SANREM CRSP

Sustainable Agriculture and Natural Resource Management
Collaborative Research Support Project

ANNUAL REPORT
1998 - 1999

Funding Support provided by the United States Agency for International Development
USAID Contract Number PCE-00-98-0019-00

PD-ABR-610

SANREM CRSP

Sustainable Agriculture and Natural Resource Management Collaborative Research Support Project

Year I - Phase II

SANREM CRSP
1422 Experiment Station Road
Watkinsville, GA 30677
USA

Partners

Global

Auburn University Heifer Project International Iowa State University Texas A&M University Tuskegee University, University of Georgia University of Wisconsin Madison Virginia Polytechnic Institute and State University, Washington State University Western Carolina University / PVO Center, United Nations Food and Agriculture Organization The Center for Holistic Management Colorado State University United States Department of Agriculture - ARS J Phil Campbell Sr Natural Resource Conservation Center

Southeast Asia Region

University of the Philippines at Los Baños (UPLB), Center for Policy and Development Studies Economy and Environment Program for Southeast Asia (EEPSEA), Xavier University Research in Mindanao Culture Central Mindanao University (CMU), Heifer Project International (HPI) Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) Provincial Planning and Development Office (PPDO), Municipality of Lantapan Municipal Government of Lantapan International Center for Research in Agroforestry (ICRAF) Southeast Asia Regional Center for Graduate Studies (SERCA) Central Queensland University Northern Mindanao International Agricultural Research Center (NOMIARC) Department of Agriculture (DA) Department of Environment and Natrual Resources (DENR) San Herminigildo Agro-Industrial School Inc (SHAISI) Bukidnon State College International Board for Soil Research and Management (IBSRAM) Ateneo de Manila University International Institute for Rural Reconstruction (IIRR) Southeast Asian Forum on Agricultural Research Southeast Asian Universities Agricultural Network Chinese Academy of Science Yunnan International Rice Research Institute Chiang Mai University-Thailand

Andean Region

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West Africa Region

Insitut de l Environnement et des Recherches Agricoles (INERA) Conseil de Developpement Durable pour l Afrique Association pour la Gestion Holistque au Burkina (AGEHOR/B) and the Center for Holistic Resources Management Council for Scientific and Industrial Research Savanna Agricultural Research Institute Center for the Development of People Institut du Sahel (INSAH) Comite Permanent Inter etat de Lutte Contre la Secheresse dans le Sahel (CILSS) Innovative Resources Managment Inc , I Insitut d Economie Rural (IER), I Institut du Sahel (INSAH) Pôle Gestion des Ressources Naturelles/Systemes de Production (GRN/SP) composed of the national agricultural research systems (NARS) of the nine CILSS countries (Comite Inter-Etats de Lutte Contre la Secheresse au Sahel) INERA (Burkina Faso) IER (Mali) INRAN (Niger) ISRA (Sengal) CNERV (Mauritania) DRTA (Chad) NARI (The Gambia) INIDA (Cape Verde) INPA (Guinea Bissau) International Livestock Research Institute (ILRI) International Center for Research in Agroforestry (ICARF) CARE-Mali Commune de Madiama, Mali

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I. Executive Summary

I Introduction

The 1998-1999 program year served as the first year of Phase II for the SANREM CRSP During that time the SANREM Global Program began both to implement Year 1 activities while also further examining and refining the objectives of Phase II This refinement occurred in the context of SANREM's efforts to operationalize a global program while maintaining its fundamental focus on the participation of local-to-global decision-makers This summary of the SANREM 1998 – 1999 Annual Report provides information on SANREM's programmatic objectives, integration among projects, highlights from Year 1, benefits to the U S and upcoming developments Further specific details from each of SANREM's projects may be found in the body of this report

II Program Objectives

The SANREM CRSP contributes directly to the Strategic Support Objective of USAID's Global Bureau, Office of Agriculture and Food Security, which is "to improve food availability, economic growth and conservation of natural resources " USAID identifies its Intermediate Results as technologies, practices, and policies that enhance food availability, improved food access and agribusiness opportunities, and enhanced long-term conservation of natural resources, and an information system to enhance decision making

The SANREM Program Global Strategic Support Objective (or mission) is **improved decision-making by natural resource managers at the local, provincial, national and regional levels** Our more focused program-level objectives are

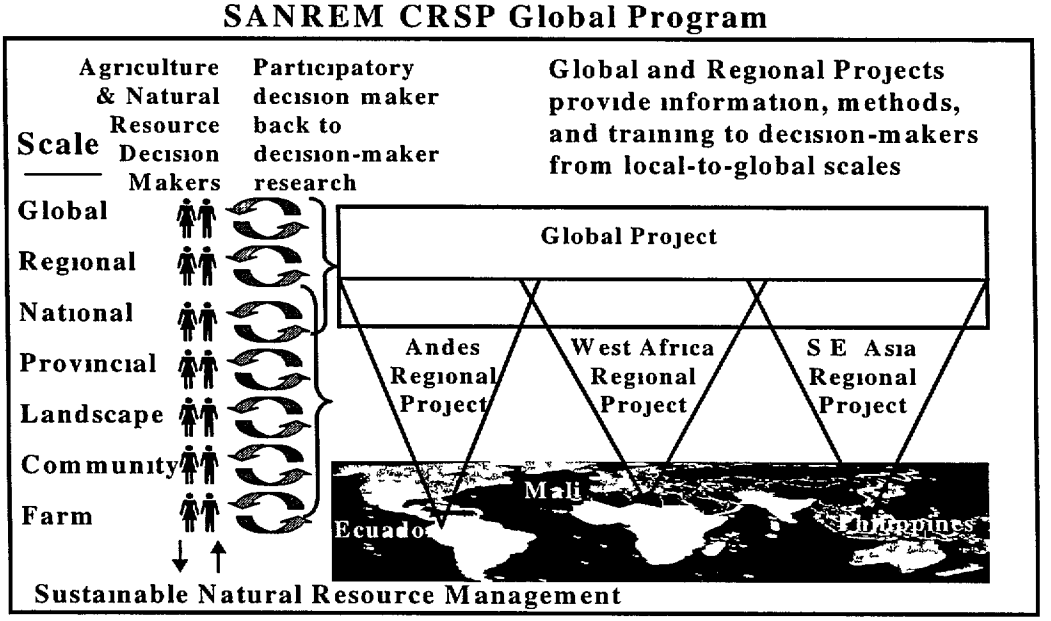
- **To develop methods, tools, and institutional capacity to support sustainable agriculture and natural resource management policy design, issue analysis, planning, and implementation at the landscape-lifescape scale by local governments and communities**
- **To develop improved methods to assist global, regional, and national decision-makers on broader issues related to sustainable agriculture and natural resources management**
- **To develop improved methods to facilitate sustainable agriculture and natural resource management information and knowledge exchange within and across multiple scales**

III SANREM Projects

In order to reach these objectives, the SANREM program is implemented via three regional projects and one global project The regional projects conduct landscape-scale research at a site in one of the countries in a given region, focusing on objective 1 The regional projects also support objective 3 by developing methods to transfer what is learned at one site to "similar" sites in the region and by aggregating information and "scaling up" the methods and tools so that they can be employed by decision-makers at

higher scales or across scales The global project supports global-to-national decision-makers It does so by developing a suite of methods and tools, by acting as the bridge between the regional projects, by capturing knowledge gained and by facilitating information exchange between and across scales (see Figure 1 below)

Figure 1 SANREM CRSP Program



- The Global Project supports national-to-global scale decision-makers, assists regional projects in their assessment of decision-makers priorities and in the development of decision-support tools and methods, and facilitates exchange of information and knowledge among the regional projects,

- The Southeast Asia, Andean and West African Regional Projects implement participatory landscape/lifescape scale research in the Philippines, Ecuador and Mali, respectively, develop methods to extrapolate results to similar landscape/lifescapes in the region, and develop methods to aggregate (scale-up) results to national and regional scales

The regional projects ensure that SANREM is addressing the priorities, needs, and constraints of local stakeholders By addressing sustainable agriculture and natural resource management issues at the landscape-scale, the regional projects respond to the demands from decision-makers at multiple scales (typically from farm-to-provincial scales) They conduct research to provide information, methods, tools, and training to support difficult natural resource management decisions regarding alternative technologies, practices, and policies

The global project collaborated directly with the regional projects in the development of methods to assess the priorities and needs of decision-makers They also worked together to develop methods and tools needed by decision-makers Examples of these are tools that researchers can use to evaluate research priorities, and methods that policy analysts can use to evaluate the consequences of different policy options The global project also explicitly addresses the needs of regional and global decision-makers As part of its cross-regional responsibility, the global project is capturing what is learned by the regional projects and facilitating exchange of information among the regions

IV Integration

All four of SANREM's projects are integrated around the objective of providing decision-makers at multiple scales with improved capacity and capability to make more informed and better decisions related to sustainable agriculture and natural resource management The regional projects focus their efforts primarily at the local and provincial levels as well as within regions, scaling up to higher levels through replication The global project works both with the regional projects and globally in order to provide this support across and within multiple scales The scales at which the global project works include national, regional and global

In the context of decision-maker support, there are several crosscutting themes that serve to integrate the SANREM projects These themes include decentralization, community-based NRM, tool development for decision-maker support, and natural resource use pressure including environmental degradation and concomitant conflict

Decentralization

The Ecuador, Philippines and Mali projects are all working within an administrative environment of government decentralization and/or devolution of power Each country is at different stage in this process As such, the SANREM projects are each engaged in a variety of activities that correspond to these respective levels of decentralization In several cases SANREM provides support to local level NRM decision-makers who formerly had little or no voice in decisions at or above the landscape scale Such support includes assistance in the formation of participatory locally governed community groups that make decisions governing the management of natural resources SANREM has also played a facilitative role bridging the gap between decision-makers at multiple scales such as municipal, provincial and national Finally, SANREM is also engaged assessing and designing tools to assist decision-makers at these various scales

Decision-Maker Support

Decision-makers assessing the options and consequences of decisions made in today's complex world require the capability to understand the multidimensional implications that often result from creating change through the application of different NRM management and policy decisions SANREM is engaged in designing decision support tools with the goal of providing decision-makers at multiple levels of scale with improved capability and capacity to make well-informed and wiser decisions regarding sustainable agriculture and natural resource management This support is provided in the

form of tools and information, capacity building activities, and participatory research pertinent to the environmental realities of a given region Support to natural resource management decision-makers cuts across all SANREM projects The 1998-1999 year has witnessed developments in all areas of support development including tools, information and capacity building

Community Based Natural Resource Management
Each of the SANREM projects works at the local level with community based organizations and government representatives These groups are engaged together with SANREM in the identification of locally defined natural resource priorities They are also working to determine positive local management of these issues through participatory research, data collection, enhanced understanding of the issues, and policy-making Final steps involve determining how to best represent these issues and findings at higher administrative levels as well as their replication within and across regions

Natural Resource Pressure and Conflict
In addition to the aforementioned crosscutting themes, the SANREM projects are also each engaged in contexts of exacerbated natural resource pressure (land use, degradation, climate change or a combination thereof) In each case, these pressures result in conflict of varying degrees among NRM decision-makers In the case of the Andes, new settlers vie with long-established residents for land tenure rights and management authority In the Philippines, the impact of high-value cash crops exerts an inordinate pressure upon decision-makers from local farmers to national ministers in terms of land use practices and biodiversity conservation In Mali, a combination of natural resource degradation, increasing population, climate change/drought and increasing competition for scarce resources has resulted in conflict among user groups SANREM is working in all three areas, not in direct conflict mitigation per se, but rather in analyzing and addressing the underlying causes of these problems as they relate to natural resource management

V Achievements

During Year 1 several notable achievements were accomplished in each of SANREM's projects These accomplishments may be categorized in the following themes capacity building, development of decision support tools, information exchange and networking, and emerging research results The project within which each accomplishment took place is indicated at the end of each statement by a three-letter abbreviation [1]

1 Capacity Building
SANREM is engaged in a variety of capacity building activities in order to support NRM decision-makers These activities are geared to reinforce or develop organizational and institutional capacity They may include training, technical exchange, or workshops Some examples of SANREM project capacity building that occurred in Year 1 include the following

- Establishment of a community-based NRM committee in coordination with CARE and a national NAR (IER/CRRA) in the Madiama commune, Mali (WAF)

[1] WAF West Africa, SEA Southeast Asia, AND Andes, GLO Global

- Formation of a tripartite institutional relationship (SEARCA-IIRR-CMU) to design and implement training and capacity building strategies at the local level (SEA)
- Training in water quality/quantity monitoring techniques in Nanegal and Cotacachi, Ecuador with local participants (AND)
- Detailed action plan developed for a collaborative study with FAO, the Government of Mali, and the Malian Institute of Economic Research to develop and use decision support systems at the national level for enhancing food security and sustainable use of natural resources (GLO)

2 Development of Decision-Support Tools

Decision Support Tools include a wide variety of useful tools designed to assist natural resource management decision-makers These tools may be composed of information, models, training or processes Each of the SANREM projects is engaged in the design of decision support tools

- FAO-WAICENT (World Agriculture Information System) - Texas A&M Cooperation on development and use of decision support systems to enhance food security and sustainable use of natural resources (GLO)
- Prototype watershed model constructed and presented for discussion at various fora (SEA)
- Landuse Change/Hydrology Model Progress geographical digital information corrected and standardized, partial parameterization of CENTURY model with local data, and acquisition and digitization of soil maps (AND)
- Sondu River Basin assessment to develop methods for representing large land scales with multiple uses to assess the impact of intensified agriculture on the environment (GLO)
- Common Modeling Environment software identified to provide automated interface between complex models (GLO)
- Preliminary data gathered for biophysical and socio-economic models (WAF)

3 Information Exchange and Networking

Methods for transferring knowledge gained in one project to another as well as within regional projects include information exchange and networking among partners This activity is key to SANREM's success Each project has attained achievements in the area of information exchange and networking

- Established Collaboration with NASA, EROS Data Center, FAO and AGRHYMET to access and use satellite imagery for Global Decision Support Systems (GLO)
- Regional Workshop on Agro-Pastoral Systems in Conflict facilitated by SANREM Project with representatives from regional research organizations (WAF)
- Memory Banking Methodology Report translated into Spanish and being applied in Ecuador (originally developed in the Philippines) (AND)
- SANREM SEA Project as co-host of international methodology conference on "Environmental Services and Land Use Change Bridging the Gap between Policy and Research in Southeast Asia" (SEA)
- Collaborators for national and regional studies identified and participating in model development (GLO)

- Moderated e-mail conference facilitated regarding "Planning and Coordination of the SANREM WA Program" with participants from 14 different international institutions (WAF)
- Kapihan sa Malaybalay (Provincial Seminar) on watershed modeling techniques and applications facilitated (SEA)
- Active partnership cemented with the global inter-agency network of organizations working on the global Mountain Agenda (AND)

4 Emerging Research Results

In addition to the aforementioned areas of achievement, SANREM projects have also produced emerging research results These results have taken the form of publications, data collection and analysis and model development

- Participatory Landscape Lifescape Appraisal conducted, baseline data components gathered, and weather station equipment installed (WAF)
- Expansion and application of the Global Agricultural Sector Model (GASM) to global level analysis (e g estimated impact of change in U S farm policy on global markets affecting developing countries) (GLO)
- Migration Studies survey completed "Migration and Community Attachment in the Highland Indigenous Communities of Cotacachi, Ecuador" (AND)
- Inventory and analysis of provincial and municipal resolutions and ordinances regarding the environment and agriculture completed (SEA)
- Kenya FIVIMS-GTOS-CCD pilot study conducted to develop and use decision support systems at the national level for enhancing food security and sustainable use natural resources (GLO)
- Methods established to translate relevant data and information from political to watershed frameworks using geo-referenced methods (GLO)

VI Benefits to the United States

The SANREM project has been beneficial to a number of developing countries as well as the United States in several ways The most notable among these is the transfer and application of research methodologies Key attributes of these methods include participatory approaches, capacity building with local organizations and inter-disciplinary research A salient example is the cross-fertilization of methodologies to work with locally composed groups of decision-makers in the Southern Piedmont that began in developing country programs

Given the unique mandate of SANREM with its focus on sustainability, aspects of tangible benefits to the U S are more difficult to measure However, efforts geared to ensure wise natural resource management and sustainable agriculture in developing countries contribute to the well being of the global environment as well as the United States These types of efforts include sound watershed management, preservation of biodiversity and reduced impacts from desertification

VII Upcoming Developments

SANREM's future activities will continue to build upon the foundation laid during the first year of Phase II These activities will further develop and enhance on-going efforts

to build capacity, exchange information, develop decision support tools and conduct research that contributes to sustainability Some key examples of anticipated future developments include the following

- Assessment of decision-maker priorities to be conducted in the Philippines, Mali and Ecuador (GLO, SEA, WAF and AND)
- Collaboration with FAO, national and regional partners will continue in order to conduct a pilot study on developing and extending models for evaluating options for sustainable food production (GLO)
- Planning workshop with Malian and West African partners will be held to initiate project (GLO)
- Data collection and initial modeling efforts to continue regarding use of the GDSS in the Mopti Region of Mali (GLO, WAF)
- Community-based NRM Advisory Committee meetings regularized and Stakeholder Training in Holistic Management will begin in Mali (WAF)
- Fieldwork and data analysis including a baseline survey, soybean trials and environmental monitoring will be undertaken in cooperation with local partners in Mali (WAF)
- A Memorandum of Understanding will be signed between CARE-Mali and Virginia Tech regarding collaborative capacity building and NRM research efforts in the Djenne Circle (WAF)
- Comparative study of landscape images will be used to develop future desired sustainability scenarios (AND)
- Water quality and land use change data will be used to model biophysical aspects of the landscape (AND)
- Biophysical models and socio-ecological analyses will be employed in Futures Scenarios workshops (AND)
- Further methodological development regarding locally based participatory research in the context of government decentralization (SEA)
- Continued development of an integrated watershed model for local level natural resource decision support and policy making with data collection as appropriate (SEA)
- Continued vertical scaling of policy lessons, combined with national and regional exchange of research results, based on ongoing activities at the Philippine site (SEA)

VIII Institutional Project Management

The SANREM Program is implemented through subcontracts from the Management Entity (ME) to different institutions that are responsible for each Project Additional institutional partners are listed inside the front cover

1 Global Project The ME, based at the University of Georgia through the Office of International Agriculture, is responsible for overall coordination of the global project However Texas A&M University is responsible for coordinating the Global Decision Support System Activities

2 Southeast Asia Project (SEA) The Office of International Agricultural Programs of University of Wisconsin coordinates the Southeast Asia Project It is implemented by both the University of Wisconsin and subcontracted institutions in the U S and in Southeast Asia
3 Andes Project (AND) The Institute of Behavioral Research and the Anthropology Department of the University of Georgia coordinates the Andes Project It is implemented by both the University of Georgia and subcontracted institutions in the U S and in the Andes region
4 West Africa Project (WAF) The Office of International Research and Development at Virginia Polytechnic and State University coordinates the WAF Project It is implemented by both Virginia Tech and subcontracted institutions in the U S and West Africa

II. Global Project

Global Project Summary

I. Introduction

The Global Project employs a participatory "decision-maker-back-to-decision-maker" strategy It does this by supporting national-to-global scale natural resource management decision-makers, assisting regional projects in their assessment of decision-makers priorities as well as in the development of decision-support tools and methods, and in facilitating exchange of information and knowledge among the regional projects

For the program year of 1998-1999, the global project was composed of three components These included the Global Information Exchange and Knowledge Base, the Assessment of Decision Maker Needs, and the Global Decision Support System

II Project Objectives

The primary objectives of the Global Project are

- **Facilitation of knowledge capture and information exchange**

To facilitate exchange of information among SANREM's regional projects and between SANREM and other institutions

- **Assessment of decision-makers priorities and decision-support opportunities**

To identify priority needs of national, regional, and global decision-makers and to develop methods and tools that can help them make better-informed decisions

- **Development of a global decision support system**

To help landscape scale research initiatives (implemented by regional projects) identify decision-makers' needs and develop tools and methods that can be used to make better-informed agricultural and natural resource management decisions

The Global Project process

- Begins with the identification of difficult agriculture and natural resource management decisions and the assessment of decision-maker priorities,
- Continues through a participatory research process,
- Produces information, tools, and training that help decision-makers identify alternative technologies, practices, and policies that contribute to more sustainable use of natural resources, and
- Synthesizes and captures information and tools in the global knowledge base

III Progress

The Global Project has made great headway in 1998-1999 Key areas of progress include information exchange, research methodology development, and product design The resulting outputs are described below Greater explanation for each is found in the subsequent activity reports

A Global Information Exchange and Global Knowledge Base Development
This group of activities emphasized the development of mechanisms to facilitate exchange between two types of clients sustainable agriculture and natural resource management researchers, and natural resource decision-makers Exchange among researchers was designed to emphasize collaborative development of a widely applicable methodology for identifying appropriate technologies, practices, and policies that support and enhance sustainability Exchange among decision-makers was designed to facilitate collaborative development of decision-support tools and methods The following list identifies key information exchange and knowledge base development achievements accomplished in Year 1

- Compilation and publication of the SANREM Phase I Impacts, Lessons Learned and Results Report, *Looking Back at the Landscape Impacts and Lessons from the SANREM CRSP*
- Establishment of computer server and electronic services initiated (including Who's Who Database, Work Plan Database, E-conferences and an E-library)
- Communications Strategy Developed (including newsletters, SANREM Web Page, SANREM Brochure, and Strategy Developed for Phase II)
- SANREM E-Library preliminary format developed
- SANREM moderation of the FAO/NL Electronic Conference on the Multifunctional Character of Agriculture and Land
- Cosponsoring and participation in International Workshop on Agrometeorology in the 21st Century - Needs and Perspectives
- Participation in USAID-Ethiopia meeting to design watershed management programming efforts in Amhara, Ethiopia
- Preparation for the Workshop on Disseminating Value-Added Information to Natural Resource Decision-Makers for Easing Conflicts in West Africa
- SANREM global project provision of technical assistance to West Africa project in facilitation of Mali PLLA
- Field visit and technical exchange facilitated between Senegalese Community-Based Natural Resource Management Project Participants (managed by Virginia Tech) and SANREM

Exchange visit between Senegalese Community Based Natural Resource Management Project USDA-ARS Georgia Farmers Virginia Tech and SANREM (Photo Dory Franklin)

B Assessment of Decision Maker Priorities

This activity emphasized the need for a better understanding of the difficult natural resource management decisions being faced by different decision makers at various levels in the decision-making hierarchy especially in settings where decentralization or devolution are in progress The purpose of the assessment of decision maker priorities is to understand the desired outcomes, issues, and difficult decisions of natural resource managers This effort is being done in order to ensure that decision support activities aimed at informing natural resource management decision-makers respond to the real demands of decision-makers Year 1 accomplishments include

- Initial methodology design meeting held with FAO decision support scientists for initiating the process of assessing decision-maker needs
- Research and analysis of decision-maker assessment methods conducted (at conferences, international meetings and through research)
- A draft interview protocol developed and pre-tested in Mali from the village to national level
- Lessons learned from the Mali experience were used to develop the approach and interview protocol for the Philippines and Ecuador

C Global Decision Support Systems

This set of activities serves to better assess the options and consequences of agriculture and natural resource decisions with multidimensional implications made in today□s complex world To assess the impact of these decisions, a ***suite of georeferenced economic, environmental, and biophysical models*** is being developed and linked to holistically assess the impact of changes in technology or policy The resulting global decision support system (GDSS) includes critical foundation data for spatially explicit analyses as well as access through global networking to other models and sources of relevant information The GDSS team made significant progress during Year 1 Some of the areas in which they made achievements include the following (a more detailed list of specific accomplishments may be found in the global activity report section)

- Global Agricultural Sector Model (GASM)
- Impact Assessment Methods at National, Regional and Global Levels
- Information on Watershed and River Basins for Environmental Impact Assessment
- Development and Demonstration of Geo-referenced Holistic Methodologies for Natural Resource Options
- Biophysical Models to Estimate Performance of Crop and Livestock Species
- Economic Models to Evaluate Impact of New Technology or Policy
- Development and Demonstration of Georeferenced Framework for Models, Information Systems and Analytic Procedures
- Extended and Expanded Integrated Package of Decision Support Tools with Case Studies
- Provision of Effective Delivery of New Methodologies
- Development and Extended Methods for Impact Assessment with Regional Projects
- Analysis of Crop-Weather Models

IV Integration

The SANREM mission to promote sustainable agriculture and environmental practices and policies is pursued through support to natural resource management decision-makers During Year 1, the global project has provided this support through four primary objectives and corresponding activities facilitation of knowledge capture and information exchange, assessment of decision-maker priorities and decision-support opportunities, and the development of a global decision support system These activities operate in tandem The knowledge capture and information exchange activities gather and synthesize information from SANREM regional and global projects to be shared with NRM decision-makers The assessment of decision-maker priorities is a coordinated activity between the global and regional projects The assessment information feeds into both the design of decision support tools and the global knowledge base – both of which are geared to support NRM decision-makers The global decision support system team is working to define mechanisms or frameworks within which the demand-driven information garnered from the regional and global projects may be fed in order to provide support to decision-makers in the form of tools (namely models for ex-ante and ex-post impact assessments)

The following chart demonstrates the Relationship between the Global Project Objectives and Activities

Activity / Objective	Global Decision-Support System	Assessment of Decision-Maker Priorities	Knowledge Capture and Information Exchange
1 Facilitate information exchange and knowledge capture among SANREM's regional projects and between SANREM and other institutions	• Development of interactive participatory delivery system • Promote data sharing for design of decision support tools	• E-conference linking decision-makers and decision supporters • Validate and expand results of assessment across regions and globally	• Regional workshops on global issues • Global Symposia • Print publications • Knowledge base with work plan, human resources, e-library, and decision-support databases
2 Identify national, regional, and global scale decision-makers needs, develop methods and tools to support their difficult decisions	• Employ the results of the assessment of decision-maker needs to facilitate design of the decision support tools	• Assessment of global decision-makers needs in the context of the Agenda 21 Conventions • Assessments in the Andes, Southeast Asia, & West Africa	• Use of SANREM communication tools (e g global knowledge base, newsletters, e-library, articles, policy papers, etc)
3 Support landscape scale researchers in their identification of decision-maker's needs, develop methods and tools to support difficult decisions	• Economic and biophysical models • GIS/spatially explicit analysis • Collaboration with SANREM Regional Projects • Decision support system for global level analysis • Geo-referenced methods for major world watersheds	• Assessment results used as demand driven input for tool design and as a monitoring mechanism to assure appropriate fit	• Use of SANREM communication tools (e g global knowledge base, newsletters, e-library, articles, policy papers, etc)

