Rift Valley 100 geo-referenced points were proportionally allocated to the simulation zones and the nearest household from the point was surveyed.

SPSS K-means cluster analysis was conducted using a series of variables representing livestock numbers, crop acreage, crop mix, mechanization, and land/labor ratios. The variables were standardized (Z scores) to overcome problems with varying scales. In the Sikasso, four farm-types were recognized: Large, Moderate, Small and Subsistence. In the Rift Valley study, five farm types were defined by the stratification procedure: (1) Large Livestock/Large Land/ Large Cropland, (2) Large Livestock/Moderate Cropland, (3) Small Livestock/Small Land/ Large Labor, (4) Moderate Livestock/ Moderate Land, and (5) Small Livestock/ Small Land/Small Labor.

Representative farms were selected based on the distance from cluster centers for each of the K-means cluster groups and the representation of each cluster type in each ASM sectoral zone. Using this approach, households in each cluster were sorted in ascending order by distance from cluster center for the appropriate cluster analysis. Modal farms for more intensive surveys were selected within each cluster by ASM sectoral zone in each of the case study areas. This resulted in selection of 11 farms in the Sikasso sites and 13 farms in the Rift Valley sites. Intensive surveys have been conducted on all farms in both sites

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and data have been organized into databases. Currently, these data are being organized for economic and biophysical analysis. Crops and management practices are being analyzed with the SWAN model (an upgraded form of the EPIC model – see below) while associated rangeland data for grazinglands surrounding the test sites are characterized with PHYGROW. Livestock requirements and demand are being modeled with the NUTBAL PRO. Our collaborating scientists from Mali and Kenya are assisting with the analysis as part of the capacity building process.

Results and Discussion

The PHYGROW model is designed to simulate forage yield and stocking adjustments of complex, multi-species plant communities for multiple grazers and associated hydrology. During the reporting period, PHYGROW underwent several improvements to include data for plant growth functions and deep-rooted tree species, and to improve handling of batch files for hundreds of simulations. A metric version of NUTBAL PRO was finalized that includes data for African livestock rearing conditions and has the framework for multiple languages (French, Spanish). The French version is ready for deployment in West Africa.

A new interface called the Soil, Water, Air and Nutrient System (SWAN) has been added to the EPIC model. SWAN is a modification of the CroPMan Shell (a system previously designed for addressing individual farm and precision agriculture modeling issues) and is designed to address technology impact and policy issues. This new interface is more user friendly and is structured to allow easier adaptation for international use. We worked with Dr. Jimmy Williams (the Agricultural Engineer and builder of the EPIC model) to modify the EPIC code to accommodate the SWAN data structure. This restructuring included the separation of soil, weather, crop/management, scenario, and location files into individual database management tables. In addition, routines and capabilities added to the SWAN version of EPIC include: 1) the change of soil water holding capacity as a function of organic carbon, 2) the addition of a sub-routine that addresses the effects of salinity on plant water availability, 3) and, by summer of 2001, routines will be added to address carbon management and carbon sequestration issues. The modifications of CroPMan that were added or modified by SWAN include: 1) the ability to run multiple crops in a year; 2) the ability to simulate inter-cropping (multiple crops at the same time); 3) the capacity to manage batch runs for creating policy scenarios; 4) reinstallation of user controlled management switches that had been turned off by CroPMan but were needed to address

management issues in West and East Africa; 5) the addition of African crop parameters and tillage equipment; and 6) the ability to create and store data for new soils, weather, and management systems. Weather files were updated from 1994 version to 2001 by adding six years of daily weather data. This longer file (now 1977 to 2001 for many stations) was processed to obtain new weather generator coefficients needed by EPIC.

Impact

Estimating potential of technology in geographically similar areas: Proof of concept for this methodology has been demonstrated (<http://cnrit.tamu.edu/IMPACT>). Extrapolations of an INTSORMIL sorghum production system from Mali to Senegal and Burkina Faso were completed. Extrapolation of smallholder dairy technology from Kenya to Uganda and Tanzania was also completed.

Specific Case Studies: The committee of users and collaborators has approved the topics to be modeled and the field studies for collecting farm level data for model development have been initiated.

Delivery of PHYGROW and NUTBAL PRO to AGHRYMET: The metric version of PHYGROW and NUTBAL PRO were delivered to Djaby Bakary at AGHRYMET. Mr. Bakary is a member of the advisory group working with SANREM GDSS in Mali with our IER collaborators. We are making arrangements for his short-term training at TAMU in use of these models.