V Progress toward 5-year Indicators

Outputs from Year 1 global project activities contribute to progress toward SANREM's 5-year indicators They are described in the following section by programmatic objectives

Outputs supporting local-to-provincial (landscape) level decision-makers (Program Objective 1)

- Methods developed to assess the priorities and needs of local-to-provincial (landscape) level agricultural and natural resource decision-makers and at least 3 documented case studies of their application

Outputs supporting national-to-global level decision-makers (Program Objective 2)

- Methods created to assess the priorities and needs of national-to-global level agricultural and natural resource decision-makers and at least 3 documented case studies of their application
- Methods investigated and produced to assist in the evaluation of priorities (ex ante) and impact (ex post) of research and development investments for use by research managers and at least 3 documented cases studies of their application
- Methods developed to assist in the evaluation of consequences of policy options for enhancing food security, reducing poverty and improving environmentally sound use of natural resources for policy analysts and documented cases studies of their application

Outputs supporting information exchange (Program Objective 3)

- On-line database designed and operationalized that includes descriptions of difficult decisions by specific decision-makers in different biophysical and socioeconomic circumstances and information and tools that can be used to support a broad range of decisions-makers
- Methods generated to translate relevant statistical data defined by political boundaries to watershed/landscape boundaries for sub-national decision-makers and 3 documented case studies of their application
- Methods produced to assess impact of technology and policy options related to food security and sustainable development at the level of major world watersheds and 2 documented case studies of their application
- Methods developed to extrapolate the impact of research policy change to geographic equivalents areas across multiple political boundaries and 3 documented cases studies of their application
- Methods or processes advanced to transfer information, tools, etc from one landscape in one geographic region to another region and at least one case study describing transfer among two SANREM regional projects

VI Institutional Partners

The global project institutional partners during Year 1 included the following
University of Georgia
Texas A&M University
The United Nations Food and Agriculture Organization
Southeast Asia, Andean and West African Regional Projects
INSAH
PCARRD

Individual Activity Reports

Global Information Exchange and Global Knowledge Base Development

Introduction

This activity emphasized the development of mechanisms to facilitate exchange between two types of clients sustainable agriculture and natural resource management researchers and natural resource decision-makers Exchange among researchers was designed to emphasize collaborative development of a widely applicable methodology for identifying appropriate technologies, practices, and policies Exchange among decision-makers was designed to emphasize collaborative development of decision-support tools and methods These information exchanges may be facilitated through a variety of methods one of which includes the establishment of a global knowledge base

Objectives

The objective of the Global Information Exchange and Knowledge Base Development Activity was to facilitate information exchange among researchers and decision-makers

Methods

- Develop a format to capture both past experience and future results of research to develop a methodology to identify appropriate technologies, practices, and policies
- Compellation of a summary of lessons learned from SANREM Phase I
- Organize both face-to-face and electronic workshops, conferences, symposia, etc to bring together researchers and facilitate exchange of experience
- Provide support for graduate training
- Establish a pilot computer server accessible from the Internet

Outputs

The SANREM Global Project accomplished several achievements in the Global Information Exchange and Knowledge Base Development Activity Most notably, they include

- Compilation and publication of the SANREM Phase I Impacts, Lessons Learned and Results Report, *Looking Back at the Landscape Impacts and Lessons from the SANREM CRSP*
- Server computer established and electronic services initiated (including Who s Who Database, Work Plan Database, E-conferences and an E-library)
- Communications Strategy Developed (first newsletter of Phase II written and distributed, SANREM Web Page designed and posted, SANREM Brochure designed, printed and disseminated, and Strategy Developed for Phase II)
- SANREM E-Library preliminary format developed
- Electronic Discussion Fora facilitated by SANREM (Multi-Functional Agriculture e-conference)

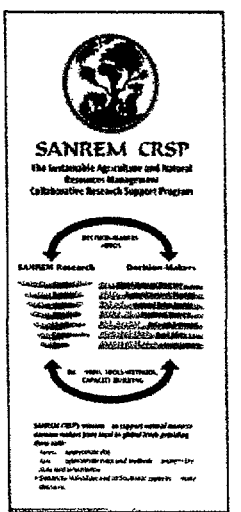
- Presentation by R D Hart, 1999 "A Conceptual Framework for a Research Knowledge Base to Inform Decision Making," an invited presentation to the Global Forum for Agricultural Research, FAO
- SANREM global project provision of technical assistance to West Africa project in facilitation of Mali PLLA
- Field visit and technical exchange facilitated between Senegalese Community-Based Natural Resource Management Project Participants (managed by Virginia Tech) and SANREM

Summary of Results

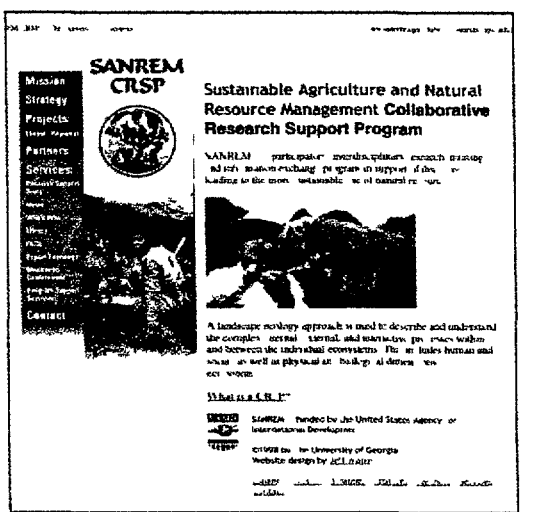
Looking Back at the Landscape Impacts and Lessons from the SANREM CRSP

- SANREM Web Site www sanrem uga edu
- Communications Strategy
- Brochure
- E-Library
- E-Conference
- Work Plan Entry Form (May be found on-line at the SANREM web site, www sanrem uga edu, Services, Program Support, Workplan on-line Database
- Who's Who Database Customized Search Form and the Who's Who Database Entry Form (May be found on-line at the SANREM web site, www sanrem uga edu, Services, Who's Who)

Impacts & Lessons Report



SANREM Brochure



SANREM Web Page

Impacts Discussion

A Who Has the Project Impacted and How?

The outputs of the Global Information Exchange have reached a wide variety of people who represent different audiences, decision-makers and levels of hierarchy Examples of the types of people impacted will be discussed by output

i The Lessons Learned document was developed for a variety of readers including those within development organizations, USAID, research institutes and the government The goal of the publication was to describe SANREM's impact during Phase I and to share with peers what SANREM has contributed to the understanding of landscape scale research These goals were accomplished through the content of the document and via its dissemination At this point, the information has been assembled and shared The document has been well received

ii The SANREM web site was developed to share a wide variety of information with decision-makers and researchers around the world Current information on the site includes subjects such as descriptions of the regional and global projects, SANREM's mission and strategy, and several on-line databases including the work plan and who's who databases Based on inquiries to the SANREM office from individuals around the world, we have learned that international researchers and development professionals have hit the site Thus the web site has been an effective vehicle for information provision and exchange

iii The SANREM Phase II brochure has been distributed at a wide variety of national and international conferences including The Convention to Combat Desertification Meeting (Dakar, Senegal) and the SANREM SEA Annual Partners Meeting in the Philippines as well as at domestic and international meetings with SANREM partners including the Assessment of Decision-Maker Priorities in Mali and the Philippines At these gatherings, decision-makers at all levels of the decision-making hierarchy were represented as well as various sectors (i e governmental, NGO and private) The brochure has been very well received In particular, SANREM has received positive feedback that the graph illustrations were very helpful to partners in understanding the SANREM program The exact impact on decision-makers is unknown at this time other than to note that information on SANREM's mission, strategy, projects and contact information has been provided

iv The SANREM E-library is still being developed An impacts assessment cannot be made at this time

v An E-Conference facilitated by SANREM served wide audiences (over 1,300 participants from 80 different countries) The e-conference regarding multi-functional agriculture brought in participants from around the world engaged in every conceivable aspect of sustainable agriculture Conference participants represented topics as diverse as farming on reclaimed mine land to commercial small-scale dairy combined with Agroforestry They reflected the perspectives of decision-makers from developing and developed countries, as well as sectors of civil society, academia and industry The impact of this e-conference was direct The results of the electronic dialogue 1) Provided insights for the keynote paper to be given September 13, 1999 at the FAO/Netherlands Conference on the Multi-Functional Character of Agriculture and Land *Cultivating our Futures*, 2) Facilitated the participation of over 1,000 people and the discussion of widely varied issues prior to the conference, and 3) Fulfilled an

important step in the CSD-8 (UN Commission for Sustainable Development) process In April 2000 at the CSD-8 conference, the conference recommendations will be discussed

B How has the Project Contributed to SANREM's Programmatic Goals?
The Global Information Exchange Activities contributed primarily to SANREM's third programmatic objective, "To develop improved methods to facilitate sustainable agriculture and NRM information and knowledge exchange within and across multiple scales " All of the activities in this global activity set responded to the need to transfer and exchange information within and across scales

Further exchange among researchers and NRM decision-makers was addressed by the Global Knowledge Base activity The groundwork for further development has been established during Year 1 of this phase and development of tools, information and methods will continue during ensuing years of Phase II

Plans for Subsequent Reporting Period
During the upcoming six months, the SANREM Global Information Exchange and Knowledge Base Development Projects plan to pursue the following activities

- Revise the ME database using Access software and move more of the routine ME management activities on-line including Annual and Interim Reports, Work Plans, Address Book, Trip Reports, Calendar, Publications and the Newsletter
- Facilitate Further E-Conferences as need arises, e g Multi-functional Agriculture E-Conference
- Update Web site (also see Knowledge Base discussion)
- Update Brochure (publish in other languages as possible)
- Create 2nd and 3rd Quarter newsletters (distribute hard copies and post electronically)
- Initiate compilation of emerging research results and policy briefs

Partners and Collaboration
Partners during Year 1 have included FAO (The United Nations Food and Agriculture Organization), INSAH (The Institut du Sahel), PCARRD (The Philippine Council for Agriculture, Forestry and Natural Resources Research and Development) and CIAT (The International Center for Tropical Agriculture) and regional projects

The following synopses represent sub-components of the Global Information Exchange and Knowledge Base Development activity They provide more detailed information than is found in the preceding summary

A. Electronic Conference on the Multifunctional Character of Agriculture and Land

Introduction
Between February 1 and March 26, 1999, an electronic conference was held in preparation for the real-world FAO/Netherlands Conference on the Multifunctional

Character of Agriculture and Land (MFCAL), which is to take place in Maastricht in the Netherlands in September 1999 The Food and Agriculture Organization (FAO) of the United Nations and the Government of the Netherlands sponsored this Electronic Conference One of the main aims of both conferences is to explore ways in which greater awareness of the multifunctional character of agriculture and related land use may contribute to their sustainable use of resources

Objectives

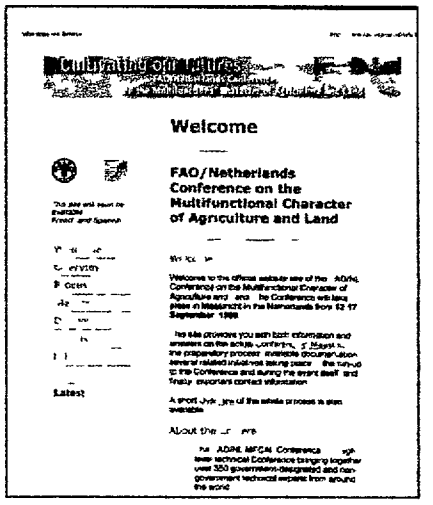
1 To produce a case study inventory on the multifunctional character of agriculture and land

2 To advance our understanding of the meaning, significance and implication of the multifunctional character of agriculture and land

3 To catalyze networks, relationships and ongoing dialogue on these issues

Methods

The E-Conference was moderated by SANREM working in conjunction with the Netherlands Group and FAO Over 1 300 people subscribed to the E-Conference, making it one of the biggest ever Electronic Conferences on agriculture and the environment Contributions to the E-Conference were received from all over the world, and included people writing from home, farms, universities, the private sector, NGOs, government, international organizations and a host of other places


Welcome

FAO/Netherlands Conference on the Multifunctional Character of Agriculture and Land

FAO/MFCAL Web Page
www fao org/mfcal

The E-Conference was organized into 3 phases in which weekly questions were raised to the participants and weekly summaries thus provided
These phases included

- Phase I clarification of concepts
- Phase II examples of successful multifunctionality, reasons for their success, complementarily and trade-offs between functions
- Phase III conclusions, hypotheses and discussion of the roles of institutions

A complete record of the questions, the replies and summaries of each week's discussions can be accessed directly at http //sanrem dac uga edu/ag-conference html

Summary of Results

A full summary of the results can be found on the SANREM web site identified above under the Summary of Summaries listing This results section will highlight a few key facets of the discussion

What is Meant by the Multifunctional Character of Agriculture and Land (MFCAL)?

The conferees were asked to give their interpretation of MFCAL Some participants sought to modify the term slightly, and referred to land "management" rather than land-

use, and as a result sought to emphasize the fact that we are dealing with human activities that have multiple purposes and outcomes They provide critical goods and services, function as a complex set of cultural interactions between human and natural systems, including and recreational functions Many also supported the view that monofunctionality has only been a temporary issue, limited to 20th century rationalism, and that we are already experiencing the 'renaissance of multifunctionality' of agriculture and land use

Several participants stated why it is important to discuss multifunctionality Too often narrow policy agendas dominate, which are one-dimensional, growth-orientated and overly economic in flavor, which creates inevitable drawbacks for the other dimensions It is also a way of giving back legitimacy to agriculture, which would also help to increase its appeal to the next generation, for instance by applying people-centered technologies Monofunctionality leads to lose-lose situations degradation of natural resources and under-utilization of human resources By listing and valuing all functions of the land the options to farmers and policy makers will be greatly increased

What Makes a Success Story a Success Story?
Forty-one case examples of success stories were shared during the electronic conference These cases came from Latin America (11), Asia (10), Australia (8), North America (5), Europe (3), Africa (3) and the Middle East (1) and varied substantially in nature In analyzing the cases for factors of success and constraints to success, the following were identified

Key factors of *success* identified in the case examples include
- Make use of what is going on already
- Engage all stakeholders (from the grassroots to the governments)
- Participants with a vision
- Farmers should feel supported by service providers and regulators
- A champion to carry the process forward
- A disaster to be used as a 'teachable moment'
- Knowledge of the local native environment
- Security over the long-term use of land
- Supervised credit with related training and marketing facilities

Key factors that were seen as limiting the ability to realize the potential social, economic and environmental benefits of a multifunctional approach included greed, ignorance, lack of money, land shortage, etc However, more specific factors are
- The stated perception among planners of land that it is something to be kept available for higher economic development,
- Prevailing market forces and other temptations from the outside world to revert to old patterns,
- Loss of impetus by change of staff or other discontinuities,
- Aiming at the impossible,
- Policies that leave farmers with the burden but without the value added by changing their approach, and

- The difficulty of integrating indigenous and academic knowledge and the different mutual expectations between stakeholders

Most contributions tended to agree that a long-term landcare ethic needs to be accepted by farmers and governments alike and that resource conservation should be integrated in the production functions Some said we should "put enlightened, participating people first" and that "the people living in a specific rural area (rather than farming as such) have their functions as guardian of biodiversity, cultural identity, landscape, local wisdom and quality of life" Others maintained that "multifunctional agriculture should shift its focus from anthropocentric to ecological considerations" Both options, however, require continuous education of local farmers and their advisors alike Primary producers need empowerment of access to new information, markets, financial and other services, in order to seek suitable solutions themselves 'Bottom-up' and 'top-down' approaches should function hand in hand and systems of incentives and regulations should make the benefits of MFCAL for all stakeholders very clear Policies should aim at optimum rather than maximum production

In the first round of case study submissions, very few were received that referred to the national level or above, the main exception being the National Landcare Program in Australia When confronted with this outcome several conferees pointed out that "if we are truly interested in knowledge that works, then the local level is where it is to be found" At higher levels (both academic and bureaucratic) the focus tends to be on single issues, whereas creativity and control regarding multiple issues are found at the farm and local level

The future of agriculture and land depends on the will of mainly city people to see farming areas and resources safeguarded To pay the full cost for this, an alliance between producers and consumers for 'sane products' is necessary Where agriculture is in direct competition with urban land uses its sustainability has to be politicized Multifunctionality is a way of decreasing dependence on a commodity market that small producers cannot control and therefore the reality of rural existence in many countries, especially where the majority of the population is rural and in most cases poor

What Should be the Roles of Different Institutions?
Points were raised on the roles of government and non-governmental organization Both are considered to have a vital role to play These roles differ with the level at which they operate

- NGOs

Partnership between NGOs, agricultural education, extension and the farmers themselves needs strengthening Trainers should investigate how farmers learn, bearing in mind that poverty causes rivalry, environmental destruction and lack of insight into the underlying causes of one's problems NGOs are crucial for establishing enabling structures and networks, at all levels It is important to distinguish between NGOs speaking on behalf of weak interest groups or sectors and those representing strong power groups (from local to international)

- Governments

Have an important role to play in providing services to farmers and jobs for people to stay in the rural areas, but need to learn ecological principles just as much as the other stakeholders The public sector is under pressure, but is there to create a suitable legal and institutional framework and to ensure there is equitable access to negotiating and no imbalance of market power Environmental legislation should go together with practical solutions for adequately managing the environment

- Private Companies

Have an important role to play in providing services to farmers and jobs for people to stay in the rural areas, but need to learn ecological principles just as much as the other stakeholders They will only apply these if they see economic benefit , but could be natural partners in the context of MFCAL

- Different Levels

Institutional development is necessary at all levels At the local level, direct and active stakeholder participation is called for At the national level there is policy development and enactment by government in consultation with NGOs Global educational and regulatory initiatives are needed, as, without such an outside force, too few human actions would be ethic-driven and thus favor human health and the environment However, the actual configuration of the various actors (both institutional and individual) is just as 'location-specific' as multifunctional agriculture itself

Did the E-Conference Work?

The E-Conference was a rich and rewarding exercise involving a valuable exchange of ideas between people who would not normally be able to discuss these issues together The range and depth of contributions was excellent, and fully confirmed the benefits of establishing an Electronic Conference in preparation to the main FAO/Netherlands Conference in September, 1999 Not only was the technical content of a consistently high standard, but also it allowed for voices and opinions that would not normally be heard to be incorporated into the preparatory process

Impacts Discussion

The benefits of the E-Conference will of course be different for different people and institutions In some cases, it will have increased people's overall understanding of some of the complex issues relating to the multifunctional character of agriculture and land In other instances, it may have acted as a springboard for new activities and partnerships The E-Conference certainly echoed the fact that there is an immense interest that surrounds this issue

All of the contributions, ranging from concepts and cases, to analyses and conclusions will contribute directly to the forthcoming face-to-face technical Conference in Maastricht in the Netherlands from 13-17 September 1999 It will do so in two ways Firstly, the insights of the E-Conference were directly incorporated into a keynote paper for the conference on Taking Stock Secondly, the E-conference will be used during the

face-to-face Conference to 'virtually' bring these participants to the table in Maastricht During this Conference, a development agenda for global agriculture in the next millennium will be discussed, which will hopefully be instrumental in bringing agriculture back to the forefront of international debate The outcome of the Conference will contribute to the upcoming Commission for Sustainable Development (CSD-8) in 2000

B. Phase I Results, Impacts and Lessons

Introduction

SANREM was requested by USAID to write a 'Lessons Learned' or 'Success Stories' document that successfully demonstrated the impact of SANREM Phase I on communities and institutions The document was also envisaged to demonstrate SANREM's past successes and lessons learned as well as give a view to the future Specifically it should

- Describe to USAID and other potential partners and donors - including UN organizations, bilateral agencies, international NGOs, etc , what has been SANREM's impact, and
- Describe to peers what SANREM has contributed to understanding how to do Landscape-scale research

Objectives

The objective of the results, impacts and lessons document was to demonstrate to USAID the return on their investment from Phase I and Share SANREM's lessons with institutions implementing similar landscape scale research, networking, and training

Methods

Case studies documented by each of SANREM's regional projects from the Philippines, Ecuador, and Burkina Faso

Outputs

The final product is a comprehensive results, impacts and lessons learned 76-page document, *Looking Back at the Landscape* It is available from the SANREM Management Entity or USAID (Christine Bergmark or Clara Cohen, Global Bureau, Office of Agriculture and Food Security)

C Work Plan Database

Introduction

Year 1 goal of the global project was to establish a Lotus Notes Database on the NT Server at the SANREM ME The design of the work plan database was geared to manage activity record forms that could be filled in and edited on-line by SANREM project

managers and principle investigators The forms would be designed to go through four phases draft, submitted, approved, and implemented Project Managers would be able to submit filled in forms The ME would then approve activities After reports were attached, the ME could move the activity record forms to the implemented status and they will be available online

Objectives
Set up work plan database that can be accessed by SANREM Project Managers and PI's

Provide project managers with tools to support work plan development and principle investigators with an opportunity to share their plans with fellow PI's

Methods
The database will be available on line so that principle investigators can enter their draft work plan and other PI's can read them and/or download the plans

Output
The Work Plan Entry form was designed with directions included on-line They will be further developed during Year 2

Provide reviewers such as regional committees and the TC/EEP access to detailed plans

Method
The database will be set up so that different groups (PI's, project managers, ME, EEP, etc) will have increasing access to the plans as they move through the process from draft to submitted, approved, and implemented

Output
The work plan entry form was designed with directions included on-line (They will be further developed during Year 2) Year 1 and Year 2 Work Plans were entered into this database The work plans are accessible to the public Work plan entry and modifications are password protected A printed copy of the Work Plan Entry Form as found in the database is located in the appendix to the Global Project report The Work Plan Entry Form and database are being revised further using Access software

D Communications Strategy Development

Introduction, Objective and Methods
An additional accomplishment during Year 1, Phase II of SANREM was the design of a communications strategy and the production of several products in relation to that strategy The communications strategy itself may be found in the Year 2 Work Plan The goal of the communications strategy is to capture research results from regional and global projects and make this knowledge available to decision-makers It was also designed to facilitate exchange of experiences among researchers and decision-makers

Several tools were identified to meet this goal They included

- SANREM Newsletter
- Web Page On-Line
- Brochure
- Semi-Annual and Annual Reports
- SANREM Library
- Post findings, data, conference proceedings, etc on SANREM's web site, etc

Output
During Year 1, the SANREM Newsletter was re-established, a web site was created and put on-line, a two-fold brochure was developed, a preliminary e-library format was designed and a semi-annual report was written
EE Discussion Fora
SANREM established a framework using Lotus Notes to facilitate electronic discussions for cross project dialogue The framework is in the testing stage The database may be accessed through SANREM's web site, Program Support Services, and Project Manager Discussion

E SANREM E-Library

Introduction
The goal of the SANREM Library is to make SANREM documents available electronically The documents in the library will include technical reports, proceedings from workshops and conferences (both face-to-face and electronic), white papers and other special reports commissioned by SANREM Abstracts will be available in English, Spanish, and French Documents, other than project reports (which will be in English), will be their original language Translation of complete documents will depend upon the availability of financial resources

Objective
The initial objective of the e-library was to provide global access to SANREM documents

Method
The method to achieve this objective was to establish an on-line electronic library set that allows SANREM partners to enter documents, search for documents by key word, author, etc , and to download full text documents

Output
A preliminary e-library format had been designed using Lotus Notes software However, it is being further analyzed before being opened to the public (A printed copy of the front page of the e-library database may be found in the appendix to the Global Project report) A library database created during Phase I is being analyzed for entry into the Lotus Notes framework Issues such as decentralizing the library among the regional projects are also being considered

F. Who's Who Database

Introduction
SANREM Who's Who database was conceived as an on-line database to include the names and contact information of those directly involved in SANREM activities at local, national, regional, and global levels It was envisaged that this service would be expanded to include names and contact information of others involved in sustainable agriculture and natural resource management not directly involved in SANREM CRSP activities

Objective
Provide technical support (access to consultants) in subject areas related to sustainable agriculture and natural resource management

Method
On-line who's who database set up so that SANREM partners can submit resumes electronically and/or search for people with specific types of expertise - e g language, ecosystem, discipline, etc

Output
The Who's Who Database Customized Search Form and the Who's Who Database Entry Form were designed and put on-line SANREM personnel have experimented with data entry and searches Printed copies of the forms may be found in the appendix to the Global Project report

G Global Climate Change

Gerrit Hoogenboom and Birama Diarra
The University of Georgia, USA & Direction Nationale de la Meteorologie, Mali

Introduction
Climate change and climate variability will have a significant impact on agricultural production and food security of most nations Especially developing countries that rely on rainfed farming systems will be very susceptible In the Sahelian countries, the onset of the rainy season varies from one year to the next Based on the uncertainty of precipitation, it is very difficult for farmers to make appropriate management decisions, as well as for policy and decision makers to estimate potential crop yield for determining food security Improved models and decision support systems are needed to help farmers, politicians, decision makers, non-governmental organizations, and others to adapt management practices for optimum use of natural resources These computers-based information tools are also critical to help determine optimum yield levels to guarantee economic sustainability for resource poor farmers

Objectives
To improve the economic sustainability and reduce weather-based risks of agro-pastoral production systems using an integrated system of weather data, weather forecasts, and computer models

Methods
- Obtain local weather data, soil data, land use data, and agronomic information
- Digitize available information and store in spatial databases
- Identify and obtain local short-term and long-term weather forecasts
- Evaluate crop simulation models for local conditions
- Combine spatial information with GIS and crop simulation models
- Develop agricultural forecast products applicable to local conditions
- Disseminate information to farmers, as well as policy and decision makers in the government
- Evaluate the effectiveness of the deliverables at harvest time with local farmers as well as politicians
- Provide training on the use of these information technology tools for the Mali Meteo Service