NUTBAL PRO Metric Ready for Delivery to Collaborators: Our collaborators in Mali (Dr. Hamidou Nantoume, IER) and in Kenya (Dr. Robert Kaitho, KARI) received copies of the NUTBAL PRO software and were trained in its use. The animal production software is in English, French and Spanish.

Geo-statistical techniques were tested (co-kriging, kriging) in Kenya to determine if stratified point-based modeling of forage production can be extrapolated to large landscapes using EROS NDVI data for Africa. The results indicate a reasonable prediction with a standard error of +/- 300 kg/ha of predicted forage. Refer to GLO-21 Global Level Analysis for a more complete description of this activity.

An initial task was completed to improve the common modeling environment (CME) software to link with spatial tools such as the Knowledge Information Management System at FAO.

The primary impact to date of this activity area is the pre-positioning of mission critical biophysical data needed by modelers in the countries of the pilot studies (Kenya and Mali). On completion and with effective technology transfer, decision-makers will have advanced analytical tools to research technologies or test policies that will lead to improved natural resource management and address future food security issues.

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Spatially Explicit Analysis

Introduction

The Decision Support System for Planning and Evaluation of Policy and Technology (DSS) provides a holistic approach to assessment of the impact of technology and policy options being considered by decision-makers at varying levels of scale. The overall system includes economic, biophysical, and environmental models that are linked together in a spatially coherent framework for integrated analysis. Research data, secondary reported statistics, data acquired from national or international sources, and the output of the various models are all being organized in this framework. The ACT contributes significantly to the capability to organize, retrieve, and display these various databases in a coherent manner. The development of the ACT and its predecessors was supported with funds outside of SANREM. The product has been applied as a stand-alone tool for data management and display. Its linkage to the overall DSS is intended to move past this function to make it an integral part of the total system of interrelated models.

With the departure of the principal investigator on this part of the DSS, we assess the status of this part of the effort to be in a logical and stable transition of leadership and application. The Mali and Kenya ACTs are in hand and serving the needs of the ongoing case studies to be conducted in these countries in year 4. The source code for the ACT is available to Texas A&M users. Deliverables in the form of CD-ROMs are available for both Kenya and Mali ACTs. The co-principal investigator, who is Director of the Texas A&M Spatial Sciences Laboratory, is a well trained and published engineer with a career involvement in GIS related activities. He is familiar with the ACT and other systems that function in a similar way. We are convinced the project will be well served in this area of continuing interest and importance.

Objective

- ▶ 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.

Methods and Approaches

New tools have been incorporated into the ACT to meet the needs of Impact Assessment Group team goals. An area-weighted averaging utility has been built for IAG use with an area calculator available in the new release of the ACT (version 3.0). Significant functionality improvements have been added to the software. Improved metadata handling, improved graphics and a more robust interface are further complemented by the additional modules for map layout (a cartographic tool), a shapefile editor, a tool to automate conversion of GPS coordinates into a shapefile for full integration into the ACT, and a full intersection capability. Several of these new functions were created in direct response to feedback from in-country training.

Results and Discussion

The Sikasso region database provided with the Mali ACT 2.02 (July 2000) has been further enhanced by the addition of several databases: a higher resolution soils database; the location of Malian Cotton Corporation (CMDT) villages; the location of villages under study by the Mali Institute of Economic Research (ESPGRN) villages; a crop-use intensity database based on NDVI imagery from the U.S. Geological Survey; and the location of a national meteorological database with daily precipitation data. These data serve to provide the IAG with

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the foundation database to establish a spatial sampling frame for a high-resolution examination of activities in the Sikasso region and they establish an appropriately finer resolution biophysical database for subsequent simulations (planned for 2001).

Using spatially explicit analysis (interpolated surfaces, spatial models of the surfaces, and a cluster analysis of the spatial model results), a set of 11 simulation zones in the Sikasso region was defined based on precipitation and temperature, soils type, and population. Three sub-areas of the Sikasso region were defined along district boundaries to link their associated economic information with the ASM.

Three sub-areas of the Sikasso region were defined along district boundaries to link their associated economic information with the ASM. For each simulation zone, representative farms were selected for subsequent economic, technology adoption, and biophysical (modeling) analysis. Two sets of geo-referenced farm level data were identified: CMDT maintains current and historical data on the farms that use its services and the IER monitors a number of farms in parts of the Sikasso region for which there are historical data on yields and other aspects of performance. At the village level, there is a general farm census that describes the use of the resource base controlled by the village. This database includes estimates of farm size and attributes and census data identifying individual farmers.