Outputs
- Hoogenboom participated in the International Workshop on Agrometeorology in the 21st Century - Needs and Perspectives This workshop was organized by the United Nations World Meteorological Organization and co-sponsored by the SANREM-CRSP It was held in Accra, Ghana, and attended by many scientists from West Africa and other developing countries Hoogenboom presented an invited review paper entitled "Contribution of Agrometeorology to the Simulation of Crop Production and its Applications " This paper will be published as part of a special issue of the journal Agricultural and Forest Meteorology

- A sub-contract was developed for the Direction Nationale de la Meteorologie

- Daily weather data were obtained from the following sources

Mali Meteo Service	16 stations for the period from 1950 to 1980, six stations start prior to 1950, mainly 1920 - 1925 and one station starts in 1897
WMO	12 stations for the period 1977 to 1997,
Precipitation only	97 stations for the period of 1950/1958 to 1979/1980, (several of the precipitation stations overlap with the Mali Meteo and WMO stations)

All data are in digital format and can be used for application of computer models The location of the weather stations is presented in Figure G1, p 29

- The Digital Chart of the World was obtained from the UN Food and Agriculture Organization The soils map for Mali was extracted as shown in Figure G2, p 30

Summary of Results
An analysis has been developed for the current state-of-the-art in crop-weather models A summary of this analysis will be published in a peer-reviewed journal

An initial weather and soil data inventory and analysis has been performed The results are shown in the following two figures

Impacts Discussion
The International Workshop on Agrometeorology in the 21st Century - Needs and Perspectives, provided a great opportunity to interact with many agrometeorologists and other scientists from West Africa and other developing countries There seems to be a great demand by these scientists to learn more about the latest Information Technologies, such as computer models and decision support systems They seem very keen in using these tools to help advance their forecasting systems and ultimately develop better forecasting products for the local farmers

Plans for Subsequent Reporting Period
- Improve communications with co-Principal Investigator in Mali
- Obtain year-to-data weather data for model applications
- Identify sources for weather forecasts
- Convert available soil and weather data into a computer-model specific format
- Obtain agronomic information for the study region
- Conduct initial model evaluation for the study region

Collaboration
- Collaboration with scientists at Institute of Rural Economy (IER) in Mali
- Collaboration with scientists at ICRISAT in Mali, as well as Hyderabad, one of the main IARCs for agricultural research in the arid zones
- Collaboration with scientists at ACMAD in Niamey, Niger
- Collaboration with scientists at IITA in Nigeria and ILRI in Nigeria and Kenya as part of a US-AID linkage project between ILRI and UGA to study livestock systems in Western Africa
- Collaboration with a PEANUT-CRSP funded project to study aflatoxin contamination
- Collaboration with a seed allocation project, funded by the PEANUT-CRSP
- Collaboration with a NOAA-OGP funded project to study Famine Early Warning Systems in Burkina Faso
- Active participation with the International Consortium for Agricultural Systems (ICASA)

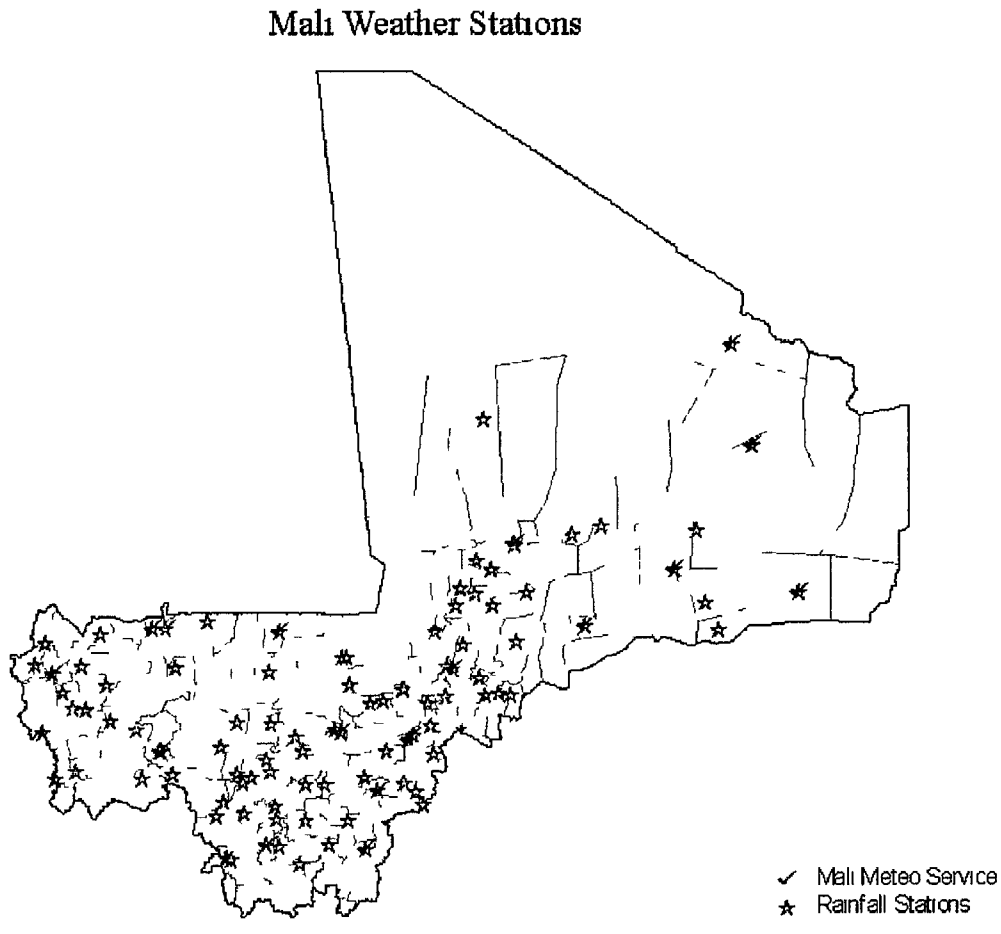


Figure G1 Location of Weather Observation and Rainfall Stations in Mali
Source Malian Meterological Service and Hoogenboom, 1999

Mali Soil Map derived from FAO Digital Soil Map of the World

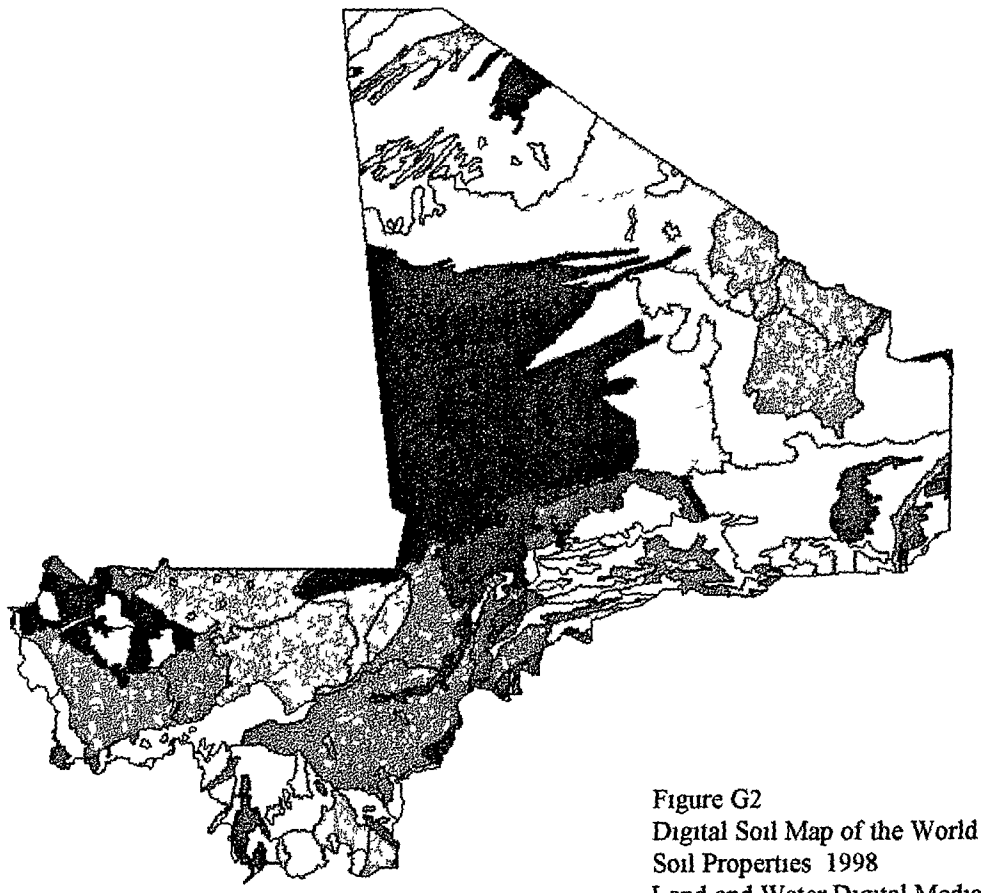


Figure G2
Digital Soil Map of the World and Derived
Soil Properties 1998
Land and Water Digital Media Series No 1
FAO, Land and Water Development Division

H. Capacity Building

Introduction
The capacity building activity during Year 1 was geared to, include both workshops, short-term trainings, and graduate training During Year 1 this activity was designed to pay for graduate training initiated during Phase I During subsequent years, graduate training will be included within regional and global project work plans

Objective
To help decision-makers use appropriate tools and data to make better-informed decisions through the support of the development of long-term institutional capability

Methods
- Continue support for graduate training begun during phase I
- Workshops to help decision-makers learn how to use decision support tools and new mechanism to access data

Output
The capacity building activity was responsible for three primary outputs that included funding for graduate training, coordination of a technical exchange between the Philippines and Ethiopia, and workshop support

1 Graduate Student Funding
Three graduate students, Daniel Kaboré, Brigitte Ngoumou and Marciel Pinero, have all received support from the global program to complete their studies

2 Technical Exchange between Ethiopia and the Philippines
The USAID mission in Ethiopia requested SANREM participation in the design of programming efforts in Amhara, an area of northwestern Ethiopia characterized by a rugged hilly terrain Based on an interest in watershed management skills and mutual English speaking abilities, AID-Ethiopia has subsequently decided to sponsor a technical exchange for a team of researchers and administrators from Amhara to the Manupali watershed in the Philippines SANREM has been involved in the facilitation of this effort to jointly analyze watershed issues, expose participants from both countries to decision-support techniques, and to coordinate exchange of technical expertise in the areas of community mobilization and management activities The SANREM global project is pleased to have participated in this direct capacity building effort

3 Workshops
The primary workshop funded as a global activity, was preparation for the Workshop on Disseminating Value-Added Information to Natural Resource Decision-Makers for Easing Conflicts in West Africa Dr Ed Kanemasu directed this activity A full activity report follows

Workshop on Disseminating Value-Added Information to Natural Resource Decision-Makers for Easing Conflicts in West Africa

Abstract
During this period, Dr Kanemasu worked with Dr Bob Hart on finalizing the co-sponsorship of an international workshop in Accra, Ghana on February 15-17, 1999 The initial request came from Dr Sivakumar, Chief Agricultural Meteorology Division, WMO Other organizations that co-sponsored the workshop were FAO, USDA, IITA, ICRISAT and FMA The workshop was Agrometeorology in the 21st Century- Needs and Perspectives The primary objective of the workshop was to determine and evaluate the future research and application needs in agrometeorology in light of current concerns with food security, environmental degradation and sustainable development

There were 95 participants from 55 countries Dr Kanemasu chaired the session on Agrometeorological Applications and, in the absence of Dr Virmani of ICRISAT, presented his contribution on sustainable agriculture

As a follow up to the workshop, Dr Kanemasu led an effort to conduct a workshop in Washington, DC on June 23, 1999 at USAID The working title of the workshop is *Dissemination of Value – added Information to Natural Resource Decision-makers for Easing Conflicts in West Africa*

Key Tasks to be Implemented

- Workshops to help decision-makers learn how to decision support tools and new mechanisms to access data

One of the interesting papers at the Accra workshop was presented by Mr Mohammed Boulahya, Director General of ACMAD (African Center for Meteorological Applications and Development) in Niamey, Niger He described an activity of distributing battery-less radios with the capability of receiving short wave, FM and AM signals to farmers, pastoralists, and extension people in Africa A small group of us met and decided to move forward to conceptualize a project to disseminate value-added information to natural resource decision-makers for easing conflicts in West Africa

A workshop was held in Washington, DC on June 23, 1999 at the Ronald Reagan Building We had over 33 participants with representation from NOAA, USAID, NASA, USDA, WMO, ACMAD, AGRHYMET, SANREM, INTER CRSP, private sector organizations and several universities The feedback has been very positive It is our plan to develop a framework of a project and to interact with potential donors We developed a draft of a briefing paper for release at the workshop It may be found in the appendix to the global project report

The specific objectives and methods for this sub-activity include the following

Objective #1
- Develop an information network among the relevant natural resource projects in West Africa

Methodology
- Communicate with relevant organizations
- Conduct a workshop with participation of key people and organizations for exchange of ideas and information

Output
Framework strategy for the development and funding of the project

Objective #2
- Use or enhance the output of the relevant projects for dissemination to natural resource decision-makers

Methodology
- Assess the needs of targeted decision-makers (use the SANREM/WA PLLA and other relevant documents including a review of the French literature)
- Develop a multidisciplinary team to develop the needed information and to engage the information stream from originator to user for timely implementation
- Training will be required at several nodes in the information stream

Output
Provision of value-added information for natural resource decision-makers

Objective #3
- Support development of long-term institutional capability

Methodology
- Training at US Universities

Output
Increased capability of the human capital

Accomplishments
The following list of achievements occurred during Year 1
- Networking and coalition building among West Africa NRM players
- Planning and organizing the Workshop
- Investigating the potential for radio disseminated information
- Working with NASA on developing their international applications program
- Facilitation of the workshop
- Action plan developed to secure funding

Institutional Support

- Faculty time of the University of Georgia
- Personnel time from WMO, NOAA, NASA, USDA, ACMAD

Assessment of Decision Maker Priorities and Decision Support Opportunities

Institutional and Scientific Collaboration
This activity set is being conducted jointly between the SANREM Global Project and the SANREM regional Projects including the USDA Institutional Partners include

1 Iowa State University for the Andean Region – Drs Cornelia Butler Flora and Jan Flora
2 University of Wisconsin for the SE Asia Region – Drs Gladys Buenavista, Ian Coxhead, Tony Sambalan
3 Virginia Tech and University of Georgia for the West Africa Region – Dr Keith Moore and Julia Earl
4 USDA-ARS J Phil Campbell Sr , Natural Resource Conservation Center, Southern Piedmont Region – Dr Jean Steiner
5 FAO of the UN – Dr Eric Kueneman

Introduction
The SANREM CRSP is centered on supporting and informing natural resource management decisions This project emphasizes the need for a better understanding of the difficult natural resource management decisions being faced by different decision makers at various levels in the decision-making hierarchy especially in settings where decentralization or devolution are in progress The purpose of the assessment of decision maker priorities is to understand the desired outcomes, issues, and difficult decisions of natural resources managers This effort is being done in order to ensure that decision support activities aimed at informing natural resource management decision makers respond to the real demands of decision-makers This project will produce an assessment of decision-maker priorities and decision support opportunities based on 3 country profiles and validated through global fora This information will be used to develop a 'demand' based Global Knowledge Base as well as for decision support research priority setting institutions It is expected that this will be used by national, regional and global institutions and individuals working to support informed decision-making for sustainable agriculture and natural resources management

Objectives

- Develop a participatory methodology to understand the priorities, issues and difficult decisions, which natural resource management decision-makers and key actors are currently facing in settings of devolution This will include identifying how to characterize natural resource decision-makers and stakeholders types of desired natural resource outcomes, types of natural resource decisions faced (trade-offs etc), sources of support (information, tools, and training) and the framework in which to elicit these responses

- Through participatory appraisal (focus groups and interview), identify desired natural resource management outcomes and the constraints to decision-making in pursuit of these outcomes in Mali, the Philippines, Ecuador and the South-eastern U S Identify what is perceived as the needed support to make these decisions

- Through electronic fora, validate the demand side (difficult decisions and potentially useful tools, information, and capacity building to facilitate decision making by natural resource management decision makers) as articulated in the appraisals and globally and assess the supply/support side of decision- making

- Synthesize and prioritize decision-maker needs and opportunities from the three regions and the electronic conference to help focus decision support research activities of SANREM, FAO, INSAH, CIAT and others

- Establish a participatory monitoring and evaluation framework within the context of landscape decisions making and stakeholder benefits optimization to aid in the prioritization of participatory research efforts

Methods

This project undertakes a participatory appraisal of what potential decision-makers identify as short and long-term issues and desired outcomes related to natural resource management Informal interviews are being conducted from the local to national (and in some cases regional) level to identify perceived constraints and needs in terms of specific decision support including information, decision support tools and capacity building as well as who decision-makers must collaborate with to address the issues This project is being carried out in conjunction with the Regional Projects and will be used to inform the other components of the Global Project including the Global Knowledge Base and Global Decision Support Systems A key piece of this research will be to identify critical institutional actors who are part of concurrent decision making with important impacts for natural resources Within this project, a participatory methodology is being developed and refined for eliciting this information from decision-makers Based upon the assessments in Ecuador, Philippines, Mali, and the south-eastern U S , the project will objectively compare the demands of decision-makers with the currently available decision support tools, mechanisms to access data, and individual and institutional capabilities to make informed decisions

Outputs

- A planning meeting was held at FAO decision support scientists[2] including biophysical and social scientists as well as GO and NGO advisors to put together preliminary ideas for initiating the process of assessing decision-maker needs It was recommended that case study reviews be conducted as well as participatory appraisals, focus groups, and interviews

- A draft interview protocol was developed and pre-tested in Mali from the village to national level Lessons learned from the Mali experience were used to develop the approach and interview protocol for the Philippines and Ecuador

[2] This included biophysical and social scientists as well as NGO and GO advisors Participants were Peter Kenmore, Jean Marc Faures Eve Crowley Robin Marsh Eric Kueneman Nora McKeon Doyle Baker Parviz Koohafkan, and Kevin Gallagher

Summary of Results

Mali Pilot Test

A pilot assessment of natural resource management (NRM) decision-maker needs was conducted in Mali, a West African country in the Sahel, in February 1999 The pilot had two purposes The first was to actually assess NRM decision-maker needs The second was to identify *how* such an assessment might be implemented This synopsis will identify output from the assessment regarding difficulties decision-makers face It was also address the assessment methodology employed and provide suggestions for future assessments

Levels of Assessment

The decision-maker needs assessment (DMNA) conducted in Mali was undertaken at several different levels These levels included the local village, the *Cercle* (or Circle administrative level, Djenne Circle), the regional capital (Mopti), the national level (Bamako) and the sub-regional level A table indicating those levels and the interviews conducted within each level, by organization and participant follows

Level	Organization
West Africa Sub-Regional Level	• INSAH (Institut du Sahel - CILSS- Permanent Interstate Committee for Drought Control in the Sahel • Regional FEWS (Famine Early Warning Systems) Office
National Level (Mali)	• USAID - International Donor (national and sub-regional representatives) • CARE - International NGO (national headquarters)
Regional Level (Mopti)	• DRAMR (Direction Regionale de l'Appui au Monde Rural - Regional Ministry for Support to the Rural World) • DRAER (Direction Regionale de l'Amenagement et de l'Equipement Rurale - Regional Ministry for Management and Provision of Farming Tools to Rural People) • DRRC (Direction Regionale de la Reglementation et du Controle - Regional Office of Regulations and Enforcement) • PGRN (Project de Gestion des Ressources Naturelles - Natural Resources Management Project) • GDRN 5 (Natural Resource Management and Decentralization NGO Network)
Circle Level (Djenne)	• CARE-Mali, Djenne Suboffice
Local Level (Village of Madiama)	• Village Farmers

It is recommended for assessments conducted in other countries that other bodies participate including National Assembly or Parliament representatives, relevant UN agencies, other donors active in the environmental arena, farmers groups, NGOs, NGO networks and governmental ministries which address NRM issues In situations where

markets and the private sector influence NRM decision-making they should also be included

Synopsis of Information
Interview Protocol The interview questions used for the majority of the assessment follows

Interview Questions
1 Could you please explain the natural resource management policy making process (and as it relates to agricultural production)? (Who is involved and how? Executive branch, Legislative, ministries, donors, local stakeholders?)
2 Are you yourself involved in the decision-making process? Do you make decisions?
   A If yes, what are types of decisions that you make?
   B How do you make those decisions?
3 What factors contribute to your decision-making?
4 Are there any difficulties that you encounter in making decisions?
   A If yes, what are the difficulties?
5 Is there something that would assist you in making decisions?
   A If yes, what is it?
6 Are there gaps in the NRM policy-making process? (or the NRM decision-making process depending on interviewee)
   A If yes, what are they?
7 Do you have any needs?
8 Explain information database idea and ask,
   A What are your *information* needs?
   B What method of way of disseminating information or support do you find the most appropriate at this level?

Output Types of Support Needed, Difficult Decisions

Difficulties, Constraints or Needs
The primary difficulties, constraints or needs cited by village participants and regional government representatives were in reference to financial resources in order to implement solutions to agricultural or environmental problems The majority of assessment participants (i e regional government ministry directors and villagers) did not generally indicate that information or tools per se were lacking in making decisions However, upon learning of SANREM's decision-maker support approach (without tangible development interventions) they also indicated that access to more information would be appreciated (In an open question format, information and tools were not indicated as constraints to NRM decision making) These responses might indicate that information on fundraising could be helpful to government level decision-makers

In contrast to this however, NGOs operating in Mali did note the need for identifying mechanisms to assist rural people at levels higher than villages (This is of particular relevance given further government decentralization to the commune level) In addition to the need for developing supra-village structures, there is also a need to develop

representative NRM decision-making structures and procedures The conflicting types of law present in the areas (or recognition of various decision-making authorities such as traditional village chiefs, transhumant herders, modern government bodies, religious law, etc) exacerbate this need Information regarding other types of decision-making bodies and tools regarding decision making procedures in similar contexts would appear to be helpful

Village

Madiama

Responses to the decision-maker needs assessment at the village level were unsurprising Village participants focused on the *needs* and *support* part of the questions The villagers indicated that they don't "make" NRM decisions Rather, they do everything they possibly can to maximize food production (including cultivating all available land, using organic fertilizers to the extent that they are available, and borrowing land from neighboring communities) The primary concerns cited in this particular village focused on enhancing agricultural productivity In response to the question regarding what would help them make better NRM decisions, the farmers first replied that they don't make decisions, but what would help them is improved the rice harvests and increased availability of fertilizer for dryland farming (They already know that soil fertility is low, that fallow should ideally be practiced and that marginally arable lands are under cultivation) Some additional factors that influence farmers agricultural production and NRM decision making are soil type and grain selection, estimated rainfall, family size, market prices for cash crops (in this case, watermelon and a fiber from a hibiscus family plant) and social factors (i e wedding, funeral expenses, etc) Government policies are not recognized as influencing factor in NRM decision-making at the village level

Circle

CARE-Mali

At the circle administrative level, an interview was conducted with CARE-Mali CARE has a strong presence in the Djenne Circle, and is active in the villages where the PLLA was undertaken In response to the needs assessment interview questions, A CARE project coordinator noted that he perceived a need for greater awareness raising regarding the links between the agricultural activities and the state of the environment among local people (regardless of whether or not the local people recognize this need) To that extent, he supported the need for more awareness and information to be made available to local farmers In addition to this insight, it should be noted that CARE's primary focus in the area is strengthening existing supra-village institutions This activity is based on the assumption that capacity building is a necessary first step to development CARE maintains that if inter-village institutional capacities are strengthened then the local ability to undertake development efforts will be strengthened and that they will in turn be sustainable because the efforts would have been initiated by the villagers themselves

Regional

Government

Much to Mali's credit, it has radically altered the way in which it conducts development activities In dramatic contrast to its formerly highly centralized government of the 60's, 70's and 80's, the Malian government has moved to a much more decentralized form of governance and policy making As such, the GOM now bases its development efforts squarely on the needs identified by local people Requests for assistance in the areas of agricultural production and environmental issues are fed up each administrative level and are synthesized Training is provided to extension agents who in turn teach rural people techniques in order to alleviate their agricultural and environmental problems The regional directors of Mali's environmentally related ministries indicated that their primary constraint in NRM decision-making is financial That is, they need financial resources to implement solutions to NRM problems and to set up trials in cases where information is lacking Although the key informants did not explicitly state this, it might be inferred that information on fundraising would be helpful to them (Financial viability/independence is a key indicator of having well-developed organizational capacity Information and training in this area could correspond to SANREM's capacity building goals

GOM participants indicated that they would certainly welcome the availability of more information If an information database was established, they suggested that they could best access it either through the use of printed bulletins with abstracts of the available information and/or diskettes containing the information which could be distributed to regional centers (where computers and electricity are available)

Regional NGO Network

An interview was conducted with the coordinator of a regional NRM NGO network Again, the impression given by this key informant was not so much that information was lacking, but rather financial resources with which to implement more development projects However, the coordinator also noted that one of the major challenges of NGOs operating in the region, was how to assist rural people as government decentralization further unfolds giving NRM decision making authority to local people at the *commune* level (particularly in reference to land tenure and juridical law, both traditional and modern) Given this concern and challenge, I believe it could be helpful if those NGOs had access to a set of decision-making tools that could be shared with their constituencies

National

Results from national level interviews were far less conclusive than those conducted at lower administrative levels (This is due in part to the unavailability of potential interviewees It is also due to agendas that the participants wanted to share with the interviewer)

FEWS

The primary client of FEWS, the USAID-funded Famine Early Warning System, is in fact USAID in Washington, D C FEWS does not actively seek to influence or support NRM decision-makers in Mali However, the data and food balance sheet output which FEWS generates (based on NASA NDVI data combined with AGRHYMET production data) is readily shared with any interested party as well as will SAP (Systeme Alerte Precose - the GOM's early warning system) To that extent it supports decision-makers (The FEWS *Sahel Vulnerability Assessment* Report indicates that its preseason vulnerability updates are, "part of a larger process of determining which population groups are in need of assistance, what is the most appropriate form of intervention, and how the intervention should be carried out FEWS collaborates in designing appropriate contingency plans to be implemented if a poor harvest ensues ") An assessment could be conducted to determine what difficulties or constraints FEWS encounters in trying to support decision-makers

USAID

Although a meeting was held with two AID representatives, the direction of that discussion turned to strategy and how to promote SANREM within the West Africa Region (Information regarding that strategy, a focus on food security, is available from the Communications Manager at the ME)

CARE

An informative meeting was held with the Project Coordinator for Institution Strengthening with CARE-Mali Much was learned about CARE-Mali's approach and ideas regarding a SANREM partnership with Mali were developed Given CARE's focus on institutional capacity building, this project officer's primary constraint was working to better understand how to work with supra-village organizations (i e local institutions which encompass several villages) and how to bridge the gap between traditional decision-making and modern law It therefore appears that information and tools regarding these issues could be useful to him in his work to support local decision-makers

Sub-Regional

INSAH

The INSAH approach to supporting NRM decision-makers very closely parallels that of SANREM's global decision-maker support program in that it provides information and data to decision-makers Dr Gaoussou Traore, NRM Specialist, indicated that INSAH provides this support at three different levels First every three years the heads of state from CILSS countries gather to discuss regional policy At these summit meetings INSAH provides the various presidents with data summaries in order to assist them in their NRM policy and decision-making processes Second, there are annual meetings with cabinet members and relevant ministry representatives from the CILSS countries INSAH targets technicians and policy makers within cabinets and ministries, and provides them with information and data in order improve their NRM decision-making Thirdly, INSAH provides support to civil society (i e village organizations and NGOs)

Information and data are shared as well as conducting awareness raising activities This work is not conducted by INSAH itself, but rather by parties that work with civil society The type of support that INSAH could use in its efforts to assist NRM decision-makers includes data collection, database development and targeted collaborative efforts among partners in information provision and dissemination

Publications

Neely, C L , R D Hart, M G Buenavista, P Koohafkan, and A T Sumbalan 1998 Real Time Demand Scaling up local level information for provincial level decision making Proceedings International Farming System Meeting Johannesburg, South Africa

Neely, C L , C Bergmark, M G Buenavista, W G Deutsch, C B Flora, W L Hargrove, and R D Hart 1998 Lessons from the Landscape Participatory Research for Local to Global Decision Making Proceedings American Society of Agronomy Baltimore, Maryland

Impacts Discussion

A Who has the project impacted and how?