With these data, the Group conducted a rapid appraisal to create a sample of farms that represent the spectrum of activities in the region. The simulation zones represent the highest order stratification for the Sikasso region. Once set, these simulation zones provide the basis for identification of representative farms for more detailed assessment and subsequent inputs to models. We subsequently recorded, for each representative farm, the level of infrastructure that supports the village in which the farm resides.

The design of the Rift Valley sample frame originated from a workshop at KARI headquarters in Kenya in September 2000. In an iterative fashion, the broad sample area was defined along district borders (to meet ASM needs) and crossing the range of physical environments (and subsequent land use practices) that characterize the Great Rift Valley of Kenya. A rapid appraisal survey was conducted early in 2001 (results reported elsewhere) based upon a spatial sample frame designed to reflect the variation in population density, market access, and biophysical conditions. Farms for intense survey were selected from the set of farms in the rapid appraisal. This effort sets the stage for future simulations (biophysical and economic) based upon representative farms and their extrapolation (or representative area) domain.

Version 3.0 of the software is characterized by: increased functionality aimed toward the long-term

goals of a robust GDSS; improved metadata handling; improved visualizations; better cartographic output; automated import of GPS data; more robust GIS technology (e.g., full intersect of multiple layers); and a series of tools to facilitate spatial awareness of target environments (distance, area, and other calculators, improved legend management). Version 3.0 of the software includes a 'beta' release of several interpolation routines to better facilitate observation of trends from point observations over space.

The Kenya ACT was completed in year 2 of this effort and previously reported. For Mali, the ACT was delivered with in-country training in July 2000, with special attention given to the regional plans for studies to extrapolate results from one country to another. Toward this end, the Mali ACT contains simulation zones and simulated crop results for both Burkina Faso and Senegal. In addition, in cooperation with CIRAD, the Mali ACT was provided with a French language tutorial/manual. Finally, the Mali ACT included a separate, higher resolution database specifically organized for the Sikasso district.

Impact

The Mali and Kenya ACTs are early deliverables that have been put in the hands of users in the national research systems of the two countries. Training in their use has been provided. In a separately funded development, similar country level ACTs have been provided to a number of East African countries. Negotiations are underway for the use of the Kenya ACT by the USAID regional office in Nairobi. This software is presently available on CD-ROMs; next generation materials will be Web-based.

Full use of the ACT awaits completion of the overall DSS development. However, work under this activity is directly linked to and contributes to the products of ongoing development and case studies. The spatial sample frame and subsequent rapid appraisals provided the data necessary to select representative farms for further detailed survey and future simulation efforts. These representative farms have a spatial domain into which they are defined as being representative. In this manner, the link between farms, simulation of biophysical and economic activities, and impact over space was created.

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National and Regional Applications of Decision Support Systems

Introduction

National and regional applications of the DSS are being made in Mali and Kenya and are established as FIVIMS-GTOS Pilot Studies. These and other such efforts involve collaboration with the Secretariat for the Food Insecurity and Vulnerability Mapping Information System (FIVIMS), the FAO Worldwide Agricultural Information Center (WAICENT) and include several activities within the FAO Department of Sustainable Development. The application of DSS models is conducted using case studies specifically applicable to our national partners. Decision-makers at various government levels counterparts in national agricultural research and extension systems are engaged.

The overall strategy is to use the priority of the commitments of developing countries to international conventions and the points of contact in FAO to add perceived priority and to promote collaboration in developing methods to achieve the goals of these conventions at the national level. This provides a means of gaining visibility and priority at the national decision-maker level for the suite of models being developed under DSS. Their participation from the outset is helping to ensure ownership and use of the products of this research in enhancing the sustainable increases in food production and natural resource management. In addition to linkages with national decision-makers, we will also engage decision-makers at other levels, from farm to global, in the development of the DSS integrated methodology package for impact assessment.

Objectives

- ▶ 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

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

Method or Approach

The DSS is being developed with active participation of national research programs and regional organizations that promote linkages among national programs. Our collaborators participate in the planning, conducting, and interpretation of collaborative research. National farm organization advisory committees and planning task forces on model use are employed to ensure relevance and focus of the products. Special attention is being focused on collaboration with FAO and SANREM partners in the applications of the DSS at regional and national levels.

Case studies involve defining a set of scenarios for either *ex ante* or *ex poste* evaluation of the consequences of policy or technology options. Spatially coherent data are either acquired or, where necessary, modeled to provide input for the several models in the DSS. Outputs from one model provide input to another model in an iterative manner. Baseline studies define the performance of the agricultural sector and relevant sub sectors from both an economic and biophysical perspective. Changes resulting from the policy or technology options being considered are compared to the baseline situation in the model. Case studies often reveal needs for further development of the models to answer relevant questions. One of the challenging tasks is to develop better methods of modeling the effects of change at varying levels of scale. We work at scales from farm to multi-national levels. Close collaboration with national partners in research, extension, NGOs and analysts in various

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ministries is required to maintain focus on needs, guide the approach, and contribute to interpretation of results.

Results and Discussion

A major report on the effort supported by several sponsors was completed in September 2000. It is titled *Impact Methods to Predict and Assess Contributions of Technology (IMPACT)* (<http://cnrit.tamu.edu/IMPACT>). This report deals with case studies evaluating the impact of an INTSORMIL– IER sorghum production system using improved germplasm, ridge tillage for water management and increased use of fertilizer. Results from this study were extrapolated to Senegal and Burkina Faso using a method called geographic equivalence developed in these studies. The evolution of smallholder dairy technology in Kenya was the other major case study reported. Again, the geographic equivalence method was used to extrapolate the results to Tanzania and Uganda.

After the inaugural workshop on this study that was held in December 1999, a second planning workshop on the Mali Pilot FIVIMS Study was held in July 2000 with representatives of government, the national research institute, and selected NGOs. This resulted in selection of specific case studies to be undertaken as part of this year's activities. This was followed by a meeting of research collaborators in November 2000 for final selection and development of specific plans for conducting a major field study on farms in the Sikasso Region of Mali. Studies underway include a major case study on the impact of intensification on cropping systems involving assumptions of an extension of technology using existing research results coupled with an *ex ante* analysis of the impact of major breakthroughs such as the use of GMOs and/or substantial increase in mechanization. Other case studies being done include: (a) a decision matrix for managing drought, (b) impact of off-farm income on the total farming enterprise, (c) economic and environmental consequences of options for land and livestock management strategies, and (d) moving subsistence farmers toward small-scale agriculture. In these studies we are developing or improving farm level, sub-regional, regional and national models. We are involving both national and regional research partners and collaboration with CMDT and the Sasakawa Global 2000 project in Mali. We continue to have active involvement by the representatives of the key parts of the government that will be the ultimate users.

After a series of meetings over a 15 month period with the Office of the President, relevant ministries, and KARI, a major planning workshop was held in Nairobi in September 2000 to initiate the field studies related to the Kenya Pilot FIVIMS study. The meeting

was well attended by government officials, a key NGO, the Kenya Institute for Public Policy Research and Analysis, the International Livestock Research Institute, and the Kenya Agricultural Research Institute. Representatives participated from the Governments of Tanzania and Uganda as well as from Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). The result is a definitive action plan for a field study of farms in the Rift Valley region of Kenya with the same general objectives as for the West African studies. Planned case studies directed to the goal of enhanced food security include: (a) impact of alternative strategies for *intensification* of production of food and cash crops, (b) impact of *extensification* of agricultural production, (c) alternative water management strategies, and (d) a drought management matrix involving three production systems and three states of nature (environmental patterns). An alternative scenario, resources permitting, would be assessment of the impact of various post-harvest and storage strategies.

The DSS models for use in the Mopti region by the SANREM West Africa Project have been completed and await progress by our partners to put them to use.

A major workshop on impact assessment methods was sponsored by USAID in July 2000. The workshop participants included senior staff of USAID, representatives from all the CRSPs, representatives of the international agricultural research centers, the World Bank and other interested parts of USAID. Detailed presentations and discussions on the global decision support system were made. The CRSP council is developing an overall plan on how individual CRSPs will conduct and report impact assessments on their products. The DSS will be considered as one of the tools.

A similar but briefer presentation was made to a meeting of the individuals responsible for impact assessment in the International Agricultural Research Centers in Rome in May 2000 under the auspices of the CGIAR's Standing Panel on Impact Assessment. This and follow-on engagements with the leadership and executive of this panel are exploring the possibilities of using the DSS for impact assessment by the International Centers.