This activity which is designed to develop a methodology as well as to understand the priorities of decision makers has brought about very strong support from institutional partners in the regions For example, INSAH has asked that this effort provide necessary input to database development and the PPDO of the Philippines has asked to be a direct partner in the project as the information will be extremely useful in provincial level planning

B How has the project contributed to SANREM's Programmatic Goals?

This activity directly addresses each of SANREM's programmatic goals It does so by developing a methodology to understand decision maker priorities that will in turn support sustainable agriculture and natural resource management These priorities are being used to understand the institutional relationships within and across multiple scales The outcome of this activity will provide one component of the decision support database

Plans for Subsequent Reporting Period

- Local to National Participatory Appraisal in the Philippines, Mali and pilot test in Ecuador
- Scientific partners meeting to synthesize learnings to date
- Expert panel electronic meeting on methodology
- Literature review of relevant case studies

Development of the Global Decision Support System

I Introduction

Assessing the options and consequences of decisions made in today's complex world requires the capability to understand the multidimensional implications that often result from creating change The consequences of such decisions as they affect agriculture and natural resources are often not intuitively obvious To contribute to improved methods to assess the impact of these decisions, a ***suite of georeferenced economic, environmental, and biophysical models*** is being developed and linked to holistically assess the impact of changes in technology or policy on the agriculture and the sustainable use of natural resources in developing countries The resulting global decision support system (GDSS) will also include critical foundation data for spatially explicit analyses as well as access through global networking to other models and sources of relevant information The GDSS will be developed and adapted for use at levels of scale from farm to global Methods will be developed and refined using relevant real-world assessments at varying scales as development-demonstration platforms The ultimate objective is to contribute to the overall SANREM goal of providing decision makers at multiple levels of scale with the improved capability and capacity to make more informed and better decisions on matters related to food, agriculture, and the sustainable use of natural resources

The SANREM-GDSS has initiated a set of collaborative efforts with FAO and national policy and decision makers in Mali and Kenya to develop and use the GDSS at national, regional, and global levels The thrust will be to evaluate the consequences of policy options aimed at enhancing food security, reducing poverty, and making prudent and environmentally sustainable use of natural resources Developing these methods by undertaking analyses important to users at varying levels of scale as test beds helps ensure that the methods are relevant by having user participation and feed back from the outset

The GDSS development is being linked to regional and other global SANREM activities by parallel development of methods and data bases useful to regional projects and by mutually beneficial collaboration on specific assessments within regional projects The products of the GDSS will be incorporated into the SANREM global information system The initial active collaboration will be with the West Africa Project while planning dialogue continues with the other two regional activities

For regional (multinational) and global applications of the GDSS, Texas A&M will continue and expand its linkages to the regional bureaus of USAID and FAO as a means of engaging regional groups of developing country analysts involved in impact assessment with the objective of gaining feed-back on improving the GDSS and creating awareness and capacity for use of the methods The relationship with FAO will include planning and initiating the use of the GDSS in assessing global progress towards achieving the goals and objectives of the several international agreements such as those

emanating from the World Food Summit and the Convention to Combat Anti-desertification A senior scientist from Texas A&M completed a six month assignment at Headquarters FAO on May 1, 1999 Agreements on collaboration on four joint efforts was achieved and an ongoing relationship established, including plans to develop specific proposals for external funding in the several areas of collaboration

Also at the global level, Texas A&M is continuing to develop and evaluate methods for use by USAID in planning and evaluating its agricultural research and development portfolio We continue to interact with the CGIAR Impact Assessment and Evaluation Group and the Technical Advisory Committee, along with individual donor members of the Group on developing and using impact assessment methods

II Project Objectives

In developing and validating the GDSS, SANREM has two overlapping objectives

(1) to 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 the landscape/lifescape level of integration and

(2) to develop the capability to assess the impact of policy and management decisions related to the general area of agriculture and natural resource management at levels of government ranging from provincial to global levels In the latter case, the intent is to make a contribution to the methodologies involved in making investment decisions for research and development in both developing and developed countries and to make the GDSS available for users at these several levels of national and international government The GDSS will provide the capability for both ex ante and ex poste analysis of plans and results, respectively

III Progress

A more complete description of progress is provided in the report on individual activities The following table summarizes these reports In contrast to the rest of SANREM II, the GDSS is a new effort Because of late release of funds, the majority of work did not commence until October 1998 Three kinds of progress have been made Active planning with FAO, national and regional partners, and other collaborators in SANREM and elsewhere in the U S has been completed Commitments to several key elements of the GDSS development have been made by our partners and a clearer picture of the overall effort is now possible The second kind of accomplishment is the development of the component methodologies needed for the GDSS as well as the critically important conceptual development of linkages between models to provide the holistic to impact assessment Third, several individual case studies have been done to provide results in addition to developing methods

The GDSS under SANREM II is an extension of work that was initiated under a separate grant from Global Bureau of USAID to develop the "proof of concept" for the integrated

suite of models Some parts of the GDSS were supported initially by the Africa Bureau, and they are continuing to provide funding for applied development and capacity building in West Africa for the products of SANREM II Research directly related to the GDSS has been supported by institutional matching funds under the cooperative agreement This has provided a substantial mutual leveraging of resources applied to achieving the overall goal

IV How Activities are Integrated in the GDSS

Producing an integrated suite of models for impact assessment is the fundamental premise of the GDSS The scientists involved are mostly from one institution and operate as the Impact Assessment Group in this and related endeavors Therefore, the integration of related activities is inherent to the institutional and procedural elements of this activity set

There are six activities and eleven objectives in the GDSS Activity Set These are summarized in Table 1 and are also shown in the following progress section of this report For the 1998-9 year, these activities address (1) development of component elements of the GDSS and (2) interactive and collaborative activities that pull together the component elements and establish external partnerships The first set of activities enables the second There is very substantial interplay between the development of component elements which is necessary to produce the integrated suite of models As the suite of models continues to develop, the integrated capacity is further enabled by using "real-world" assessments as test beds In year-two, the GDSS development is placing increased emphasis on products of analysis, while still continuing to develop and extend the overall methodology Increasing emphasis is being given to definition of explicit deliverables to various stakeholders

The integration of models and the general approach is illustrated by the outline of the general protocol that is used in case studies to develop and evaluate the GDSS

- acquisition of primary and secondary economic, natural resource, and environmental data related to the agriculture of the political entity under evaluation

- in cases of missing information, biophysical models are used to estimate the needed data (EPIC, PHYGROW, NUTBAL, *inter alia*) a spatial framework is established and related geographically based information on natural resources, weather and related variables is acquired, validated, and organized for ready access, historical data and models for estimating data gaps provides the basis for the stochastic elements of the suite of models

- the technology or policy option to be considered is defined in terms of cost of production, environmental consequences, and potential areas of application

- National and (sometimes) provincial multi-commodity agricultural sector models are created for the relevant area under study with established baselines and projected adoption profiles This is an economic surplus model with interactive components and includes estimates of the elasticity of demand The model assumes farmers make decisions that minimize risk and maximize economic benefit The output includes prices and quantities of food and shifts in land use based on economic advantage These outputs serve as useful proxies of indicators of the status of food security and vulnerability

- Biophysical models such as EPIC and PHYGROW estimate the environmental consequences of shifts in land use and intensification of input use in enhancing production at the level of field and pasture Basin scale hydrologic models such as SWAT are used to estimate the consequences of upstream agricultural practices on soil erosion and downstream concentrations of agricultural chemicals

- A farm-level economic model (FLIPSIM) is used to assess the impact of technology or policy options on farm level income, risk, and household nutrition

- A new software package that creates a JAVA-based common modeling environment for ready interaction between models has been developed and is being refined for use in developing country situations This is intended to provide a mechanism to deliver an integrated, pre-configured suite of models to help produce a capability for optimization of environmental and economic of alternative methods to enhance production of food

- GIS methods are being used to create a spatial framework for data and models that can be used to estimate adaptation zones for new technology based on geographic equivalence to the site where research is conducted and to provide ready access to pre-processed information that is routinely used in defining problems and running one or more of the suite of integrated models This capability is being made available in CD-ROM form in development which has been partly sponsored by USAID's FEWS program

- Research to improve decision making to improve the service value of range resources will entail a collaboration with Goddard SFC, AGRHYMET, EROS, and ILRI to explore the relationship between biomass and greenness estimates from satellite imagery and nutritional status of livestock as estimated by NIRS fecal profiling It will involve developing models of the interaction between livestock and the extensive lands in the Sahel and will contribute to the definition of decision rules used in managing the natural resources of the region and the ability to mitigate crisis related to conflict between pastoralists and sedentary farmers

Table 1 Global Decision Support System Activity Set

GLO-99-21 Decision Support System for Global Level Analysis

- Objective 1 Expand and Apply the Global Agricultural Sector Model (GASM) to Global Level Analysis
- Objective 2 Use the Texas A&M suite of impact assessment methods to expand the ability to interpret satellite imagery for decision making at national, regional, and global levels
- Objective 3 Expand and apply the GDSS impact assessment methods to 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

GLO 99-22 Holistic Georeferenced Methods for Impact Assessment of Major World Watersheds

- Objective 4 Acquire access to or obtain the relevant information on the watersheds and major river basins of the world to serve as input to analysis of the environmental impact of agriculture and use of natural resources
- Objective 5 Develop and demonstrate the utility of georeferenced holistic methodologies to evaluate options for the use and conservation of natural resources, the consequences of changes in agricultural production technologies and practices, and the environmental consequences of related policy and regulatory options at the level of the major waterways of the world

GLO 99-23 Development of Economic and Biophysical Models

- Objective 6 Develop and demonstrate the utility of biophysical models to estimate performance of crop and livestock species under developing country conditions
- Objective 7 Develop or adapt and demonstrate the utility of economic models to estimate the impact of introduction of new technology or policy affecting the food, agriculture, and natural resource agendas for developing countries

GLO -99-24 GIS and Spatially Explicit Analysis

- Objective 8 Develop and demonstrate the utility of a georeferenced framework for models, information systems and analytic procedures (Spatial Characterization Tool - SCT and Almanac Characterization Tool -ACT) These tools will be expanded to a multi-regional and (ultimately) global scale providing methods to make projections of the utility of research products to other geographically similar areas

GLO- 99-25 Interactive and Participatory Delivery System

- Objective 9 Extend and expand the integrated package of decision support tools through the cooperation with partners by using specific case studies at various levels of government as platforms for development of methodologies
- Objective 10 Provide effective delivery of new methodologies to customers and assure their ability to use them

GLO - 99- 26 Collaboration with Regional SANREM Projects at Local Levels

- Objective 11 Develop and extend methods for impact assessment by collaboration with regional SANREM projects in studies at the watershed and provincial levels, and provide collaboration to regional projects for their self assessment of impact

GLO-99-21 Decision Support System for Global Level Analysis	
Objective	**Progress**
Objective 1 **Expand and Apply the Global Agricultural Sector Model (GASM) to Global Level Analysis**	• **Applications** in 28 world regions • **Stochastic component added** and value enhancement demonstrated in El Niño assessments • Estimated **impact of change** in U S farm policy on global markets affecting developing countries
Objective 2 **Use the Texas A&M suite of impact assessment methods to expand the ability to interpret satellite imagery for decision making at national, regional, and global levels**	• **Established collaboration** with NASA, EROS Data Center, FAO, and AGRHYMET to access and use satellite imagery with GDSS • **Methods** to link NDVI/CCD satellite imagery with biophysical models on grazing lands to estimate forage and related land requirements for livestock
Objective 3 **Expand and apply the GDSS impact assessment methods to 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**	• **Specific plans for collaboration with FAO, Mali, and Kenya** • **Mali FIVIMS-GTOS-CCD Pilot Study** to develop and use decision support systems at the national level for enhancing food security and sustainable use of natural resources • **Kenya FIVIMS-GTOS-CCD Pilot Study** to develop and use decision support systems at the national level for enhancing food security and sustainable use of natural resources • **WAICENT-Texas A&M Cooperation** on development and use of decision support systems to enhance food security and sustainable use of natural resources • **GTOS-Texas A&M collaboration** on sustainable development and food security in watersheds of the world (a plan to develop and market a joint proposal for multilateral funding of a multi year project involving several FAO agencies and the GDSS

GLO 99-22 Holistic Georeference Methods for-Impact Assessment of Major World Watersheds	
Objective	**Progress**
Objective 4 **Acquire access to or obtain the relevant information on the watersheds and major river basins of the world to serve as input to analysis of the environmental impact of agriculture and use of natural resources**	• **Continued development** of the Almanac Characterization Tool • **Linkages and access to FAO** and GRID Arendal data bases on watersheds and basins • **Interactive automated linkages** between the spatial characterization tool, EPIC, PHYGROW, and SWAT models • **Methods** in place to translate relevant data and information from political to watershed frameworks using georeferenced analysis
Objective 5 **Develop and demonstrate the utility of georeferenced holistic methodologies to evaluate options for the use and conservation of natural resources, the consequences of changes in agricultural production technologies and practices, and the environmental consequences of related policy and regulatory options at the level of the major waterways of the world**	• **Agreement to prepare a proposal** for external funding with funding for GTOS and GDSS • **Sondu River Basin assessment** to develop methods for representing large land scales with multiple uses to assess the impact of intensified agriculture on the environment • **Common Modeling Environment Software** to provide automated interface between complex models
GLO 99-23 Development of Economic and Biophysical Models	
Objectives	**Progress**
Objective 6 **Develop and demonstrate the utility of biophysical models to estimate performance of crop and livestock species under developing country conditions**	• **Methods to compute land area** and related forage to support livestock demand as input to the agricultural sector model • **Cluster analysis to characterize production zones** for selection of modal farms for more intensive surveys • **Developed concept of virtual landscapes** as a method to characterize production zones relative to commodities • **New methods** for accessing and using weather data from WMO

Objective 7 **Develop or adapt and demonstrate the utility of economic models to estimate the impact of introduction of new technology or policy affecting the food, agriculture, and natural resource agendas for developing countries**	• **Agricultural sector models for Kenya and Mali** developed and validated (previous grant) • **Extended GDSS development** of models for FIVIMS and GTOS studies in year two • **Method** to link sector and hydrology models • **Acquisition of primary and secondary data** needed for FIVIMS-GTOS pilot studies partly completed • **Added variability to agricultural sector models** to introduce risk assessment
GLO 99-24 GIS and Spatially Explicit Analysis	
Activity	**Progress**
Objective 8 **Develop and demonstrate the utility of a georeferenced framework for models, information systems and analytic procedures (Spatial Characterization Tool -SCT and Country Almanacs - ACT) These tools will be expanded to a multi-regional and (ultimately) global scale providing methods to make projections of the utility of research products to other geographically similar areas**	• **Almanac Characterization Tool** further developed and applied to national and regional analyses, operational on PCs in developing countries Operating units o spatial tools o weather reporter o data base query o document module • **Methods** to establish spatially coherent sampling frames for data acquisition and analysis • **Methods** to link spatial analysis and crop models • **Method** for extrapolating research results from origin to geographically equivalent areas
GLO 99-25 Interactive and Participatory Delivery System	
Activity	**Progress**
Objective 9 **Extend and expand the integrated package of decision support tools through the cooperation with partners by using specific case studies at various levels of government as platforms for development of methodologies**	• **Detailed action plan** has been developed for a collaborative study with FAO, the Government of Mali, and the Mali Institute of Economic Research to Develop and Use Decision Support Systems at the National Level for Enhancing Food Security and Sustainable Use of Natural Resources • Similar **plan** for pilot study in Kenya • **Commitments for collaboration by FAO**, regional, and national governments and research partners

Objective 10 **Provide effective delivery of new methodologies to customers and assure their ability to use them**	• **Collaborators for national and regional studies** identified and are participating in model development • **Workshops in East and West Africa** on assessment methods • **ACT development as a method for delivering models** and data to national and regional partners
GLO 99-26 Collaboration with Regional SANREM Projects at Local Levels	
Activity	**Progress**
Objective 11 **Develop and extend methods for impact assessment by collaboration with regional SANREM projects in studies at the watershed and provincial levels, and provide collaboration to regional projects for their self assessment of impact**	• **Proactive approach** in exploring collaboration with regional projects • **Definitive plan** of action with West Africa Project • **Continuing dialogue with managers** of Andean and Southeast Asia Projects

V Progress Towards Five Year Indicators

Details of progress on individual activities is found in the individual reports In a number of instances, milestones were successfully completed In most others, substantial progress, consistent with annual planning was achieved Indicators are reviewed on a continuing basis and revised annually to reflect changes and new opportunities

VI Plans for Subsequent Reporting Period

We anticipate finalization of the action plans for studies in Mali and Kenya and further engagement with national and regional partners over the next six months Primary and secondary data acquisition for the pilot studies will be well underway Plans will be solidified for workshops in Mali and Kenya Activities on method development will continue

Decision Support System for Global Level Analysis

Introduction

Donor development agencies and FAO 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 which range from local to national to global (satellite imagery) The SANREM GDSS will collaborate with several of these key global programs to develop methods which will extend the breadth and depth of analysis at the global level to *assess the current status and trends of food security, the factors which determine this status, and the impact of alternative strategies, policies, or use of new technology to improve the sustainable production of food*

The Global Agricultural Sector Model (GASM) developed by Texas A&M, will be used as one part of this effort It is a world trade model, covering supply and consumption in and between more than 30 world regions and a growing number of commodities GASM will also be used in national and regional level analyses to project the impact of change in other parts of the world on food availability and cost GASM will contribute to the analysis of the impact of changes in agricultural productivity in developing countries on U S agriculture

Global assessments draw on aggregated national information and analyses as one basis for their synthesis Another key element is the use of satellite and related imagery to provide global estimates of food production and related natural resource and meteorological data and analyses Texas A&M will work with those entities having the mandate for global assessments to develop or extend the assessment at national and regional as well as global levels

Objective 1 Expand and Apply the Global Agricultural Sector Model (GASM) to Global Level Analysis

Method

The GASM will be a component part of the development of the Texas A&M methods using specific case studies in developing countries and in multinational settings

Output

The Global ASM will contribute to the GDSS in four ways

- places a total market perspective on the economic consequences of policy actions within a country by factoring in world reaction
- allows an analyst to project the consequences of developments in the rest of the world on a specific country
- appraises the consequences of policy actions with multi-country application both in the countries to which the policy actions directly apply as well as in other countries in the total marketplace
- brings a global perspective into more detailed and focused analyses at lesser geographic scales (countries or regions) with other models

Progress

Development of the Global ASM has continued during year-one of SANREM, having been initiated under previous state and federal support Progress has been related to model refinements and addition of new countries to the model Global ASM embodies a linkage of a detailed U S agricultural sector model and a world trade model The U S agricultural sector model was developed and implemented at Texas A&M over the last 15 years The trade model follows the spatial equilibrium modeling approach The model includes a detailed representation of world trade in corn, rice, soybean, sorghum, hard red spring wheat (HRS), hard red winter wheat (HRWW), soft red winter wheat (SOFT), and durum wheat (DURW) These products are included because of the importance of global trade in these commodities ***The model incorporates ten trading regions in the United States along with the 28 "rest of the world" regions listed in Table 2*** Global ASM simulates detailed United States production, consumption, export and import of 60+ commodities along with supply and demand in the 28 world regions for each of the above listed traded commodities There is also a representation of U S aggregate imports and exports for a large number of other commodities The model permits one to analyze the regional implications of changes in production patterns both in specific regions and throughout the world in terms of price, supply, consumption and cost of the diet Versions of Global ASM have been developed which incorporate yield uncertainty

The Global ASM framework is assisting in depicting how the effects of policy and environmental changes affect production, trade, and welfare in individual countries or regions The framework was applied to the estimation of the effect on price, trade, and welfare of El Niño/Southern Oscillation (ENSO) of induced yield variability (Chen and McCarl 1999) That study found that the value of information increases by about 10 percent when the ENSO effects in the rest of the world are factored into value of forecasting information It was also found that incorporating uncertainty on the magnitude of the ENSO phases led to the value of the forecast tripling

A second study estimated the effect of a change in U S agricultural policy on world trade (McCarl and Chen 1999) The elimination of U S farm programs increases U S total social welfare while it decreases U S producers, consumers, and foreign country welfare Elimination of the U S farm program increases U S producer and consumer prices along with world price variation for several commodities It also increases the welfare variability for U S producers and foreign interest

Future Plans

The GASM will be an integral part of the suite of models that are used in the Kenya and Mali FIVIMS-GTOS Pilot Studies (national and regional), to appraise the regional pressures implied by alternations in regional and global productivity Discussions are underway with FAO on a collaboration that would use the GASM in improving the assessment of the status of food security on a global scale (Agriculture Toward 2015 and 2030)

Table 2 Global Agricultural Sector Model Non U S Regions Defined in Model

Number	Region Name	Counties Included
1	WEST AFRICA	Dahomey Angola Benin Cameroon Canary Island Ghana Guinea Ivory Coast Liberia Mauritania Niger Nigeria Senegal Sierra Leone Togo Burkina South W Africa Zaire
2	NORTH AFRICA	Algeria Libya Morocco Tunisia
3	EAST AFRICA	Botswana Malawi Kenya Mozambique South Africa Tanzania Uganda Zambia Zimbabwe Rwanda Madagascar Swaziland Lesotho Burundi
4	EAST MED	Egypt Israel Lebanon Syria
5	RED SEA	Ethiopia Somalia Sudan Yemen
6	WEST ASIA	Afghanistan Bangladesh Nepal Pakistan Sri Lanka India
7	PERSIAN GULF	Iran Iraq Kuwait Saudi Arabia Bahrain Oman Un Arab Em
8	ADRIATIC	Cyperus Greece Turkey
9	CHINA	China
10	SOUTHEAST ASIA	Hong Kong Indonesia Malaysia New Zealand Okinawa Philippines Singapore Thailand Vietnam Fr Pac Is So Pac Is Other Pac Is
11	JAPAN	Japan
12	SOUTH KOREA	South Korea
13	TAIWAN	Taiwan
14	EAST AMERICA	Belize Brazil Costa Rica El Salvador Curacao Guatemala Honduras Nicaragua Panama Paraguay Surinname Uruguay Venezuela Fr Guiana
15	CARRIBEAN	Lee Wind Is Bahamas Barbados Dominican Rep Fr Wst Ind Haiti Trinidad Jamaica
16	AUSTRALIA	Australia
17	N CENTRAL EUROPE	Austria Belgium Germany Netherlands Switzerland
18	EAST BLOCK EUROPE	Bulgaria Czechoslovak Hungary Poland Romania Yugoslavia
19	WESTERN EUROPE	Italy Malta Portugal Spain Others
20	ISLANDS	Iceland Ireland U K
21	SCANDINAVIA	Denmark Finland Norway Sweden
22	CANADA	Canada
23	EAST MEXICO	Mexico
24	UNITED STATES	United States
25	USSR	Former USSR
26	WEST AMERICA	Bolivia Chile Colombia Ecuador Peru
27	BRAZIL	Brazil
28	ARGENTINA	Argentina

Objective 2 Use the Texas A&M suite of impact assessment methods to expand the ability to interpret satellite imagery for decision making at national, regional, and global levels

Method
The **method** involves establishing collaborations with FAO and NASA/NOAA to develop and extend Texas A&M's impact assessment methods for global level analysis of data from multiple levels of scale

Output
The **output** will be improved methods for global level analyses that provide for integration of economic, environmental, and societal impacts of trends and alternative interventions to improve food security and use of natural resources