In April 2001, a seminar was presented at FAO by our team and attended by approximately 80 people. This provided a forum for review of the DSS and was followed by four substantial expressions of interest in collaboration. In late May 2001, a briefing was provided on the DSS to the more than 100 national delegates to the FAO Committee on Food Security. This is the group that organizes and monitors the World Food Summit.

Impact

Since the research and demonstrations with case studies are still in progress, there is only limited

adoption of the DSS by its several levels of potential users. Task forces of potential users in both Mali and Kenya are working together to understand the DSS and to determine how it will be applied in evaluation of food security options in their countries. The CILSS (Comité Permanent de Lutte Contre la Secheresse dans le Sahel) strategic planners are evaluating the DSS as a tool for assessing the impact of policy options at both national and regional levels. FAO is planning to use the DSS methods in assessing the impact of alternative strategies for integrated production management in African countries. A pilot study is underway to examine the use of the DSS in assessing the regional and national impact of the U.N. Special Programme for Food Security. The CRSP Council is considering ways to use the methods in assessing the impact of their programs.

Publications

See the section of this report on GLO 00-26



Delivery Systems and Capacity Building

Introduction

The development of delivery systems and the human capacity to use them are integral parts of the overall DSS project. Involvement of both decision-makers and analysts in developing demand for the methods, designing and participating in the research, and ultimately in the evaluation of the product are all occurring throughout the project. This activity captures that effort and couples with it other specific actions. Increasing resources will be directed to capacity building and delivery systems in the last two years of the DSS development under SANREM II. Additional funds outside SANREM are being sought to broaden capacity building to other countries in the East and West Africa regions.

Objectives

- ▶ Prepare and deliver products from the GDSS that are in usable form and format for national and regional partners
- ▶ Participate with national and regional partners in information, training and evaluation workshops on the products of the GDSS
- ▶ Provide long-term training of national analysts in both research and operational parts of the government
- ▶ Engage with national and regional partners in ongoing training and mentoring on the use of the GDSS and its component parts in impact assessment

Method or Approach

After initial modeling methods have been developed and proof of concept completed, there is need to continue to work with national and other partners to make these methods as useful and usable as possible. This is part of an evolutionary process that is ongoing throughout the duration of the project. For example,

simplifying input and output portals to such models makes them more accessible to other than the inventors. Levels of model complexity difficulty in use of integrated suite of models can be reduced through careful development of software. Development of methods for effective networking of related databases and models so that they can be accessed by users other than the developers is being undertaken in our collaboration with FAO. Also, a module in the FAO-WAICENT Resources Kit that provides a distance learning capability is planned. The module will direct potential users through a Web based distance-learning program that allows them to use the methods.

Workshops of three types are now being conducted: (1) planning and evaluation workshops of collaborators directly involved in the development of the DSS, (2) workshops for analysts and others who will use the DSS but are not directly involved in the research and (3) regional workshops to provide capacity to use the methods to scientists and analysts from other countries. These workshops require multiple members of the U.S.- based team to travel to various locations. We also pay for transportation and per diem of participants in the workshops.

With additional external funding, we would amplify long-term training by at least three fold in each of the regions where we have been working. We would like to have more people receive the three month training at Texas A&M; we would like to have masters and PhD students in the pipeline.

Results and Discussion

Work was initiated to determine the best programming language and approach for the online development of our various tools. The NUTBAL PRO model was selected for testing purposes. After extensive tests with JavaScript, Java Applets, Java Beans,

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and xml-rpc communicating with Python, it was determined that the best approach would be to use straight PYTHON code to write HTML code as needed. This is accomplished by using the Apache Web server with a handler that allows the web server to understand pages requested by a client with a .py or .psp page extension, namely a PYTHON or a PYTHON Server Page file. The PYTHON handler generates HTML and allows calls to a database without opening any additional ports on the target server.

Our Kenyan colleague who received long-term training at Texas A&M last year is conducting training courses in his country and also is mentoring eight graduate students in the use of our methods. In the past year, we have trained two Malian scientists in the use of the DSS methods. They will return to Mali in July to take up training workshops on the methods for others in that country and in the region. To improve the delivery capacity, a Malian scientist was invited to the U.S. to work closely with scientists at Texas A&M and receive necessary training for using and modifying the Mali ASM. Malian scientists, in collaboration with TAMU colleagues, developed the three sub-regional ASMs for the Sikasso region. Also, a training manual was provided for other scientists in West Africa. We have conducted two major planning and training workshops in Kenya and two in Mali during the last year. We have actively participated in planning workshops in the Institut Du Sahel (INSAH) and at the regional level in East Africa with a consortium of Kenyan, Ugandan, and Tanzanian collaborators on the development of models and interpretation of the results of case studies that were conducted there.

Impact

We are still in the research and development phase of this project and have not fully achieved the planned results for delivery systems and capacity building. However, we believe we are on track with our five-year plan. Through our engagement with national and regional partners, we recognize the need to do more under this activity than present funds will permit. Our partners in the pilot countries and in the regions are enthusiastic about the capability provided by the DSS and are keen to learn to use the methods. We have very positive responses from senior decision-makers in both Kenya and Mali about the future use of the DSS for evaluating food security and natural resource management options in their countries. In short, research collaborators, potential analysts and key decision-makers are involved in the process of developing and using the models. Through that involvement we are encouraged to believe that the DSS will find ultimate utility. We also see substantial potential that the USAID CRSPs, FAO, and the International Centers will adopt and use the methods.

Publications

- Impact Methods to Predict and Assess Contributions of Technology (IMPACT). USAID Grant No. PCE-G-00-97-00051-00. Final Report. URL: <http://cnrit.tamu.edu/IMPACT>
- Second Planning Workshop on Development and Evaluation of Models and Methods to Improve the Assessment of Status and Estimate the Economic and Environmental Impact of Options to Enhance Food Security. Bamako, Mali. July 4-6, 2000 (originally scheduled June 27-29, 2000.)
- Summary of presentations Made During the Planning Workshop for the Mali Pilot Study on FIVIMS-GTOS, SANREM CRSP Global Decision Support System. Prepared for The Joint Meeting of Committees and Project Managers, SANREM CRSP. Watkinsville, GA, December 14-16, 1999.
- Summary of Presentations Made During the Planning Workshop on Development and Evaluation of Models and methods to Improve the Assessment of Status and Estimate the Economic and Environmental Impact of Options to Enhance Food Security. A Pilot Study Conducted in the Republic of Kenya. Nairobi, Kenya. September 13-15, 2000.
- Summary of Presentations Made During the Workshop on Impact Assessment of Smallholder Dairy Technology in East Africa During The Workshop on Impact Assessment of Smallholder Dairy Technology in East Africa. Nairobi, Kenya. September 12, 2000.

Acronyms

ACMAD	African Center for Meteorological Applications and Development	CGE	Natural Resource Office Computable General Equilibrium
ACT	Almanac Characterization Tool	CGIAR	Consultative Group on International Agriculture Research
ADMP	Assessment of Decision-Maker Priorities	CIAT	Centro Internacional de Agricultura Tropical
AID	United States Agency for International Development	CILSS	Comité Permanent Interétats de Lutte contra la Sécheresse Dans le Sahel (Interstate Committee on Drought Control in the Sahel)
AGRHYMET	West Africa Regional Center for Training and Application in Agriculture, Meteorology and Hydrology (a CILSS Organization)	CIMMYT	International Maize and Wheat Improvement Center
AGRHYMET-CILSS	Centre Régional de Formation et d'Application en Agrometeorologie et Hydrologie Opérationnelle	CIRAD	Centre de coopération internationale en recherche agronomique pour le développement
AND	SANREM-Andes	CLIMAG	Climate Prediction in Agriculture
ARO	Ethiopian Agricultural Research Organization	CLUP	Comprehensive Land Use Plan
ARTEMIS	Africa Real-Time Environmental Monitoring Information System	CMAT	Malian Company for Cotton Industry Development
ASARECA	The Association for Strengthening Agricultural research in Eastern and Central Africa	CME	Common Modeling Environment
ASB	Alternatives to Slash-and - Burn	CMU	Central Mindanao University, The Philippines
ASM	Agricultural Sector Model	CNRIT	Center for Natural Resource Information Technology
ATSAL	Agroforestry Tree Seed Association of Lantapan, The Philippines	CODELSPA	Defending San Pablo Lake Committee
AU	Auburn University	CONDESAN	Consortium for the Sustainable Development of the Andean Ecoregion
AWS	Automatic Weather Stations	COP 6	The 6th Conference of the Parties under the United Nations Framework Convention on Climate Change
BIDANI	Barangay Integrated Development Approach for Nutrition Improvement, a unit of CMU	CORAF	Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricole
BIFAD	Board for International Food and Agricultural Development (USAID)	CQ	Central Queensland
CARE	Cooperative for American Relief Everywhere	CQU	Central Queensland University
CBNRM	Community Based Natural Resource Management	CRRA	Regional Agriculture Research Center, Mali
CCD	United Nations Convention to Combat Desertification	CSD	Commission for Sustainable Development
CDC	United States Center for Disease Control	DA	Department of Agriculture, The Philippines
CENRO	Community Environment and		