Progress
Plans have been developed in year-one for linkage with several agencies that manage and use satellite imagery These agencies have experience and will provide access to data bases, both historical and current, that will be needed to achieve this objective Specifically, commitments to collaborate have been achieved with the NASA Goddard Spaceflight Center, EROS Data Center, AGRHYMET, and FAO that involve linking data systems of other agencies and models being developed for the GDSS to create the needed output Several initial studies, discussed below, have been done to explore the interfaces between the GDSS and satellite imagery from these agencies

The Livestock sector is a major component of agricultural systems in developing countries Forage production is ultimately limited by available land and competition for the use of this land To model the contribution of livestock to the overall agricultural sector and at the farm level requires (*inter alia)* data and/or estimates of forage requirements and related land use for livestock populations In earlier studies, a method was devised to estimate forage required and the land needed to produce it, assuming a given intake by a population of animals in a given area The initial method was limited in utility by the fact that forage intake is impacted by diet quality, particularly digestible organic matter, and to a lesser extent by physiological status and temperature More robust methods are needed to accommodate these factors in the methodology To meet this need, studies were initiated to determine if Normalized Difference Vegetation Index (NDVI) derived from satellite imagery could be used to represent the spatial and temporal variation in digestibility of and protein in forages

A method using Near Infrared Spectrophotometry to analyze fecal samples of ruminants and other livestock was previously developed to estimate dietary crude protein and digestible organic matter (Lyons and Stuth 1992) This method has been recently used in to analyze 300 georeferenced fecal samples from four countries in East Africa to determine the dietary status of cattle in conjunction with research done under the USAID Global Livestock CRSP To explore the use of satellite imagery to predict forage quality,

these geo-referenced estimates of diet crude protein and digestible organic matter were paired with NDVI grid data for the appropriate dekadal of sample collection using the WinDISP3 image software

Preliminary results indicate dietary digestible organic matter content was more highly related to the NDVI 7 6 km grid data (r= 0 71) than crude protein (r = 0 39) when viewed from a regional perspective (East Africa) Predictability of the digestible organic matter using dekadal NDVI data was moderate (R^2 = 0 52 (Figure 1), whereas the predictability of crude protein was low (R^2 = 0 15) and standard errors of the estimates were high for both (± 8%) These preliminary analyses indicate that, while relationships do exist, continued data collection will be required to refine the analyses In addition, a multivariate regression analysis using multiple-source images (e g , cold cloud duration rainfall estimates will be employed to improve predictive power of the analyses)

Future Plans

Plans are being developed to link with EROS and NASA Goddard SFC to explore the use of these data and related biophysical models to predict livestock performance in West and East Africa by linking them with higher resolution satellite imagery and precipitation estimates Plans are also being developed to use existing crop use intensity mapping and the new LANDSAT 7 imagery to refine estimates of land use/cover change over time As these methods are developed, they will be used in the Mali and Kenya FIVIMS-GTOS Pilot studies to evaluate the impact of introduction of technology and the consequences of alternative policy options to enhance food security Initial efforts have been focused on use of WinDisp3 software to extract historical 7 5-km gridded NDVI and Rainfall Estimates (Cold Cloud Duration data), and the creation of unsupervised, data downloading processes to acquire the data as it comes on line from EROS and NASA server

Objective 3 Expand and apply the Texas A&M impact assessment methods to 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

Method

Collaborate with existing FAO programs and/or the Global Terrestrial Observing System (GTOS) and Food Insecurity and Vulnerability Information Mapping System (FIVIMS)

Output

- Identify areas of mutual interest and establish collaborative relationships between the GDSS development and FAO research, monitoring, and analysis functions

- Link the development and evaluation of the GDSS to ongoing FAO monitoring functions at national and regional levels in the developing world as a mechanism for effective engagement of policy level decision makers in development and use of the GDSS

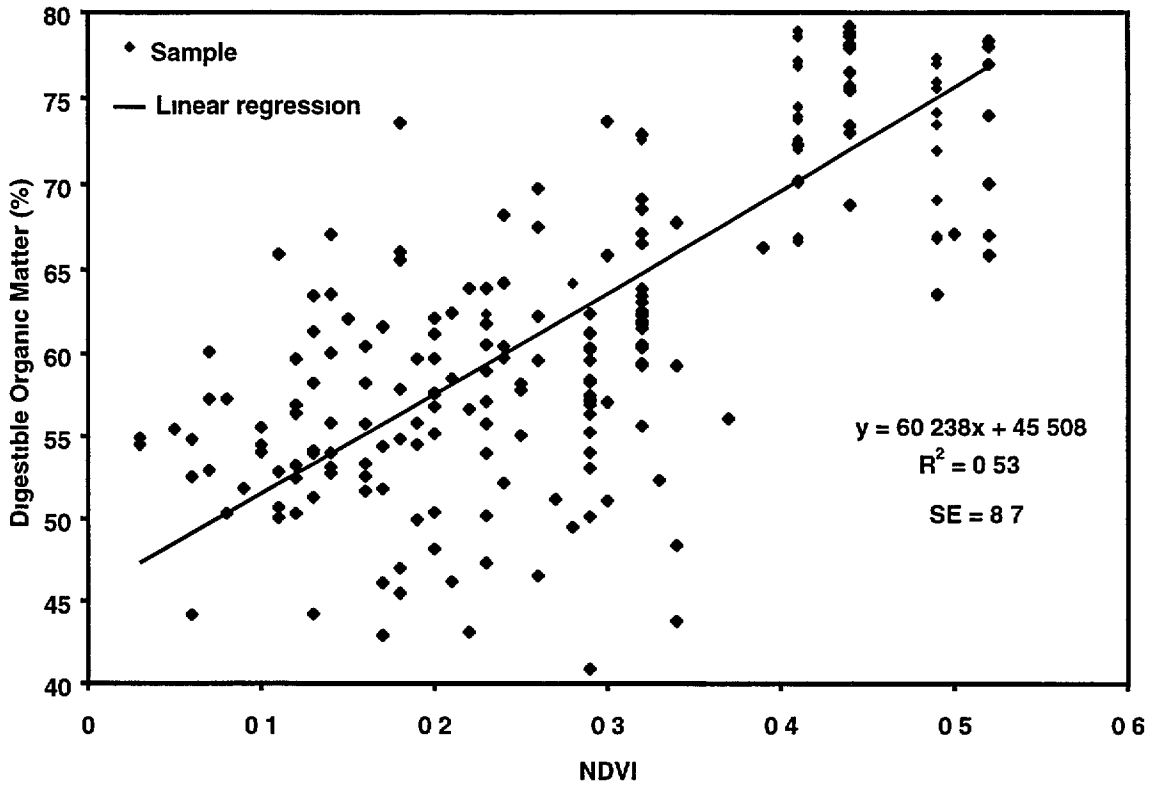


Figure 1 Relationship between Normalized Difference Vegetation Index (NDVI) and digestible organic matter predicted via near infrared spectroscopy scans of geo-referenced fecal samples of cattle during a period from December 1996 to May 1997 on pastoral grazinglands in East Africa These data were not stratified nor transformed at this stage of analysis The next step is to apply environmental stratification and more advanced multivariate statistical techniques to improve the methodology

- Establish collaborative efforts for use of the GDSS in FAO global level analysis of factors related to the sustainable production of food

- Through this collaboration, SANREM gains access to global data bases and resident expertise in FAO and in return, FAO has opportunity to expand its analysis capability through participating in the development and use of the GDSS models at multiple levels of scale

Progress
Strong and continuing interest of USAID has been a driving force in seeking these relationships and through them to contribute to the development of improved methods of measuring and monitoring progress of developing countries toward achieving the goals of international conventions and bilateral agreements related to sustainable production of food and, through agriculture, the reduction of poverty

A senior scientist from Texas A&M spent six months in FAO building relationships and developing collaborations during the period October 1998 to June 1999 Additional site visits were made by other Texas A&M scientists to FAO Headquarters and regional offices and to Mali and Kenya to further develop the framework for these collaborations The detailed end-of-mission report is available to interested parties and is summarized here

The following Key players were identified during the engagement They include the secretariats for monitoring and mapping functions related to several key international conventions as well as the operating offices of FAO that have ongoing programs and have mandates to support the several conventions These players are

- Food Insecurity and Vulnerability Information Mapping System (FIVIMS)
- Global Terrestrial Observing System (GTOS)
- Interdepartmental Committee on Convention on Combating Desertification (CCD)
- Bio-diversity Convention
- World Agriculture Information Center (WAICENT)
- Africa Real-Time Environmental Monitoring Information System (ARTEMIS)
- Global Information and Early Warning Information System (GIEWS)
- Farm Management and Production Economics
- Agriculture Toward 2015/30 (AT2015/30)
- Human Nutrition and Food Balance Sheets

FAO and Texas A&M have agreed that there is mutual benefit in an ongoing general collaborative relationship in areas related to the development and use of the GDSS at national, regional, and global levels A general memorandum of understanding has been developed and submitted to the Director General of FAO for signature (Impact Assessment Group 1999a)

From initial discussions about some twenty potential activities identified for possible collaboration, four major activities emerged which will form the specific basis of initial

collaborations A concept paper was developed and endorsed by FAO collaborators for each of these activities These concept papers are now being converted into action plans (Impact Assessment Group 1999b) These collaborations are integral to the other activities of the GDSS which are **described in following sections of this report** They are

- Mali FIVIMS-GTOS-CCD Pilot Study to develop and use decision support systems at the national level for enhancing food security and sustainable use of natural resources

- Kenya FIVIMS-GTOS-CCD Pilot Study to develop and use decision support systems at the national level for enhancing food security and sustainable use of natural resources

- WAICENT-Texas A&M Cooperation on development and use of decision support systems to enhance food security and sustainable use of natural resources

- GTOS-Texas A&M collaboration on sustainable development and food security in watersheds of the world (a plan to develop and market a joint proposal for multilateral funding of a multi year project involving several FAO agencies and the GDSS

Future Plans
Specific plans of action for the first three efforts have been drafted by Texas A&M and are being coordinated with FAO offices in the early part of year-two These plans are described in more detail in following sections of this report

Resources for the initial activities of the first three items are in-hand between FAO and the GDSS Full accomplishment of these objectives in future years will require additional funding which is being sought Other options for collaboration will be considered in future years as human resources and funds permit

Holistic Georeferenced Methods for Impact Assessment of Major World Watersheds

Introduction

The overall goal of this activity set is to develop an integrated suite of models to assess the economic, environmental and societal impact of introduction of technology or practice or the adoption of policies and regulations that affect or are affected by agricultural production and its use of natural resources Traditionally, agricultural statistics and models dealing with production are organized by political boundaries Environmental and natural resource implications or consequences of production are often best analyzed at landscape and watershed levels which transcend these boundaries

Methods will be developed to improve the ability to transpose data and results from politically defined boundaries to watersheds As one moves to national, multinational, and global levels of analysis, the impact of agricultural operations must be considered at the same levels This often involves looking at the upstream implications of farming practices in the major waterways of the world This capability will be developed and used along with other elements of the Texas A&M suite of models at local, provincial, national and regional levels It will be part of the overall capability for analysis at the global level

Objective 4 Acquire access to or obtain relevant information on the watersheds and major river basins of the world to serve as input to analysis of the environmental impact of agriculture and use of natural resources

Method

Establish functional relationships with relevant data bases and their sources to provide input for development and use of integrated impact analysis methods at the watershed and major waterway levels at local, national, and global levels

Output

Access to data sets or networks that provide information in usable form for analysis of impact at the level of watersheds and major river basins

Progress

Year-one activities have involved the continuation of development of linkages between biophysical and watershed models and their relationships to the methodology for developing Almanac Characterization Tools for various countries Under this objective, major progress was made in accessing the data bases within FAO as part of the senior scientist academic program noted above In addition, other data bases have been acquired through worldwide engagements

One of the areas of initial collaboration with FAO is the development of a proposal for external funding to initiate a major activity in this area The overall goal is to develop an integrated suite of models to assess the economic, environmental and societal impact of introduction of technology or practice or the adoption of policies and regulations that

affect or are affected by agricultural production and its use of natural resources Traditionally, agricultural statistics and models dealing with production are organized by political boundaries Environmental and natural resource implications or consequences of production are often best analyzed at landscape and watershed levels that transcend these boundaries

Methods have been extended to improve the ability to transpose data and results from politically defined boundaries to watersheds As one moves to national, multinational, and global levels of analysis, the impact of agricultural production practices must be considered at the same levels This often involves looking at the downstream implications of upstream farming practices in the major waterways of the world

Under this activity, Texas A&M has continued to acquire and organize, in the Spatial Characterization Tool, the relevant data on the major watersheds of the world, drawing on the considerable work that has already been done in this area by FAO and others Interactive automated linkages have been established between the spatial characterization tool, EPIC, PHYGROW, and SWAT models Existing models such as SWAT and SWRRB were adapted for improved ability to assess the impact of changes in agricultural production at the level of these major waterways and their principal tributaries This capability will be developed and used along with other elements of the Texas A&M suite of models at local, provincial, national and regional levels It will be part of the overall capability for analysis at the global level

Texas A&M and FAO are collaborating to establish functional relationships with relevant data bases and their sources to provide input for development and use of integrated impact analysis methods at the watershed and major waterway levels at local, national, and global levels Data sources include FAO, NASA, USDA, NOAA and other international and national agencies Specifically, progress in year one has provided

- Linkages and access to FAO and GRID Arendal data bases on watersheds and basins
- Interactive automated linkages between the spatial characterization tool, EPIC, PHYGROW, and SWAT models
- Methods in place to translate relevant data and information from political to watershed frameworks using georeferenced analysis
- Agreement to prepare a proposal for external funding with funding for GTOS and Texas A&M

Future Plans

The principle initial effort in year-two will be the development of a proposal for external funding which is anticipated to be completed in January 2000 Full engagement of this will be undertaken after that But initial effort will continue in the interim

The SANREM GDSS will continue to acquire and organize data bases from FAO, The GRID Arendal Group and national and subnational sources as well as from the considerable existing literature as funding from external grants is acquired

Objective 5 Develop and demonstrate the utility of georeferenced holistic methodologies to evaluate options for the use and conservation of natural resources, the consequences of changes in agricultural production technologies and practices, and the environmental consequences of related policy and regulatory options at the level of the major waterways of the world

Method
The World Watershed Analysis will be part of the overall development of the Texas A&M methods, using specific case studies in developing countries and at the global level with FAO

Output
Development and demonstration of the use of interactive and iterative models to assess the environmental consequences at the watershed and major water basins of alternative agricultural practices and policies for production agriculture

Progress
Watershed Level Integrated Modeling Methodology

While the major effort on this activity awaits external funding, a substantial pilot study is underway on a watershed in Kenya to test the utility of the currently defined GDSS for watershed analysis Using models and data bases developed for Kenya under a related Global Bureau grant, a case study is being done to determine the utility of these models for the kind of analysis that will be done more broadly under the FAO-GDSS collaboration There are major economies in time and funding in using these existing Kenyan resources to conduct an initial pilot study at the watershed level These studies are resulting in extensions of methodologies and identification of future needs to be addressed in the broader study

One of the challenges in this effort is to determine how best to represent large landscapes at the basin scale in a way that reflects the diversity of production systems in a spatially coherent manner, and supports both economic analyses and examination of environmental consequences The Sondu River Basin in the highlands of Kenya was selected as the platform for pursuing this concept The analysis of impact of introduction of new technology involves an examination of the impacts of (1) small holder dairy production as previously studied and (2) a hypothetical increase in intensification of overall agricultural production in the watershed The Sondu river is a major basin feeding Lake Victoria

Seven distinct small holder dairy production environments were identified from previous studies conducted by Kenya Agricultural Research Institute (KARI) The soil and

climate characteristics of these zones were categorized and projected using the Almanac Characterization Tool The Sondu River basin was then delineated in Kenyan Almanac Characterization Tool and the various small holder dairy production environments were projected over the watershed (Figure 2)

Representative landscape components were defined by typical ecosites An ecosite is defined as an ecological unit of a landscape where soil and climate interact to produce similar composition and yield of natural potential vegetation or yields of crop species Ecosites are delineated by permanent physical features (soils, topography, geochemical) within a precipitation/potential evapotranspiration (P/PE) zone To represent the combination of ecosites in a given production environment, the concept of "virtual landscapes" was devised to avoid the need to map individual farms Virtual landscapes are scalable delineations of land areas which have definable boundaries and known composition of ecosites within that boundary each represented by modal plant communities/crops and modal soils in a specified topographical region Actual locations of the ecosites within the virtual landscape are not specified Each ecosite within a given virtual landscape is parameterized in biophysical simulation models (EPIC for crops and PHYGROW for grazing lands) to generate crop/forage yield, animal yield, runoff, sediment loss, nutrient loss and pesticide load Each of these "virtual landscapes" is being stratified across sub-basins in the Sondu river basin to link with water routing functions in the SWAT basin-scale model to provide basin scale responses Landscape components within the Sondu river basin not classified as small holder dairy production environments (Figure 2) were then surveyed by in-country experts using a rapid-appraisal of land cover types using a GPS unit traversing the road network within and around the road basin The new virtual landscapes are currently being analyzed using cluster analysis linked with the "spatial analysis" function in ARCVIEW to create surfaces of these landscape components

Sondu River stream flow gauge data has been acquired to help verify SWAT basin hydrology analysis Spatially explicit analysis of each production system/virtual landscape combination will allow detailed modeling with EPIC and PHYGROW and routing of resulting water yield, soil loss and nutrient loading via the SWAT model A baseline run will be made to reflect current conditions and then changes in technology and resulting land use will be reflected across these "virtual landscapes" to determine basin scale impacts in terms of water yield and water quality This analysis is expected to be completed by September 1999

During this process, a more robust method of landscape characterization has been designed and recoding of the software is now under way to accommodate this new structure Figure 3 provides a stylized view of the components of a virtual landscape within a sub-basin representing a topographical sequence or an gradient ecosite that can change in land area over time and shift species composition in the case of grazing lands, or shift to different crops in the case of crop land Figure 4 provides a conceptual view of how the complex virtual landscapes could then be reconciled along administrative boundaries for economic analyses or along watershed boundaries for environmental impact projections The integrated framework allows a regionally synchronized analysis

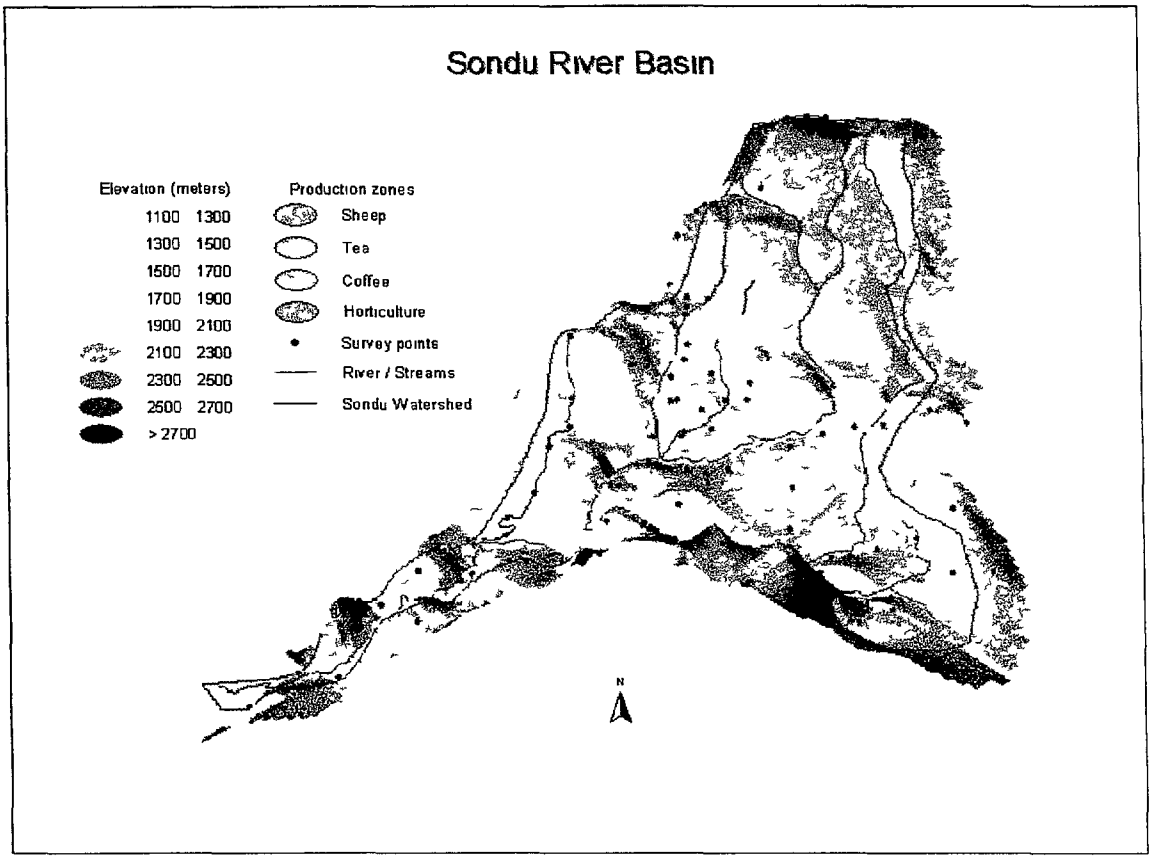


Figure 2 Topographical representation of the Sondu River Basin in Lake Victoria watershed Production environments associated with small holder dairy farms in Kenya (Wheat, Tea, Sheep, Horticulture, Coffee, and Coast Dairy) were projected across the basin and simulation modeling conducted on forages and crops from representative farms in each zone, The gray regions represent environmental conditions that are not indicative of current small holder dairy production environments and were systematically sampled with a GPS unit using rapid appraisal methods for assessing land cover/composition The resulting hydrological output from the EPIC model on croplands and the PHYGROW models on grazinglands will be linked with the SWAT basin scale hydrology model to investigate whole basin impact of technology intensification The methods form the foundation for methodology for linking economic and environmental models across river basins

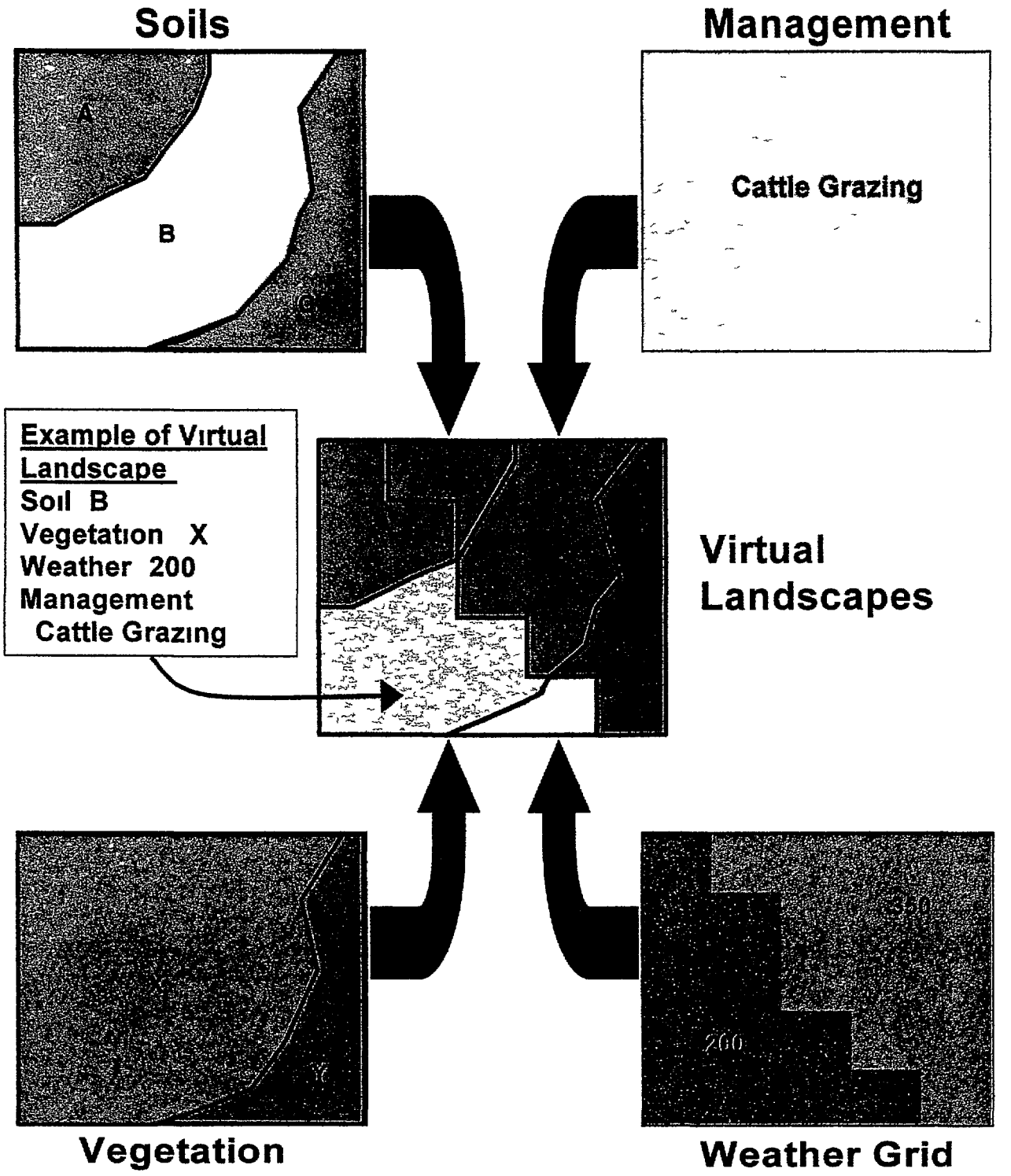


Figure 3 Conceptual view of virtual landscapes A virtual landscape is a land area having similar soils, vegetation, climate, and production management In this example, if the soils, weather grid, vegetation, management themes are merged together, six virtual landscapes are created These virtual landscapes would then form the basic unit for forage and crop simulation modeling These simulation model outputs can then be linked or routed to adjacent virtual landscapes, thus forming the basis for basin and sub-basin impact assessment

of weather-induced crop and livestock yields and resulting economic and environmental responses

Common Modeling Environment

The use of an integrated suite of economic, environmental and sociologic models for impact assessment introduces a potential complexity that can limit the utility of the methodology This becomes particularly important as consideration is given to making these models available to partners and customers with limited computing capacity This has led to the development of a set of software called the Common Modeling Environment (CME) A fully functional version of the CME has been developed (but not beta-tested) It allows linkages of models either on standalone computers or via the Internet The CME allows placement of computer models in a web-ready environment that users can use without having to learn the intricacies of the model CME is designed so that primary functionality of the model remains intact while the CME manages the interface between the user and the model Legacy model analyses (those analyses conducted throughout a given project) can be retained on both local and remote servers Critical attributes of the model can then be designated and changeable via a JAVA interface over the Internet or local host The model can be exercised and results returned to the user CME offers users a mechanism to capture past analyses and explore critical attributes of the model run CME also minimizes training needs and leads to greater sustainability of the use of the models Users can assess models that are maintained at "centers of excellence" without highly trained computer programmers/analysts

A test was successfully conducted where selected runs of EPIC (a crop simulation model) and PHYGROW (a grazing land model) were simultaneously run on two servers at separate locations (College Station and Temple, Texas) (Figure 5) After this test was completed, a large soils database was installed on another server and both models shared the same soils database to complete their runs After these tests were completed, enhancements have been made to the functionality of the system to allow it to run simultaneously on both a local PC (laptop or desktop) and a remote server (UNIX, NT, etc) Since the system is neutral to the type of server operating system, it is possible to develop a distributed modeling environment capable of sharing distributed databases to support those models via the Internet Further testing of the system will take place in mid-July with FAO's World Agricultural Information Center (WAICENT) to help determine its role delivery of analytical models under the FIVIMS umbrella as part of the FAO information system

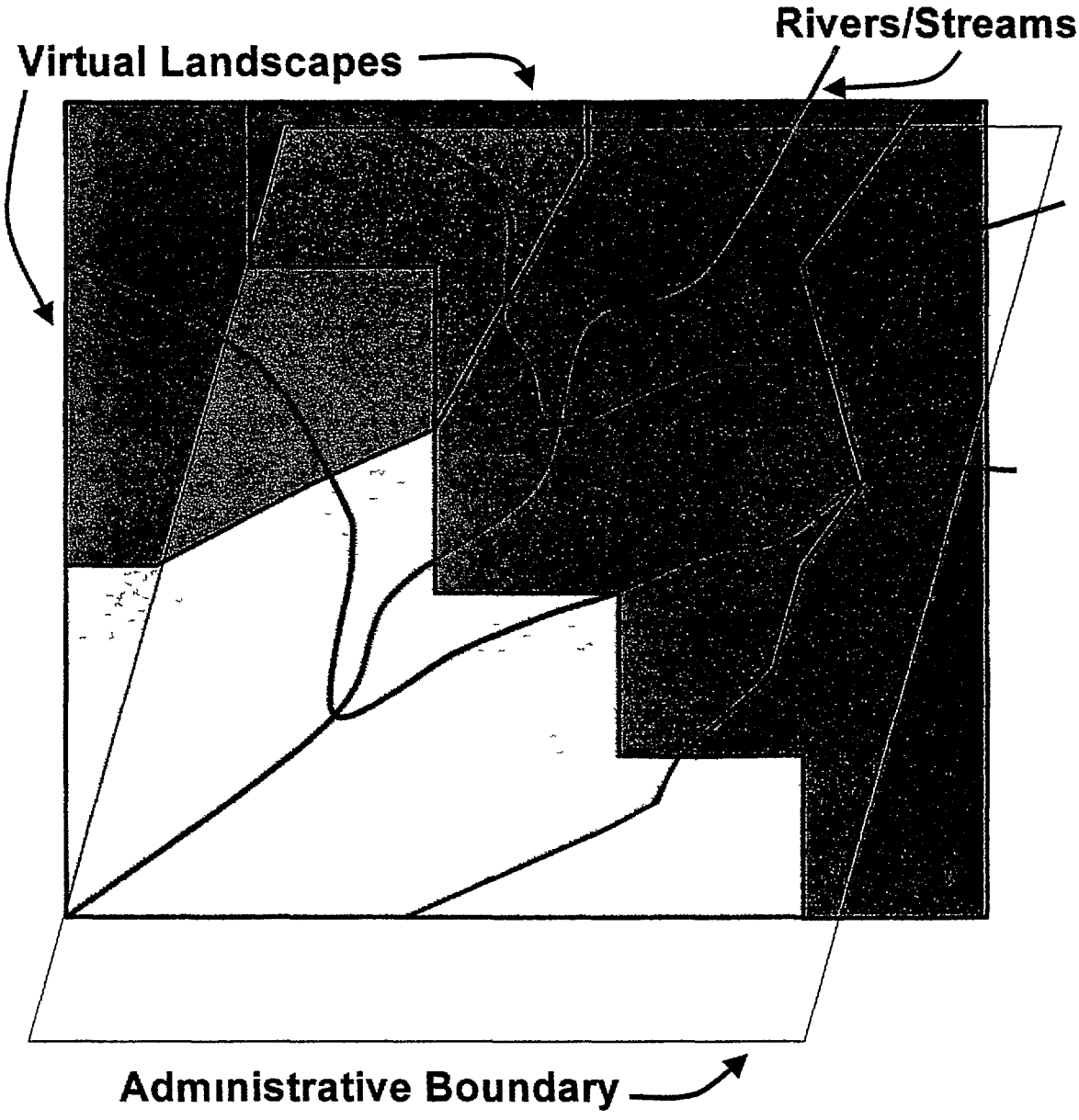


Figure 4 Conceptual view of how complex virtual landscapes can be reconciled along administrative boundaries for economic analyses, or along watershed boundaries for environmental impact projections An integrated framework of this type will allow regionally synchronized analyses of weather-induced crop and livestock yield variations, and the economic and environmental responses resulting from these

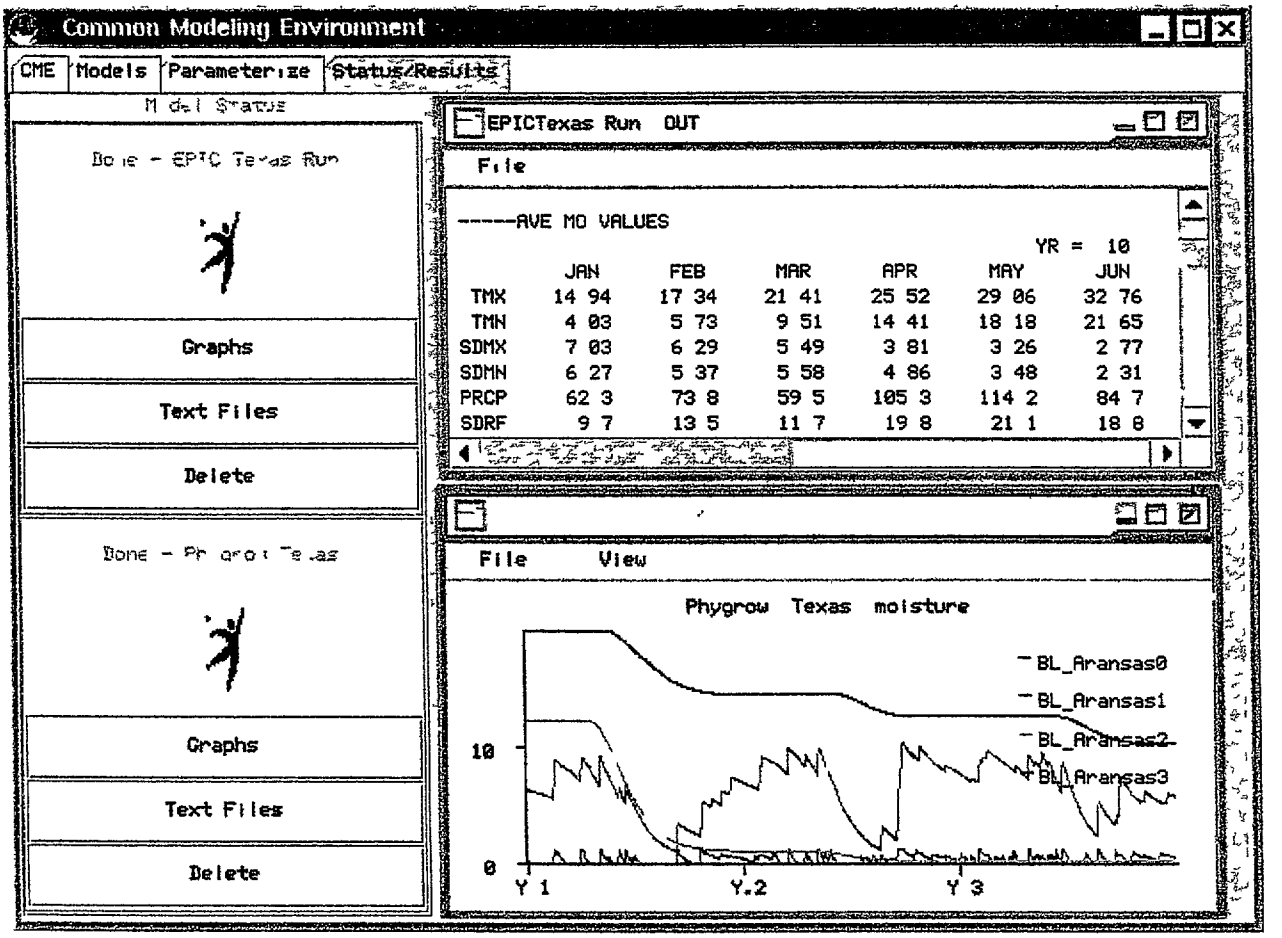


Figure 5 Example output from the Common Modeling Environment (CME) where two models were run simultaneously from separate server locations over the web from a remote location Currently, the EPIC crop simulation model and the PHYGROW grazingland simulation model have been integrated and can share a soils database located at another server location The CME system is designed to allow models to be added by the model developer using the toolkit provided by the Center for Natural Resource Information Technology (CNRIT) The intent of CME is to allow legacy models to be placed on line with no modification to exiting code and be fully controlled by the model developer

Over time, these models will be integrated to allow transfer of one model's critical functions to that of another model This latter goal requires that all of the critical models be placed on line and functional interactions designed A complete description and download site for the current version of CME can be found at http //cnrit tamu edu/CME

Future Plans

The development of a proposal for external funding will be done jointly with FAO, as noted in the preceding section

The same methodology will be used to exercise the watershed level suite of models to estimate the impact of hypothetical scenarios in which an overall intensification of the entire agricultural sector (multiple crops and livestock) to meet projected demands resulting from population increases This will serve to evaluate the utility of the models and identify areas for improvement in future years

Currently, we are working on improving the "Model-to-JAVA" interface process, allowing greater flexibility to accommodate differences in units between models, improving graphing functions, accommodating spatial functions, and improving file management issues The goal of this effort is to allow the full suite of impact assessment models used in the Global Decision Support Systems to reside in CME

Additional watersheds will be evaluated in the out-years of the current SANREM II agreement This will include watersheds in Asia, possibly including an evaluation of the impact of alternative management strategies for the Manupali watershed (to be considered with the South East Asia Regional Program) There may also be opportunity to apply these models in the collaboration with the West Africa Project for the Niger river in the Mopti region of Mali

Development of Economic and Biophysical Models

Introduction

Models developed for domestic purposes will be modified for application to developing world agriculture and natural resource scenarios where appropriate Models developed specifically for application to developing country scenarios will be developed where necessary The general approach is to develop models with broad utility by constructing general analytic frameworks with site specificity provided by varying inputs Experience with the current USAID grant to Texas A&M has shown this to be a practical and working methodology

Biophysical models are used to estimate the performance of crops or livestock in situations where experimental data is limited or absent or where extrapolation of the use of new technology to geographically equivalent locations is being made These models, along with GIS based information on natural resources and other factors related to production of food and fiber are being developed for use in estimating performance given the introduction of new technology or policy Examples of biophysical models include the Erosion Productivity Impact Calculator (EPIC) - which deals with effects of farming practices on yield, erosion, and chemical runoff (among others) , PHYGROW - a multi species plant growth/runoff model designed to address animal stocking rates, and NUTBAL - which characterizes the impact of changes in environment, nutrient intake, genetics, and feed inputs on animal products production

Methods for better characterization of the variables that relate to environment and natural resource management are needed for all aspects of the science in this area Development of the GDSS will be enhanced in this area through collaborations with other players, such as the Interdepartmental Working Group on the CCD in FAO

The Agricultural Sector Model (ASM), providing interaction among commodities and otherwise reflecting the total agricultural sector in a given country, is a necessary component of the suite of models being developed by Texas A&M Methods to streamline the development of these models to facilitate multinational impact assessment are being developed Economic models, in addition to the agricultural sector 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 The model predicts 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 which include an index of vulnerability, net food surplus, index of mobility, equilibrium values for resource allocation, and household production to maximize profit and minimize cost

Objective 6 Develop and demonstrate the utility of biophysical models to estimate performance of crop and livestock species under developing country conditions

Method
Using impact assessments in developing countries as test platforms, extend existing or develop new biophysical models that mimic the function of the crop or livestock species and predict the interaction of key variables in crop and crop-livestock systems for use as input to other economic and environmental models in the Texas A&M portfolio Such systems typically include germplasm, management practices, natural resources, purchased inputs, and pest management

Output
Capability to accurately predict the performance of crop or crop-livestock systems and their component parts in geographically equivalent situations based on site specific experimental and demonstration results

Progress
Research reported under the next activity on **GIS and spatially explicit analysis** was initiated under a separate USAID grant and has been continued under year-one of SANREM II This research established a spatial framework for representing yield and yield variability across provinces crop, forage, and livestock production These results, in turn, allowed development and application of biophysical models at two levels needed to fully exercise related economic models Progress on biophysical model development is reported in this section of the report

This section of the report describes how spatial stratification procedures were linked to biophysical models which were then used as inputs to economic models at two levels of scale These are (1) use of biophysical models at provincial and national levels to provide input to economic models of the overall agricultural sector level at national and regional levels and (2) provide input to farm level economic models to assess impact and risk on representative farms within production zones This research was also begun under a previous USAID grant and extended under SANREM

The Agricultural Sector Model (ASM) developed for Mali and Kenya requires input about each component commodity, including cost of production, yields of individual commodities, and land use devoted to these commodities The model computes quantities and prices of commodities produced at national and provincial levels and the shifts in land use resulting from economic advantages related to new technology or policy affecting one or more commodities Where data are inadequate or missing, biophysical models are used to estimate these inputs Developing needed inputs to the ASM for the livestock sector presented the greatest challenge for biophysical modeling because estimates are needed not only for animal numbers and products but for the related forages upon which livestock depend and land use and forage production related to their production In most developing countries, livestock are partially supported from land that is owned or controlled by individuals with the remainder of forage being provided by off-site harvest of roughages and purchased concentrates

Reasonable estimates of crop land area exist, but knowledge of land supporting animals is very limited To provide this needed input, a method was devised using a combination of

the Nutritional Balance Analyzer Program (NUTBAL) and a new Excel spreadsheet call "LAND DEMAND " NUTBAL was used to predict regional herd demands, nutrient requirements, and meat/milk yields A new version of the model (NUTBAL PRO) was developed and has undergone alpha testing and possesses many new features to enhance the impact assessment process, including milk partitioning, protein partitioning, and effect of parasites Other features that were upgraded were the addition of more breed type production attributes and improved environmental stress algorithms (Stuth et al 1999)

Given estimates of intake needed to produce the measured amounts of milk, meat, and other animal products, and knowledge of numbers of animals by geographic area from population estimates, a method was developed to estimate the amount of land needed to produce the forage required to support the various kinds of livestock present in an area Once intake was determined by major breed and class, representative herd structures were defined and intake "per head" of an average animal was derived District level livestock population estimates were then acquired and spatially distributed according to environmental production zones The LAND DEMAND program (Figure 6) allowed representation of a livestock population and its mean annual intake, resulting in an estimate of total forage/fodder demand in a district Based on expert opinion and literature, mean annual diets were assigned to the total intake to determine how much dry matter would be consumed for each forage/fodder type Each forage/fodder type was then assigned a mean district level production (kg/ha) and the level of harvest efficiency (percent of annual production actually consumed) to derive the necessary land area to support the demand The computed hectares of forage/fodder needed to support the demand was compared with existing land cover assessment in the districts to assure that computations were within tolerances for the area These land area values and forage/fodder yields were provided to ASM as well as the livestock population requirements for dry matter, protein and energy This methodology along with the analytical tools is undergoing refinements

To provide input to economic models that assess the impact of technology and policy on survivability and risk at the farm level, a method of stratifying regions into environmental production zones and selection of representative farms was devised A population of farms was surveyed for minimal production attributes, subjected to cluster analysis and a representative farm selected from each cluster for intensive interviews These interviews derived the necessary input data for the economics analysis with the Farm Level Income and Policy Simulation Model (FLIPSIM - see next section) and identified crops and forage types to be run in the EPIC crop model and PHYGROW grazing land model Simulations were run for each major crop and forage resource type using 20 years of historical weather sequences from the World Meteorological Organization (WMO) stations and modal soil series for each environmental production zone (Figure 7) Means and standard deviations were generated for crop and forage yields to allow risk assessment in FLIPSIM and to establish financial risk of representative production systems at the farm level across environmental regimes New techniques in extrapolation of weather data using weather generator coefficients from the WMO data sets to areas within derived environmental zones were devised and are undergoing

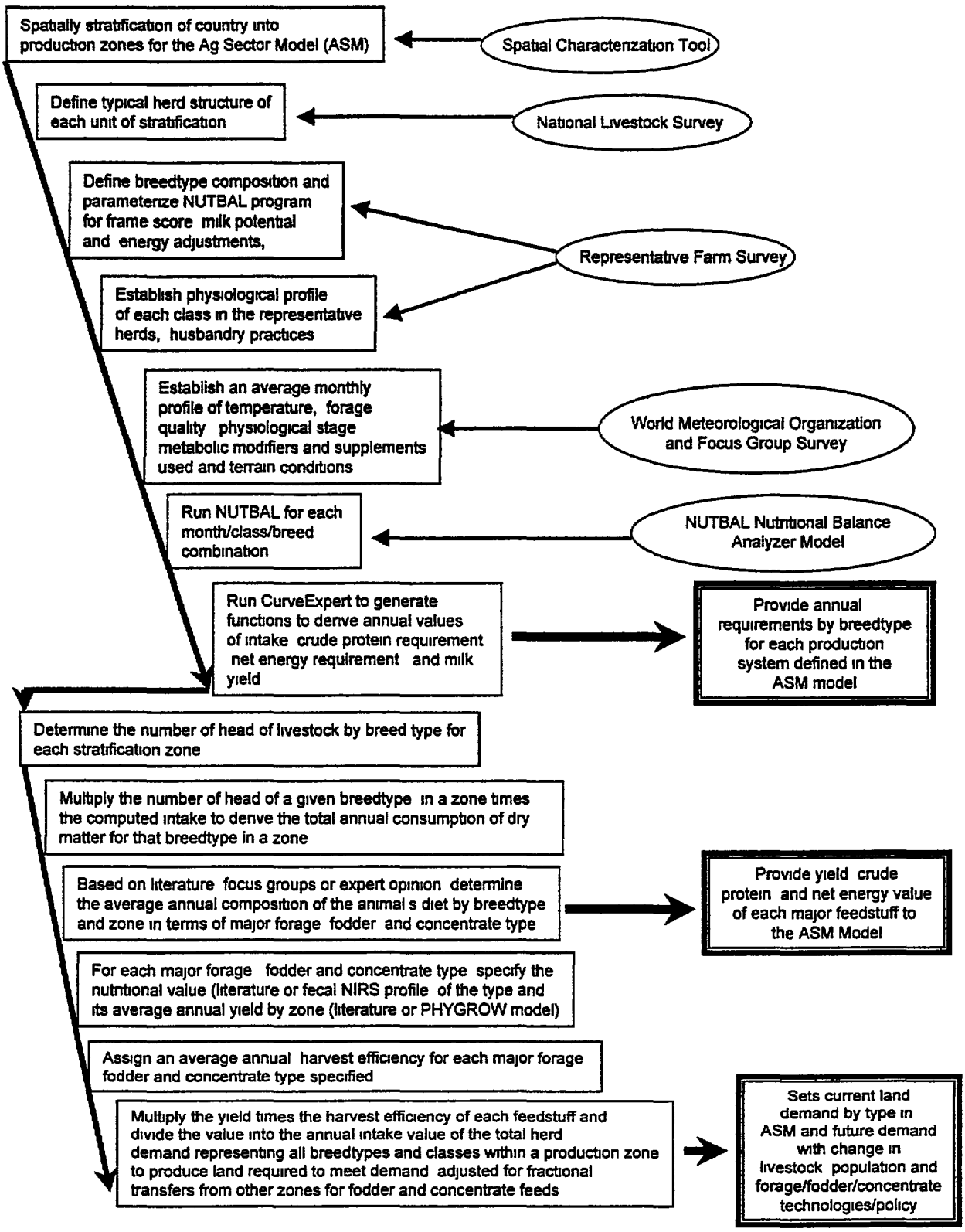


Figure 6 Process flow for determining the necessary amount of land by major forage, fodder and concentrate source to support livestock in stratified zones of a country The LAND DEMAND decision support system was developed to support production, animal nutrition/demand, and land constraints in the Agricultural Sector Model

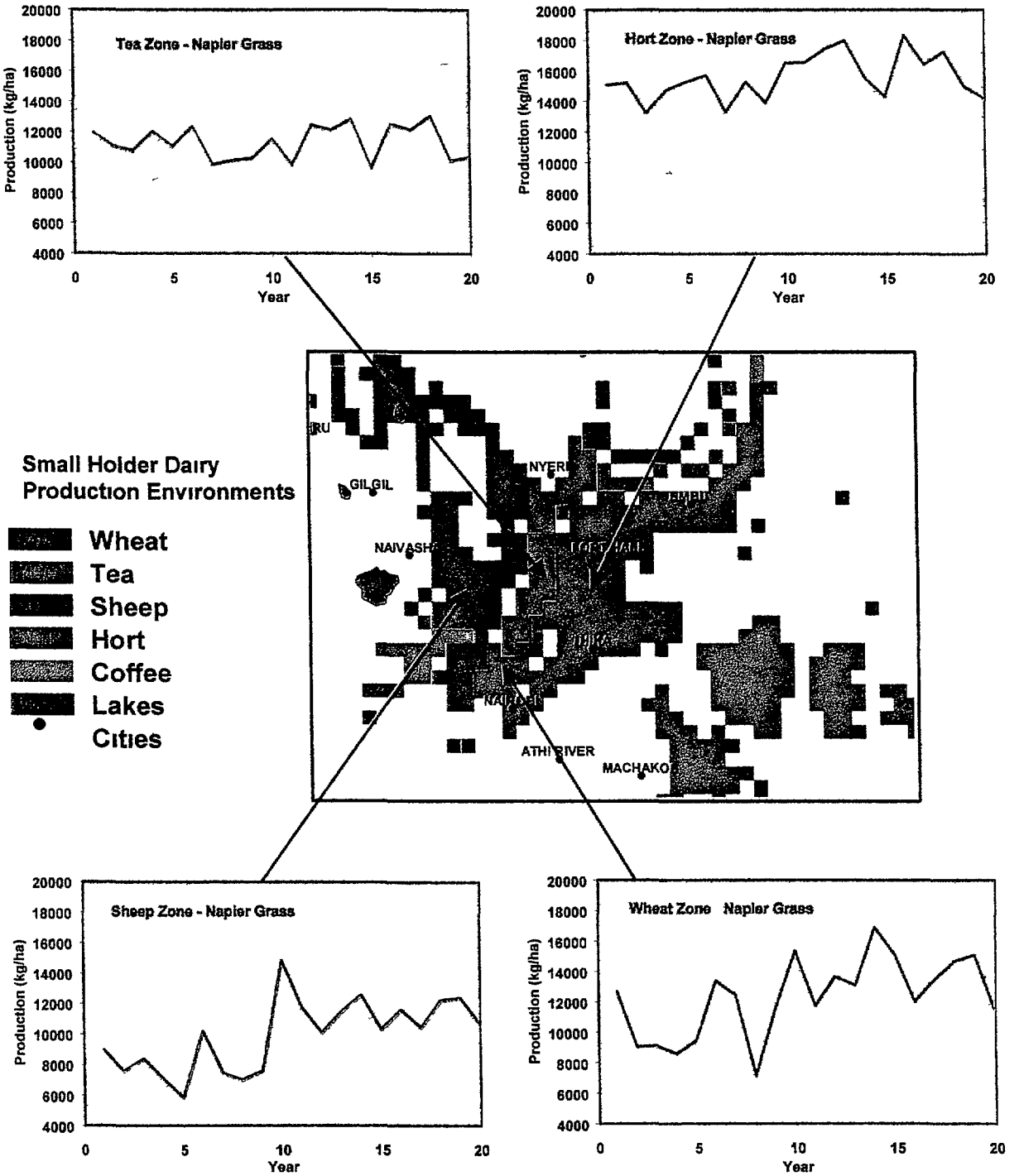


Figure 7 Biophysical models (PHYGROW, EPIC) were used to simulate forage and crop growth within small holder dairy production environments in Kenya Using 20 years of climate data from WMO stations within the production environments and corrected for temperature differences due to elevational influence, spatially explicit forage and crop yields were determined These yields are then used to develop spatially synchronized yield probabilities needed for economic risk analyses in FLIPSIM and ASM In this example, yearly production of Napier grass is shown for several small holder dairy production environments

continued refinement Various "states of nature" (sources of variance) are being identified and analyzed in the Agricultural Sector Model adding a stochastic component and allowing more dynamic assessment of the impact of technology and policy at the sector level

Linking grazing land forage production models with animal production has been identified as a major need for integration of biophysical responses with economic models Linking two models such as PHYGROW and NUTBAL will require a long term, yet fruitful investment In the interim, the use of the forage value index (FVI) produced by PHYGROW simulations was tested to determine if it could be used to predict annual shifts in animal performance (offspring crop, weaning weighs, milk) (Lee 1999) It was determined that key producers in a specific region could be placed in a focus group and come to a consensus as to how animal performance varies from one year to another This heuristically derived data is then linked with variability in PHYGROW's FVI for the appropriate response period for each variable (e g The average FVI for the period from birth to weaning affects weaning weights) Once this relationship is derived, the model then generates destock/restock decisions and animal performance changes throughout the simulation period based on forage supply and FVI flux, respectively, for each specified response period This mechanism allows integration of local knowledge with complex biophysical models, capturing the human decision process in the simulations