DENR	Department of Environment and Natural Resources, The Philippines	GLO GO GOLD	SANREM Global Project Governmental Organization Governance and Local Democracy
DILG	Department of the Interior and Local Government	GOLD	Governance for Local Democracy, a program of USAID-The Philippines
DMB	Database management		Government of Mali
DMNA	Decision-Maker Needs Assessment	GOM	
DRAER	Regional Ministry for Management and Provision of Farming Tools to Rural People	GPS GTOS	Global positioning system Global Terrestrial Observing System
DRAMR	Regional Ministry for Support to the Rural World	HES HLURB	Human and Ecology Security Housing and Land Use Regulatory Board
DS	Decision Support		Holistic Management
DSS	Decision Support System	HM	
DRRC	Regional Office of Regulations and Enforcement	HPI HRS	Heifer Project International Hard Red Spring Wheat
DURW	Durum Wheat	HRSW	Hard Red Spring Wheat
EEP	External Evaluation Panel	HRWW	Hard Red Winter Wheat
ENRO	Environmental and Natural Resource Officer	HTML IAG	hypertext markup language Impact Assessment Group
ENSO	El Niño/Southern Oscillation	IARC	International Agricultural Research Center
EPIC	Erosion Productivity Impact Calculator		International Board of Soils Research and Management
EROS	Earth Resources Observation Systems	IBSRAM ICAAE	International Center for Aquaculture and Aquatic Environments
ESPGRN	Production systeme and Natural Resource Management Team	ICIMOD	International Center for Integrated Mountain Development
ESRI	Environmental System Research Institute		
FAA	Department of Fisheries and Allied Aquacultures	ICRAF	International Center for Research in Agroforestry
FAO	United Nations Food and Agriculture Organization	ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
FEWS	Famine Early Warning System		
FIVIMS	Food Insecurity and Vulnerability Information Mapping System	IER	Institut d'Economie Rurale (Malian Institute of Rural Economy)
FLIPSIM	Farm Level Income and Policy Simulation Model	IIRR	International Institute for Rural Reconstruction (NGO)
FVI	Forage Value Index	ILRI	International Livestock Research Institute
GASM	Global Agricultural Sector Model	IMPACT	Impact Methods to Predict and Assess Contributions of Technology
GDRN5	Natural Resource Management and Decentralization NGO Network	INERA	National Institute for Agricultural Research and Study (Burkina Faso)
GDSS	Global Decision Support System		
GEM	Growth with Equity in Mindanao, a program of USAID-The Philippines	INSAH	Institut du Sahel (The Sahel Institute)
GIEWS	Global Information and Early Warning Information System	INTSORMIL CRSP	International Sorghum and Millet Collaborative Research Support Program
GIS	Geographic Information Systems	IPAS	Integrated Protected Area System