Future Plans

Out of this process, the PHYGROW model is being modified to accommodate a new dynamic, landscape modeling scheme A hierarchical structure is being added to the system to allow more complex, spatially coherent analyses to be conducted and allow improved support of the economic and environmental assessment process

Plans are being formulated to link NDVI and rainfall estimates (derived from cold cloud duration) imagery with predicted variations in FVI of virtual landscapes synchronized with the appropriate grid image If this proves successful, it will afford a mechanism to link human rule bases with remotely sensed data using biophysical models We feel that this methodology could constitute the next generation of methods to allow pursuit of more easy to-use multiple-scale impact analyses Our challenge is to understand the limitations of each tool used in impact assessment and then devise mechanisms to use more heuristic or soft systems to support weaknesses in our hard systems at the appropriate level and scale

As noted above, there will be a continuing refinement of these methods Continuing research will be done to refine the capability to link biophysical, environmental and economic models As the FIVIMS-GTOS-CCD Pilot studies in Mali and Kenya are initiated, these models will be critical Opportunities will be exploited to incorporate improved indicators of environmental health and natural resource management by relationships with partners

Objective 7 Develop or adapt and demonstrate the utility of economic models to estimate the impact of introduction of new technology or policy affecting the food, agriculture, and natural resource agendas for developing countries

Method

A streamlined approach to developing country level agricultural sector models will be developed Existing models such as FLIPSIM will be adapted for household or farm level economic analyses to reflect the impact of new technology or policy options Economic, biophysical, and georeferenced models will be integrated to predict the adaptability of new technology to other locations

Output

The capability to provide credible agricultural sector models for developing countries will facilitate ongoing analysis for FIVIMS, GTOS and other national, regional, and global impact analyses Development of farm level models and econometric models as needed for national, regional, and global analysis will permit an estimate of impact in modal farms across different agroecological zones

Progress

In research sponsored by a related USAID grant, agricultural sector models and farm level economic models were developed and evaluated for Mali and Kenya at national and provincial levels Results from this analysis are summarized in Figure 8 This was part or a larger effort to develop a suite of integrated models for impact assessment The methods for integration of models are summarized in Figure 9 The initial studies evaluated introduction of new technology from research supported the Global Bureau emanating from the INSORMIL CRSP and the International Livestock Research Institute (and their national partners) This provided a "proof of concept" for the integrated suite of methods Work under SANREM II year-one has involved extending methodology and acquiring data for developing country studies Year-two will see the application of these models and data to specific case studies in Mali and Kenya

Under SANREM II, these models are being refined and prepared for application in FIVIMS-GTOS-CCD Pilot Studies and in collaboration with regional SANREM projects Methods are also being developed to link the Global Agricultural Sector Model (GASM) described under the first activity of the GDSS effort to national and regional studies using models developed in this part of the effort

A computerized way of efficiently interfacing crop mix results from a sector model with the hydrology/watershed simulator SWAT was developed (Atwood et al 1999) The resulting system was applied to two United States case studies one involving introduction of a new set of crop varieties and the other involving changes in national soil conservation policy

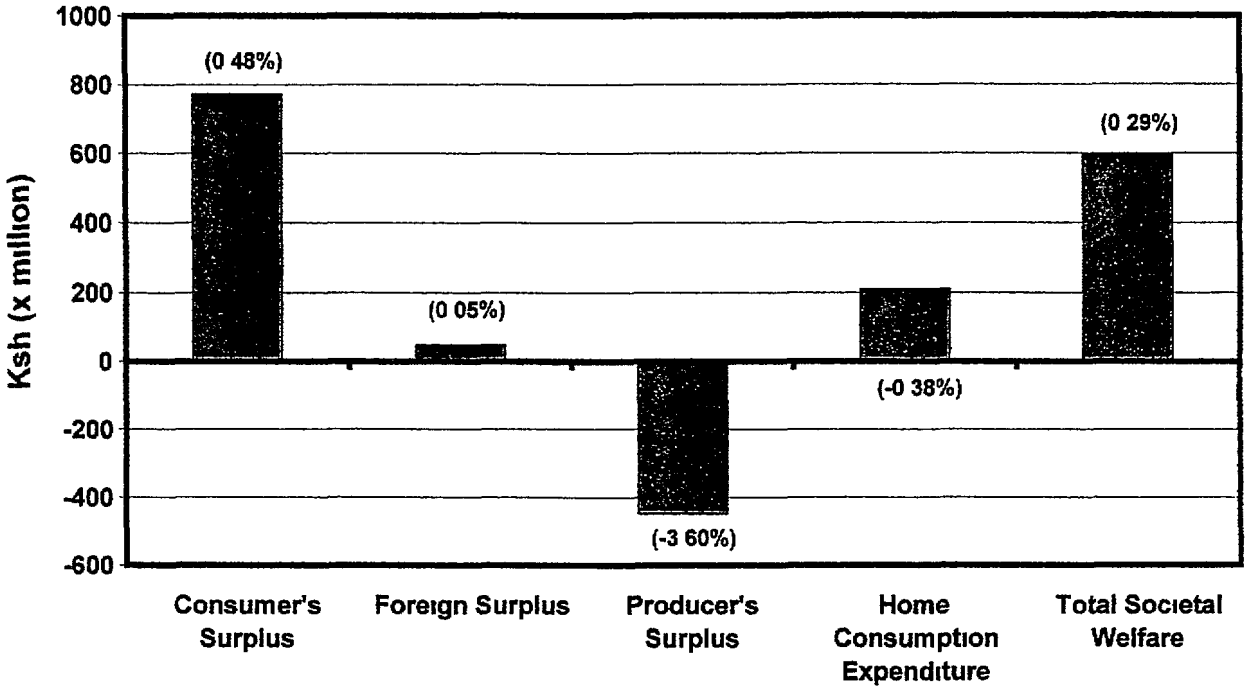


Figure 8 Multiple-commodity consumer, producer and total social welfare economic impact at upper threshold adoption rates of improved production technologies for small holder dairy in Kenya as determined by the Agricultural Sector Model As we see in many instances, improved technologies tend to benefit consumers and total society while producers who are non-adopters or late adopters of improved methods of production tend to not benefit innovations in new production technologies The bars represent absolute value in shillings while the percent values in brackets represent the percent change from current adoption rates of technologies

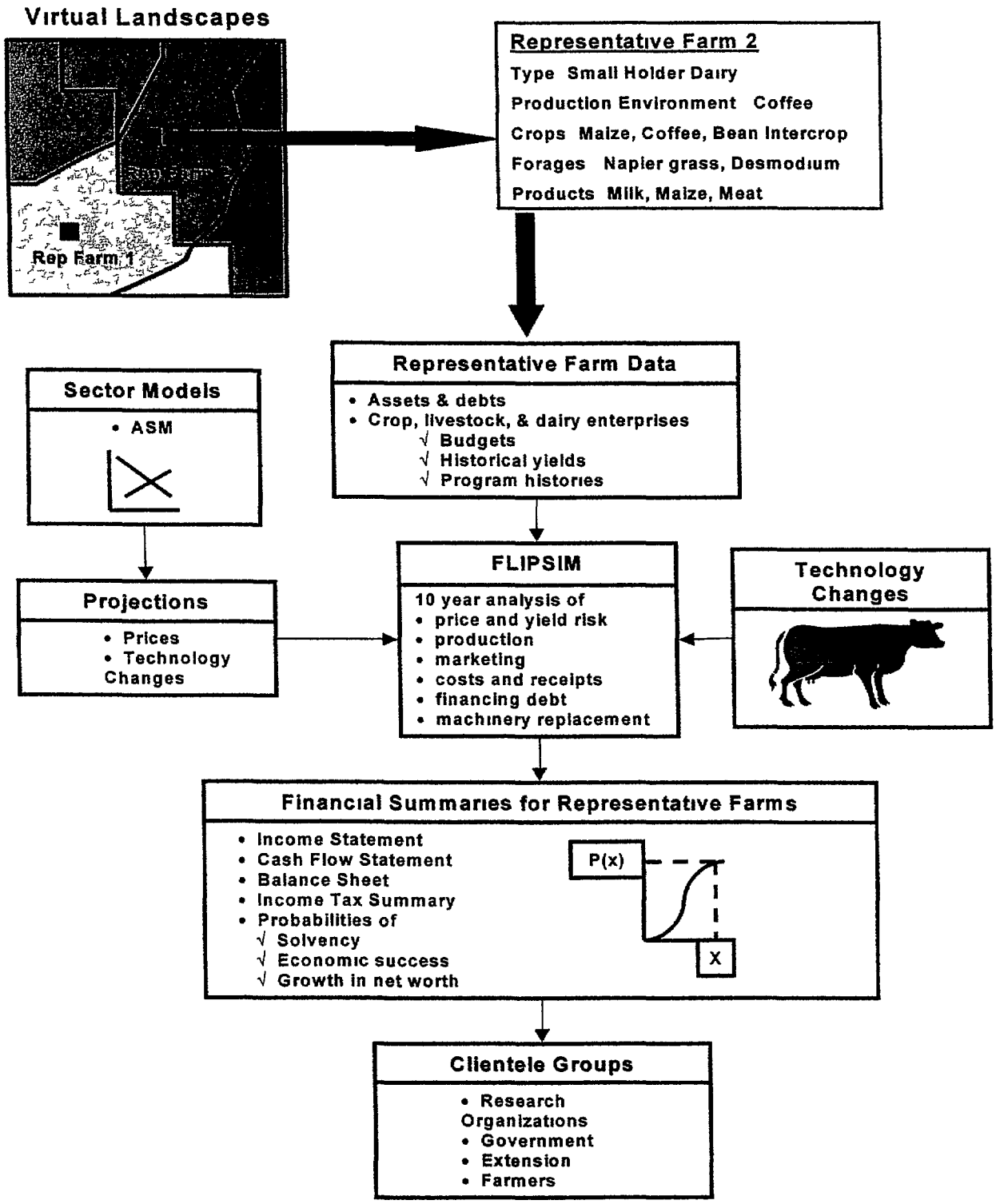


Figure 9 A stylized view of the relationship between virtual landscapes, representative farms, and the FLIPSIMS economic model Within each virtual landscape, representative or average farms are chosen for in-depth surveys regarding income, yields, sales practices, farm management practices, etc This information is used to parameterize the FLIPSIM model and also to establish the management practices needed for the biophysical models Biophysical models are then used to simulate forage and crop yields, and variability of various technology suites over time, and these are input into FLIPSIMS for economic risk analyses

Many frameworks have and are being used for technology appraisal The consequences of the assumptions behind these alternative technology evaluation frameworks were examined This was done in the context of pesticide restrictions in U S agriculture In particular the withdrawal of two pesticides was investigated permitting the substitution of other technologies in their place During this study we examined what would happen if one considered versus ignored national price and multiple commodity effects One method investigated involved the spreadsheet-based technology appraisal framework as has been made popular by Julian Alston, George Norton, Phil Pardey, and others versus using our multi region/multi commodity economic appraisal technology We generally found that our appraisal technology raised the benefits due to the consequences in other markets and had great implications for the estimation of changes in income distribution (McCarl, Schneider and Chen 1998)

In collaboration with national partners, data collection for sector and farm level economic modeling studies in countries adjacent to Kenya and Mali are well along and will be completed by September 1999 This will permit completion of research to develop methods for defining spatially equivalent areas for technology application across multiple countries (Jointly supported by SANREM and another USAID grant) This will be done using a mixture of EPIC simulation results, GIS-based land suitability identification, an econometric model of land allocation and our applied results in the countries with detailed models

Substantial efforts were devoted to interfacing the EPIC crop simulator with a sector model Once developed this approach would be usable with any of the sector models developed under this project

A major methodological question being investigated in the study involves sector modeling under risk This is being pursued since technology adoption and reactions to policy changes are influenced not only by average conditions but also by times of scarcity and times of plenty Often people focusing on the appraisal of production enhancing technology consider production increases to be good for agricultural producers while production deficits are judged bad However from an aggregate country wide market standpoint if demand for food is fairly inelastic then excessive production often means price collapse while shortage in production often means increased prices This has large implications for the appraisal of producer incomes and consumer food expenditures Producers may be unwilling to adopt production enhancing technologies given their experience with price collapse Thus, risk is an important factor in appraisals of technology adoption and policy This is of obvious concern in establishing policy Technologies may well be needed which allow goods to be stored from times of plenty to times of deficit to level out prices, income variability and food expenditure variability The stochastic sector modeling component of our project is being pursued both in terms of country models and global ASM

Mali has a dramatically variable weather pattern Rainfall ranges from 600 to 1200 mm per year Little irrigation is used Such variation in weather causes substantial crop yield variation Therefore, uncertain yield distributions for both existing and newly developed

technologies are relevant in considering technology adoption along with farmer attitudes toward risk The Mali sector model includes a yield distribution separated into five states of natures based on observed rainfall patterns The model determines prices which depend on rainfall events This allows us to depict reaction to price collapse and price increases induced by the weather

Yield uncertainty was also included in the Global ASM model In that model, regional crop yields in both the U S and the world vary by weather event In turn global ASM was used in appraising the value of improved ENSO prediction skills The major findings are

- When uncertainty is incorporated in the form of alternative event strengths given an ENSO phase, the estimated value of providing producers with ENSO phase information is raised by almost a factor of three relative to just considering point estimates of ENSO phases (Chen and McCarl)

- When ENSO sensitivity in the rest of the world is considered the value of providing ENSO information to producers is increased by about 10 percent relative to an analysis of U S only benefits

- When more refined five phase ENSO information is provided as opposed to the current three phase information we find almost a doubling in the value ENSO information

Future Plans

Model refinements done in year-one and data being collected in Burkina Faso, Senegal, Uganda, and Tanzania will be used to evaluate options for technology adoption or consequences of policy options in Mali and Kenya pilot studies on FIVIMS-GTOS-CCD as described below

Further development of computerized interfaces between economic, biophysical, and environmental models will be developed and evaluated

GIS and Spatially Explicit Analysis

Introduction

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 for less detailed simulation (other models in the GDSS) It will serve as both as an output visualization tool and internal data base input organizer The SCT will be a GIS application tool which 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 SCT/ACT are being developed for use at the onset of GDSS analyses to scope the problem and define inputs to other models It also functions to link and facilitate iterative interactions between models in the suite and finally serves to interpret the spatial projections of outputs from one level of scale to another In SANREM II, the ACT will be further developed and expanded, linked to WINDISP 3 to acquire NASA and NOAA data and then used as part of the total interactive GDSS

Objective 8 Develop and demonstrate the utility of a georeferenced framework for models, information systems and analytic procedures (Spatial Characterization Tool -SCT and Almanac Characterization Tool - ACT) These tools will be expanded to a multi-regional and (ultimately) global scale providing methods to make projections of the utility of research products to other geographically similar areas

Method

Further development of the SCT and ACT and related software will be done through the use of case studies on new technology or policy options with integration of this with the other elements of the Texas A&M portfolio Advances in state of the art methods of analysis and display of information will be incorporated into the SCT as will an expanded capability for statistical treatment of input and output data

Output

Expanded use of the SCT will be central to the ability to extrapolate research and demonstration results to other locations It will provide a capacity to develop input to other economic and biophysical models as well as extend and display outputs of these models to other scenarios It will provide a framework for storage and management of both raw and foundation data for ongoing analysis and a focal point for interacting various models in the Texas A&M suite

Progress

The SCT was developed with support from several preceding USAID grants Its development has continued in year-one with partial support from SANREM The ACT has been more recently developed with substantial support from SANREM II in year-one

The general templates for the SCT and ACT have been developed Research is continuing to apply these methods to the specific studies underway in SANREM II The ACT will be particularly useful as a deliverable to developing country customers because of the relative ease in its use

Characterization Tool Development
Accurate identification and characterization of production zones and potential production zones are key to the development of the GDSS New opportunities exist to greatly improve the mechanisms for characterizing agricultural possibilities GIS tools empower innovations that build upon traditional "agro-ecological" models which rely on static zones, analog reproduction technology, and fixed crop-environment relationships These tools use GIS technology, iterative and dynamic processes, and interpolated spatial data to allow the user to select boundary or 'discriminating' criteria with the output then uniquely reflecting the user decisions These more dynamic tools enabled the characterization of target areas to be greatly, and rapidly, enhanced

Characterization is not a single or simple process within the framework of the GDSS Spatial databases need to support a variety of efforts that range in scale from broad areas based upon political boundaries to 'virtual landscapes' necessary to provide functional input data to sophisticated daily time-step models The role of the characterization effort ranges from activities that are analogous to simply 'archival' to proactive steps providing interpolated information to statistical assessments and use of simulation models

A key capability within the GDSS is the use of the characterization concept to provide a spatially coherent sampling frame Exploiting this opportunity is the basis for considerable efficiencies within and between component models within the GDSS A spatial sample frame may be required to rapidly assess a political region to fill-in missing data for an Agricultural Sector Model A spatial sampling frame can also be employed to organize data collection strategies for long-term monitoring sites The ideas inherent to a spatial frame are based upon the link between multidisciplinary data at multiple resolutions used in combination to increase the knowledge base prior to a data collection effort The GDSS development has used a spatial sample frame in a 'virtual' mode to assemble necessary information across many environments for the smallholder dairy work in Kenya Results from these environmental transects were then extrapolated out of Kenya and into Tanzania and Uganda A spatial frame was then employed in a rapid appraisal mode to check the validity of the environmental categories To answer specific questions about production in a specific area, both field visits and interactions with local experts were made more efficient The feedback from this field activity improved the 'characterization' database, which iteratively improves the spatial sampling frame This key spatial sampling capability has another important and inherent attribute All data from each iteration are recorded and stored by location, thus building an accessible database for future investigations (and investigators)

Spatial sampling is further utilized when linked to crop simulation models Crop simulation models offer an untapped source of highly specific analytical capability in evaluating germplasm - environment interactions Linked to spatial data, a crop

simulation model can characterize the spatial extent of the adaptation zone for a specific germplasm while providing detailed information unavailable through any other mechanism except a massive (and prohibitively expensive) field trial experiment The results of this method (linking a crop simulation model to spatial data for eastern Africa) provide an example of a powerful new idea for ecosystem characterization identifying 'similar' areas based upon dynamic environmental interactions Other uses of the same method have been employed in developing the GDSS to provide input information to Agricultural Sector Models, and using a biophysical model to provide the mean yields for an economic assessment

Under non-SANREM sponsorship, the Blackland Research Center officially released the Spatial Characterization Tool or SCT This Arc/Info (GIS software by ESRI - Environmental System Research Institute) based product was our first published package of spatial data, query and access tools, visualization software, and containing limited analytical processes The requirement for use of Arc/Info restricts the use of this package to well-endowed GIS units, but more than 350 copies of the software were mailed to researchers on all continents save Antarctica The SCT contained information on Africa and subsequent evaluation of its use shows the SCT supporting publications in human and livestock health, agricultural characterization, and for natural resource management

Technological innovation in software led to development of tools similar to the SCT but which can operate on PCs and without the need for expensive proprietary licenses This software package named "Almanac" has been applied to for 11 African Countries and one state in the USA (Texas) (Corbett et al 1999) We often structure our in-house data to be used by the SCT as a precursor to porting information to the ACT The ACT, however, with its large user base, is rapidly evolving into a powerful analytical tool as its architecture is far more open to third party enhancements than is the SCT's more highly structured, Arc/Info-based organization

The ACTs are based upon a modular, component architecture which enables considerable flexibility in data access, visualization, and in potential analytical processes Early products have emphasized spatial data management, query and access to those data, and visualization of them Efforts presently underway have begun to emphasize more of the emerging analytical capabilities of the spatial sciences At present, the ACT contains up to four separate, but linked, modules

> Spatial Tools the spatial tool's module is the backbone module to the ACT Data visualization and access are emphasized Querying capability includes the identification of all areas based upon a user selected set of criteria as well as examination of data describing any selected point Custom queries can be built interactively and statistics describing any selected zone are provided
>
> Weather Reporter the weather reporter accesses daily meteorological data and provides visualization and export tools Development of the weather reporter module is rapidly evolving as demands for examination of daily data are growing both for support to daily time-step simulation models but also because of the

increased emphasis on risk assessment in the face of greater variability in macro-climatic events (El Nino etc) (Collis and Corbett 1999a, Collis and Corbett 1999b)

Database Query Tool The database query tool is a generic package developed initially to deliver summary information from yield trial nurseries supplied by CIMMYT (International Maize and Wheat Improvement Center) Though containing few advanced capabilities, the design is robust enough to support records from any source in which a date and series of observations are important (it remains necessary to locate the observations - use of GPS is supported) A specific example of future utility of this module will be its support of the Livestock Early Warning System (LEWS), a USAID CRSP (Collaborative Research Support Program) effort to monitor livestock health For the GDSS, this module lays a foundation for the storage and access of any point observation data, from livestock to dairy and human health (Corbett and Stuth 1999)

Document Module a digital 'library' has been built to support a wide range of documents This technology is effective in supporting ongoing research activities as great volumes of written material can be provided to large groups anywhere in the world for a nominal cost (typically the cost of copying a CDROM)

Continued development of the ACT will expand not only into additional modules but also the capability of the present modules For example, efforts supported in part by SANREM II have led to the development of techniques to link results of crop simulation models to economic models These area averages from point simulation models require a systematic process within the spatial sampling frame A module is being designed to handle the many steps needed to move from individual biophysical data layers through the crop simulation model, into an area average by political region, through an agricultural sector model and then back to the Spatial Tools (already built) to evaluate the output of the economic assessment

The concepts embodied in the ACT (ease of data access alone is a key characteristic necessary to the efficient activities of a multidisciplinary team) form one of the pillars of the design of the overall GDSS There is a broad suite of models employed in the GDSS, each with highly sophisticated rules for use and interpretation of the output Each of these other GDSS 'pillars' provides significant analytical capability Creating an effective tool to link between the models fosters not only their use but also their evolution as hypothesis can be tested that previously were not possible or were possibly but at significant cost This is a major goal of the GDSS development and we continue to build upon the strengths embodied in each team member through construction of effective mechanisms to 'port' processes and data between the models

Development of Impact Assessment Methods in Mali

The GDSS will include methods to evaluate the potential for technology developed in Mali to be applicable within neighboring countries of the region Because the use of agricultural technologies is closely related to environmental factors, the agro-ecological zones of the Sahelian region were studied, seeking a coherent pattern in the biophysical character Traditional zonation schemes for the region are quite straightforward, describing the region either by annual precipitation or by the precipitation to potential evapo-transpiration ratio These zones have proven useful over the years for their accurate if overly general assessment of the regions agricultural character

One goal of the GDSS is developing methods to extrapolate research results from the place where experiments were done to geographically equivalent areas with the adjacent region The biophysical character of the region was examined using GIS methods to provide greater specificity and flexibility than is otherwise possible Interpolated climate databases, growing season models, and crop simulation models provide a resource for model development in the GDSS that, integrated together, was nearly impossible as little as 10 years ago

Our tools and spatial databases afford opportunities to exercise our suite of integrated models to evaluate this question of the ramifications and impact of technology developed in one place and, possibly, moved into another

After creation of the interpolated climatic surfaces, a growing season model was created to identify the five consecutive months that maximize water availability in the environment This growing season model has been shown to be quite effective in the identification of the growing season in Africa where water is the main limiting factor A cluster analysis was run with the input variables being the climatic characteristics of each month of the growing season (maximum and minimum temperature, precipitation, potential evapo-transpiration) We call the results of this clustering "effective environments" as they are areas of highly similar climatology during the growing season

We then took a general soil map of the region (FAO Source, as modified by the World Soils Resource Group) and cross-tabulated the climatic clusters and the soil map units The results of this spatial cross-tabulation (overlay) result in our simulation environments (Figure 10) These simulation environments express both climate and soil characteristics These simulation zones, and the suite of GDSS models, allow the extrapolation of technological innovation developed in one country to another We will be building a case study from the Mali information and applying it to Burkina Faso and Senegal

The EPIC crop simulation model was then run for each simulation environment EPIC has a weather generator and it was fed the climatic means from the cluster analysis For distribution of precipitation (a vitally important factor) the nearest WMO daily weather station was selected to provide the wet-dry day statistics Because of the strong north-south precipitation gradient, we used a nearest station routine that sought stations east-west at a 3 1 ratio of distance relative to north-south This kind of highly specific biophysical modeling exploits tools that can be exercised across regions, evaluating the