IRRI	International Rice Research Institute	NIA	National Irrigation Administration
ISPPS	Institute for Strategic Policy and Planning Studies, a unit of the College of Public Affairs at UPLB	NOAA	National Oceanographic and Atmospheric Administration (United States)
ISU	Iowa State University	NPC	National Power Company
IWMI	International Water Management Institute	NRM	Natural Resource Management
KAP	Knowledge Attitudes and Practices Survey	NRMAC	Natural Resource Management Advisory Committee
KARI	Kenya Agricultural Research Institute	NRMC	Natural Resource Management Council
KIMS	Knowledge Information Management System	NRMDP	Natural Resource Management Development Plan
KIN	Kitanglad Integrated Non-Governmental Organizations	NRMDP	Natural Resources Management and Development Plan
KNP	Kitanglad Natural Park	NRMP	Natural Resource Management Plan
LANDSAT	Sattellite used to acquire remotely sensed images of the earth	NUTBAL	Nutritional Balance Analyzer Program
LEWS	Livestock Early Warning System	NVS	Natural Vegetative Strips
LGU	Local Government Unit	OFDA	The Office of U.S. Foreign Assistance (USAID)
ME	SANREM CRSP Management Entity	OID	Office of International Development
METEOSAT	a satellite	OIRD	Office of International Research and Development (Virginia Polytechnic and State University)
MFCAL	Multifunctional Character of Agriculture and Land	P/PE	Precipitation/Potential Evapotranspiration
MKRNP	Mount Kitanglad Range National Park	PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
MLUP	Municipal Land Use Plan	PAMB	Protected Area Management Board
MOSCAT	Department of Aquaculture and Technology of Misamis Oriental State College of Agriculture and Technology	PAR	Participatory Action Research
MOU	Memorandum of Understanding	PARRFI	Philippine Agriculture and Resources Research Foundation, Inc.
MW	Manupali Watershed, The Philippines	PCARRD	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
NAPACOR	National Power Company	PCC	Pole Coordination Committee
NARS	National Agriculture Research System	PGRN	Natural Resources Management Project
NASA	National Aeronautics and Space Administration (United States)	PHYGROW	Phytomass Growth Simulator
NCIP	National Commission on Indigenous Peoples (The Philippines)	PI	Principal Investigator
NDVI	Normalized Difference Vegetation Index	PLLA	Participatory Landscape Lifescape Appraisal
NGAs	National Government Agencies	PME	Participatory Monitoring and Evaluation
NGO	Non-Governmental Organization	PPDO	Provincial Planning and Development Office, Province of Bukidnon, The Philippines
		PPZS	Pole Pastorale de Zone Sèche in

	Senegal		Watchers’)
PRA	Participatory Rural Appraisal	TWG	Tigbantay Wahig Group
PU	Purdue University	UAF	University of Agriculture and Forestry (Vietnam)
PUCE	Pontificia Universidad Católica del Ecuador (Catholic University, Ecuador)	UGA	University of Georgia
		UK	The United Kingdom
RAP	Research Application Program	UN	The United Nations
RFE	Rainfall Estimates	UNCED	United Nations Conference on Environment and Development
SADC	Southern Africa Development Community		
SAM	Social Analysis Matrix	UNDP	United Nations Development Program
SANREM-CRSP	Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program	UNEP	United Nations Environment Program
		UNESCO	United Nations Educational, Scientific and Cultural Organization
SANREMSEA	SANREM–Southeast Asia Project		
SANREM WA	SANREM-West Africa Project	UNORCAC	United Peasant Organization of Cotacachi, the indigenous peasant secondary level organization located in the canton of Cotacachi, Ecuador
SAP	System Alerte Precose (Mali National Food Security Early Warning System)		
SCO	Site Coordination Officer		
SCO	Site Coordination Office (officer)	UPLB	University of the Philippines at Los Baños
SCT	Spatial Characterization Tool	USAID	United States Agency for International Development
SEA	Southeast Asia		
SEAMEO	Southeast Asian Ministers of Education Organization	USDA	United States Department of Agriculture
SEARCA	Southeast Asian Center for Graduate Studies	USGCRP	United States Global Change Research Program
SEARCA	SEAMEO Regional Center for Graduate Study and Research in Agriculture	USGS	United States Geological Survey
		UW	University of Wisconsin-Madison
SLO	Secondary level organization		
SLUP	Sustainable Land Use Planning	VSO	Volunteer Services Organization
SNRM	Sustainable Natural Resource Management	WA	West Africa
SO	USAID Strategic Objective	WAF	SANREM-West Africa
SOFT	Soft Red Winter Wheat	VT	Virginia Polytechnic and State University
SpO	USAID Special Objective		
SPSS	Statistical Products and Service Solutions	WAICENT	World Agriculture Information Center
SUBIR	Sustainable Use of Bio-Resources Project (Ecuador)	WANRM	West Africa Natural Resource Management
SWAN	Soil, Water, Air and Nutrition System	WAP	West Africa Project
		WCM	Western Carolina University
SWAT	Soil Water Assessment Tool	WFS	World Food Summit
SWRRB	Simulator for Water Resources in Rural Basins	WMO	World Meteorological Organization
TAES	Texas Agricultural Experiment Station	WSM	Watershed Model
		WSU	Washington State University
TAMU	Texas A&M University		
TAT	Thematic Apperception Test		
TNA	Training Needs Analysis		
TOT	Training of Trainers		
TSS	Total Suspended Solids		
TW	Tigbantay Wahig Inc. (“Water		