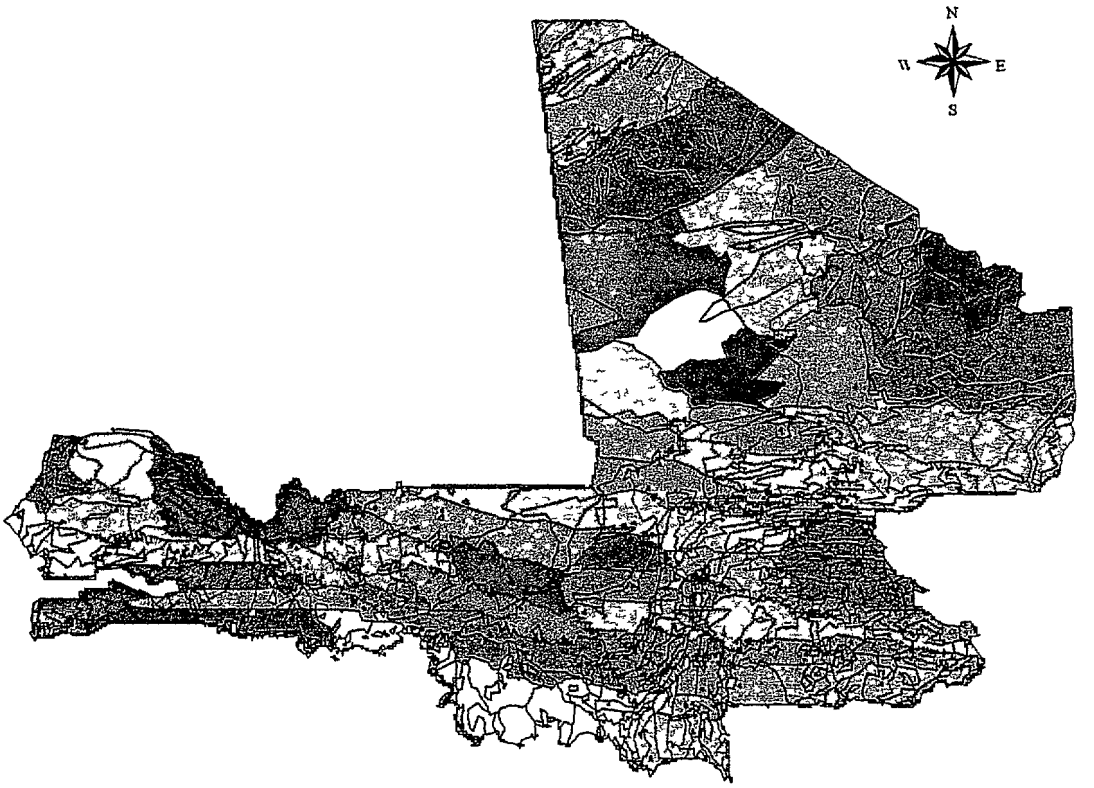


Figure 10 Biophysical stratification of Mali used in methodology to reconcile crop yields by administrative district to support Agricultural Sector Analysis across the 8 provincial sub-national reporting units in the country Using the weather grids in the Spatial Characterization Tool (SCT), cluster analysis on 5 consecutive months that maximize water availability to create a series of "effective environments" (areas in color) Soils groups from SCT were delineated with black lines Crop growth is simulated for each unique combination of soil and climatic zone using 20-years of weather data from the nearest WMO station in the same "effective environment"

biophysical adaptation of technology developed in a specific place The crop simulation models use data from the specific place to 'verify' the simulations (in this case Mali) Extrapolations of verified, simulated results in one place provide some confidence for estimates in another

Biophysical adaptation is not sufficient information to address issues important to adoption or use of the new technology For this, the GDSS is developing economic models to further evaluate impact of introduction of new agricultural technology into the region The agricultural sector model (ASM) required an estimate of mean yield for production zones defined by political units (this is necessary for many reasons regarding input data to the ASM) Biophysical mean crop yield simulations were done by simulation zones that reflected climate and soils One of the powerful options afforded by GIS is the ability to rapidly assemble geographic information into new geographical groups - in this case, political zones We used administrative units for which numerous economic and other census data were available (the ASM input values), and 'overlayed' the political units with our simulation environments For each crop simulated, we could then provide an area weighted mean yield for the political unit In this way we are able to link economic models that are based on political units with biophysical models that are essentially point-models (though in our case we exercised the biophysical as though it represented an area)

A key feature to the ACT application of this suite of models is our ability to manage both the input and the output of each model because each model as some measure of geographic specificity This enables multiple simulations at each step (varying management or germplasm in the biophysical models to evaluating different policies in the economic models) Each set of inputs and outputs are managed in the same way, enabling iterative improvements in each as discussions around the premises of each type of model can be more easily dissected

Future Plans

ACT for Mali

An ACT of Mali is being planned to manage additional data requirements for impact assessment A module will be added to handle the steps to go from a climate surface through to an effective environment layer (clustering or other spatial statistical method), creation of a simulation layer, crop simulation, creation of area weighted mean yields, and into and out of economic assessment

Developing Scalable Frameworks to Spatially Represent Landscape Complexity

To address land tenure customs and emerging policy impacting natural resources, a need exist to establish the distribution of environments linked with hydrological systems overlaid with agricultural production systems An approach is currently being designed to represent dynamic, virtual landscapes composed of cropland, grazing land and forest lands within sub-basins of watersheds or basins and develop techniques to reconcile biophysical output (production, environmental) with political or administrative boundaries and addociated socioeconomic data See initial design ideas at http //cnrit tamu edu/rsg/phygrow/landscape and Figure 11 A concept of a dynamic,

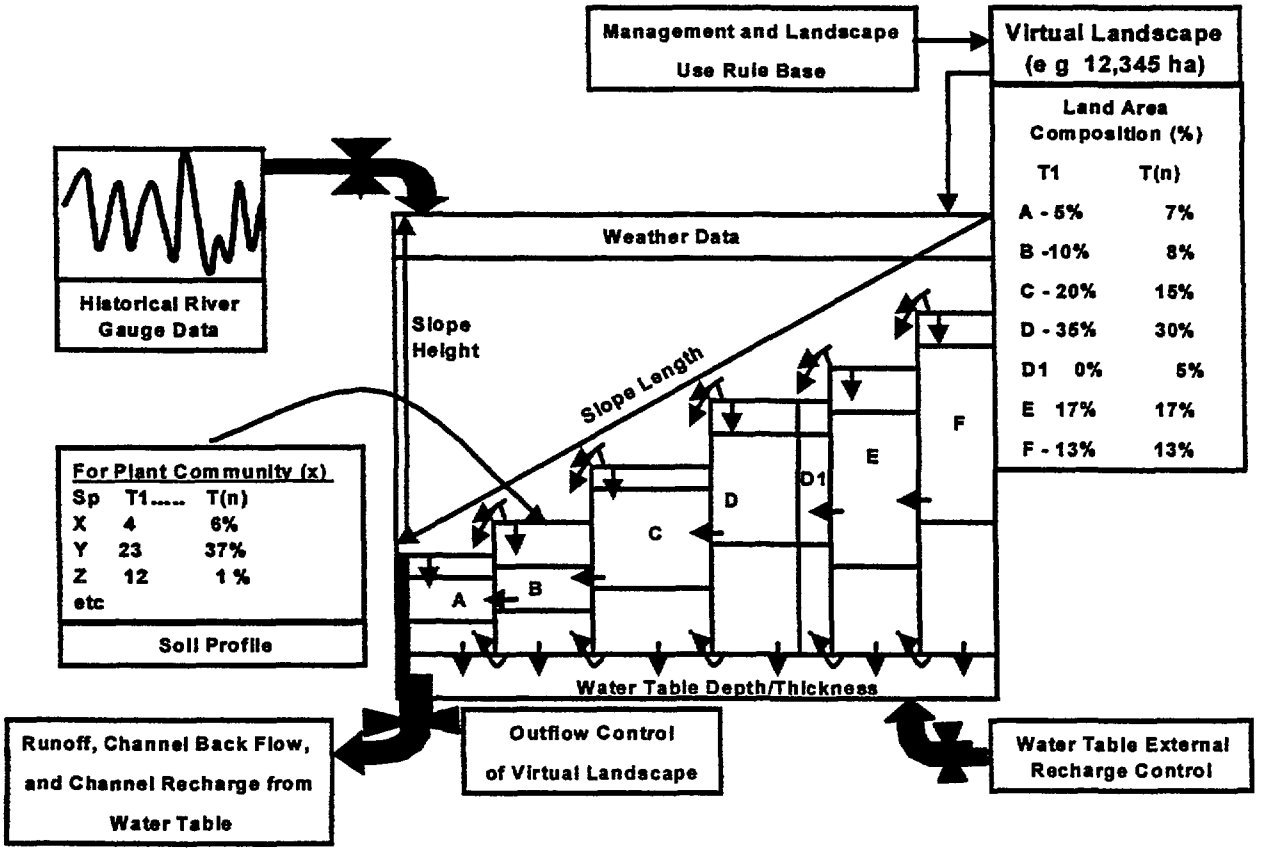


Figure 11. A stylized view of the components of a scalable dynamic, virtual landscape within a sub-basin that will be incorporated into future simulation modeling efforts Individual columns in the figure (A, B, C, D, D1, E, F) represent topo-sequences of ecosites/cropland that can change in land area (derived from experts, ground survey or satellite imagery) over time due to management practices within the virtual landscaped Shifts in species composition over time on grazinglands due to overgrazing or climate change can also be represented over time in the modeling environment This capability allows representation of land changes due to intensification or extensification of cropping and subsequent degradation to remaining grazinglands This concept forms the foundation for linkages with economic and basin scale hydrology models

virtual landscape is being developed which allows biophysical models such as EPIC and PHYGROW to simulate crop and forage yield as landscape composition changes through time based on heuristic rule bases Within these dynamic virtual landscapes, heuristic rules can be imbedded to reflect how plant species will change over time as cropping systems expand (extensify) and differentially adopt new technologies (intensify) and impact the livestock populations that are either being forced to be in one place and use residues and supplements, pushed into nearby marginal lands where degradation occurs with and without external grazing from other pastoralists, or migrate (transhumance) to other regions where exclusive use can occur with more and more animals, with more and more degradation, or compete for those resources with other people

Interactive and Participatory Delivery System

Introduction

The engagement of decision makers from farm to global levels in the development of the GDDS package for impact assessment will provide early and continuing collaboration and input to ensure relevance and help build capacity through participation Under this activity, Texas A&M is focusing special attention on collaboration with FAO and SANREM partners in the development of *regional and national decision support systems* Texas A&M envisions working through practical real life impact assessments at varying levels of scale

There will be staged delivery of products for use by decision makers at varying levels in both developing and developed countries over the five-year period of SANREM II A steady stream of deliverables will be provided as the methodologies are developed and validated The products of this research will be packaged so that they can be used by farmers or those (NGO) advisors to farmers as well as by decision makers at several levels of government We envision a range of deliverables from relatively simple CD-ROMs which provide a self-contained package that allows for decision making at local or provincial levels Also planned is an active web-site to provide access to current data and methodologies by others who will conduct more sophisticated analyses

Because Texas A&M will have relatively few resources committed to long-term international assignment, it is dependent on effective collaborations with others to provide the necessary coupling to ensure ongoing coupling to its customers Texas A&M intends to be one node in a broader network of groups engaged in similar research and development and has the goal of developing mutual commitments to participate in these networks A distributed system of information and methodologies with shared responsibilities for upkeep is envisioned The SANREM data base is clearly a part of this network and participants are intended to have access to all of its parts

Close collaboration with other elements of the Global Project will help build and sustain linkages with our customers The assessment of decision makers' needs and capacity building will form primary conduits through which the Texas A&M products will be delivered

Objective 9 Extend and expand the integrated package of decision support tools through the cooperation with partners by using specific case studies at various levels of government as platforms for development of methodologies

Method

The activity set description defines a series of potential collaborations which are being developed to provide engagement at various levels of government

Output

The product of these collaborations will be the integrated impact assessment methodology, reports of specific case studies that were used as platforms for developing methods, and capacity with customers built through involvement in the development process

Progress

A detailed action plan has been developed for a collaborative study with FAO, the Government of Mali, and the Mali Institute of Economic Research to Develop and Use Decision Support Systems at the National Level for Enhancing Food Security and Sustainable Use of Natural Resources The objective of this research is to use models previously developed by Texas A&M under USAID sponsorship to enhance the capability of the Government of Mali (GOM) in assessment of the current and future status of food security and natural resources and to evaluate the impact of policy and technology options on the access and availability of food and on the sustainable use of natural resources in production of food Research and development will be jointly conducted by Texas A&M, the GOM, and FAO

Since the GOM is a member of CILSS, INSAH and AGRHYMET are also collaborative partners at both national and regional levels This is an activity encompassing four years for full development However, useful and usable products will be produced throughout the life of the project Initial studies will evaluate the utility of the suite of models previously developed by Texas A&M for assessing food security and sustainable development of options to enhance it Models will be modified to enhance their utility Then a set of specific case studies, identified by the GOM, will be undertaken to demonstrate the utility of the models Institutional utility and survival will be achieved by ongoing participation of national partners in the research and development, workshops and mentoring, and training of key operators

Agreements with FAO and senior decision makers in the GOM and regional organizations have identified the institutional collaborators that will be involved in this study The following table identifies the key institutional players and their contribution to the study In the early part of year-two of SANREM II, these initial commitments are being solidified in explicit statements of intent A workshop sponsored by key Ministries of the GOM, INSAH, FAO, and USAID will be held in the fall of 1999 to finalize the action plan for the study which will be initiated immediately thereafter

Summary of Institutional Involvement

Institution	Contribution
Texas A&M Impact Assessment Group	Development and application of an integrated suite of models for assessing impact of change, overall project leadership and coordination
FAO-FIVIMS Secretariat	Guidelines for National FIVIMS, sponsorship of Mali FIVIMS, institutional coordination in FAO
FAO-GTOS Secretariat	FAO focal point for on sustainable development, access to global and regional data bases on terrestrial systems
FAO-WAICENT	Collaborator on development and use of models and data bases, capacity building workshops, enhancing analysis capability
FAO-GIEWS	Linkage of famine early warning data bases and analysis to Mali Pilot Study
FAO-Interdepartmental Working Group for the Convention to Combat Desertification	Linkages with counterparts in Sahelian countries and relevant data bases and analysis on antidesertification
Institut D'Economie Rurale (IER)	Collaboration on data acquisition and model development for the integrated suite of models with emphasis on economic and GIS components
Ministry of Rural Development and Water	Cosponsors of the Pilot Study Collaboration with the Celle de Planification et de Statistique (CPS) as agency with prime responsibility for agricultural and population statistics Evaluation and use of methods
Ministry of Environment, Office of Environmental Planning	Cosponsors of the Pilot Study Collaboration in the process of developing the National Environmental Action Plan and CCD Program, evaluation of the use of Texas A&M methods for these activities
Institut du Sahel (CILSS)	As a regional organization, INSAH focuses on promotion and coordination of research and development in the area of food security, natural resources management, and population/development through (*inter alia*) case/pilot studies in member countries, exchange and dissemination of information and capacity building

Institution	Contribution
Institut du Sahel (CILSS)	With related studies by Texas A&M, the West Africa Project of the SANREM CRSP, FIVIMS, GTOS, and CCD experiences from this national study in Mali will be used to develop principles that can be applied to neighboring countries in West Africa Within its mandate in concert with established goals, INSAH will be a principal partner in these studies at both national and regional levels and will be heavily involved in facilitating training and capacity building in national programs
Centre Regional de Formation et d'Application en Agrométéorologie et Hydrologie Opérationnelle (AGRHYMET) (CILSS)	Linkage with study on livestock sector and use of semiarid lands in the Sahel, collaboration with Goddard SFC, EROS, and FAO-ARTEMIS in providing weather and related data from satellite imagery
West Africa Project - SANREM II	Collaboration in developing decision support tools for decision makers from household to national levels
International Livestock Research Institute (ILRI)	Collaboration on modeling mixed crop-livestock systems in semiarid regions of the Sahel
USAID - Mali	Continuing inputs on needs for national and regional ex ante and ex poste impact assessment of investment opportunities for West African countries and evaluation of products

Kenya Pilot Study

A similar action plan is being developed for the Kenya Pilot Study The concept papers have been developed by FAO and Texas A&M and discussed with national leaders and research colleagues in Kenya in the same manner as is reported here for Mali Endorsement of the concept by senior administrators in the Office of The President has been secured and contacts with relevant parts of the government initiated The intent is to initiate the Kenya study about six months after the initiation of the Mali study The action plan is similar in concept and content and, therefore not repeated here

Future Plans
The following are the planned areas of research in year-one of the Mali Pilot Study The details of the full plan are provided in the Plan of Action (Impact Assessment Group 1999b)

- Further Development of Models and Data Acquisition

- Baseline Study of the Food, Agriculture, and Natural Resource System in Mali and Kenya

- Studies to describe the interaction between livestock and the extensive rangelands of West Africa to enhance overall sector models and to provide methods contributing to conflict resolution between sedentary and pastoral livestock operators (with improved interpretation of NVDI, AVHRR, Weather and other data derived from satellite imagery as it pertains to crop-livestock systems

- Projection of the Status of Food Security in Mali Assuming Current Trends in Food Production and Productivity and Population Projections in the year 2015

- The Impact of Adopting New Technology on Food Production and Productivity in the Year 2015 in Mali and Kenya

- The Impact of Agricultural Policy to Subsidize Fertilizer for Intensive Agriculture on Food Production and Productivity in the year 2015 in Mali and Kenya

- Evaluation and Modification of the Suite of Models in Reflecting the Impact of Technology and Policy on Agricultural Production, Food Costs and Availability, and the Sustainable Use of Natural Resources

- Studies to Estimate the Impact of Options for Interventions Selected by the GOM (Two Contemporary Case Studies from the Real World from Mali and Kenya)

- Capacity Building Workshops and Short/Long Term Training

Objective 10 Provide effective delivery of new methodologies to customers and assure their ability to use them

Method
Participate with SANREM and other partners in developing deliverables, conducting or participating in workshops, and providing training in using the Texas A&M methodologies

Output
Provide deliverables in the form of workshops where initial results are presented and feedback from customers is sought Preparation of prototype CD ROMs containing data and analysis methods for two to four countries

Progress
Collaborators and customers have been identified in West and East Africa and initial workshops were held under a related USAID grant on model development and results evaluating INSORMIL CRSP (Eddleman et al 1999b, c) and ILRI technology (Eddleman 1999a,d) Last year, the Texas A&M research was reported in West Africa Workshops conducted by Purdue University Texas A&M, ILRI, and KARI conducted workshops on for East African collaborators This formed the basis for new funding from the Africa Bureau which is now being finalized that will support capacity building in West Africa With this new funding to cover the shortfall in SANREM funding, there will be a substantial effort at capacity building in the future Regional activities of SANREM II have not progressed to the point of justifying workshops

Active participation of colleagues from the Kenyan and Malian Agricultural Research Institutes in development and evaluation of models contributes to capacity building in these countries

Development of the ACT (see above) has proceeded over the year and sets the stage for deliverables to developing country partners at national and regional levels in year two

Specific plans have been made with the FAO World Agricultural Information Center (WAICENT) to collaborate on conducting a workshop in Mali in November 1999 on capacity building and joint research on methods to enhance impact assessment of options to enhance sustainable production of food and improve food security as a prelude to the Mali Pilot Study described above

Collaboration with Regional SANREM Projects at Local Levels

Introduction

A key component of the overall SANREM II strategy is to ensure that the efforts of the regional projects are clearly focused on decision makers at various levels from farmers to global decision makers The strategy includes the intent of linking regional and global projects to develop and use methods to experimental design can be improved and assessments made of the outcomes of regional projects in terms of their economic, environmental, and societal benefits

Texas A&M approaches the engagement with regional partners with enthusiasm and optimism It is presumed that by careful planning, situations can be identified in which there is a clear perception of mutual benefit

The funds budgeted for the Texas A&M effort under this activity will cover the costs of its participation It is assumed that the regional projects will provide funding for their part of the engagement which should include the acquisition and analysis of data needed as input to the Texas A&M impact assessment models

Objective 11 Develop and extend methods for impact assessment by collaboration with regional SANREM projects in studies at the watershed and provincial levels, and provide collaboration to regional projects for their self assessment of impact

Method

Through consensus-based negotiations, select one or more regional SANREM projects for study in year-one

Output

Methodologies for impact assessment further developed for use at watershed and provincial levels and evaluation of impact of planned or completed studies at the regional level

Progress

Texas A&M has taken a proactive approach in seeking collaboration with regional and global project managers and scientists Active participation in the West Africa Project's Electronic Conference during the fall of 1998 was followed by travel to Washington State University in January 1999 to engage colleagues there on possible collaboration A member of the Texas A&M team participated in the West Africa Project's planning workshop in January 1999 The Project management for West Africa has been very helpful in identifying contacts and making introductions for our effective engagement at regional and national levels A definitive commitment to collaboration has been made wherein the Texas A&M models will be applied to the Mopti region, which is the initial focal point of the West Africa Project's research The results will provide baseline results on economic consequences of the options for intervention to reduce conflict between land and water users in the region Texas A&M will gain insight and data related to

sociologic factors important to the adoption of technology or implementation of policy The GDSS and West Africa Project will work jointly in future years on extrapolation of lessons learned at the commune and village level to provincial and national levels in Mali and other countries of the region

Plans to collaborate with other activities in the Global Project are continuing As user needs are identified in this effort, it will feed directly into shaping the approach used in developing the GDSS The data bases and information systems envisioned for SANREM under this project will be directly linked to those emerging from the GDSS

A cooperative effort with the Southeast Asia Project has been discussed in some detail with the Project Manager and principal scientist at Purdue University that is doing impact assessment on the previous results in the Manupali watershed The amount of data suitable to exercise the Texas A&M models was deemed insufficient at this point for meaningful engagement However, it was agreed that ongoing dialogue will be maintained Texas A&M believes The Philippines is a useful country to initiate its involvement in Asia since some background sector models and other data exist and could be used

Because of limited funds, not all regional projects could be effectively engaged by the GDSS development, at least in the first years of SANREM II At this point, engagement with the Andean Project has not reached an active state, although discussions about involvement in a global effort on waterways have potential for fitting together with similar goals in the Texas A&M plan As the joint Texas A&M and FAO proposal for studies on watersheds is drafted in the coming year, we will continue dialogue with the Andean Project leadership to seek mutually attractive areas for collaboration

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III. Andes Project

Andes Project Summary

I Introduction

The SANREM Andean program aims to develop a process whereby stakeholder groups along with scientists can jointly create sustainable land and water management systems appropriate for mountainous conditions The worldwide trend toward decentralization of responsibility for natural resource management has had a strong impact on the communities of the Andes, especially northwest Ecuador where the pilot research takes place Local decision makers are faced with the unique challenge of managing resources that reach beyond jurisdictional boundaries, across extremes in topographic relief and poorly accessible terrain, in a context of high stakeholder conflict The special difficulties faced by resource managers in mountainous regions has been addressed in Chapter 13, Agenda 21, thus making a mountain and steeplands focus a natural one for SANREM and those who worked in the Ecuador project of Phase I In broad strokes, therefore, the SANREM-Andean program carries out research and methodological support to local, regional, and global decision makers concerned with sustainable mountain development in regions characterized by fragile highland-lowland interactive landscapes

II Project Objectives

The Andean program is organized around a single objective The advancement of sustainability in fragile mountain landscapes through participatory ground-truthing and application of multi-objective, multi-scale, and multiple stakeholder decision making methods and tools related to land and water management

III Progress

For detailed activity reports see section following this summary

1 Over the past year, the SANREM Andean program has cemented an active partnership with the global inter-agency network of organizations working on the global Mountain Agenda As a result of Chapter 13, Agenda 21 (Sustainable Mountain Development) there has been a major worldwide effort to research and promote sustainable farming and natural resource management in mountains and steep hilllands especially in the Andes, East Africa Highlands, and the Hindu-Kush Himalayan Region As a result of the Andean Program Manager's participation at the UNCED mountain meeting in Rome, SANREM-Andes has been given a highly visible role in conferences and events associated with the UN-sponsored Year of Mountain, scheduled for 2002 Such events will provide an ideal forum in which to present the lessons learned from the SANREM-Andes experience

2 Lessons Learned Study A survey questionnaire was administered to over 100 individuals (representing 37% of the families) in the Nanegal area and a focus group was held with 10 farmers from Chacapata, La Perla, Palmitopamba, and Playa Rica to discuss a range of issues dealing with general attitudes toward SANREM and other agencies and how these groups have affected local farming practices Although the report focuses on the impacts of research conducted over the previous five years in the study area, a knowledge of current attitudes within the study communities is essential for effective research during the next year The full report is available upon request from the Sustainable Human Ecosystems Laboratory, Department of Anthropology, UGA

3 During the year, SANREM-Andes has successfully leveraged resources and collaboration from various institutions within the Andes and internationally In December, SANREM-Andes co-sponsored the III International Symposium on Sustainable Mountain Development In May, we co-sponsored an international conference on integrated conservation and development with SUBIR/USAID-Ecuador Throughout the year a number of workshops were jointly organized with CIAT's hillsides program on "dynamic shared vision modeling " Alliances were cemented with ICIMOD in Nepal to develop mountain-specific methodologies for sustainable land use The ISU Institution team began a joint study on decision making with the SANREM-ME The water team from Auburn has developed strong alliances within the study area and has helped make local participants more open to other SANREM activities

International Conference on Integrated Conservation and Development Quito, Ecuador May 1999

IV How the Activities are Integrated

The integrating research theme of the SANREM Andean Phase II program is community-based natural resource decision support Every activity is designed around the local decision makers and their needs The *Ethnoecology* activity attempts to understand the social structure in which the decision makers operate and the important attitudes toward

natural resources and environmental processes The *Institutional Management* activity explicitly examines the decision-support structure and the capacity of communities and groups to make effective decisions The *Landuse Change* activity reports the consequences of past decisions on soil fertility and future crop yield The *Water Resources Management* activity provides data, training and increased decision making capacity dealing with water quality and quantity

V Progress Toward the Five Year Indicators

Deliverables on which significant progress has been made include

- *Memory banking methodology report* The entire methodology developed in the Philippines has been translated into Spanish, and is being tested in Nanegal
- *Migration studies* Gabriela Flora completed her Master's thesis "*Migration and Community Attachment in the Highland Indigenous Communities of Cotacachi, Ecuador*" Statistical analysis of the larger survey of 750 individuals in several agroecological zones was advanced during the year
- *Landuse change/hydrology model* Review, correction and standardization of existing geographic digital information for the Nanegal area including vegetation cover for 1969 & 1990, contour lines, roads, rivers, towns and geomorphology, partial parameterization of CENTURY model with local data, acquisition and digitization of soil maps in 1 50,000 scale for the Nanegal region
- *Training in water quality/quantity monitoring techniques* Field visits to several communities in the Nanegal area and Cotacachi were made by Auburn University personnel and the drinking water systems of these communities were evaluated Several water quality measurement workshops were held to train local personnel
- *Increased Institutional Capacity* In-depth interviews have been conducted with individuals chosen on the basis of present or past involvement in local organizations, Mary Garcia completed a monograph on the history and organizational structure and activities of the organization, titled "UNORCAC Organizational and Grassroots Processes" Forty-four "decision makers" participating in the III International Symposium on Sustainable Mountain Development visited the SANREM site in Cotacachi and learned about ongoing research

Gabriela Flora UGA graduate student interviews Cotacachi women during migration study Peribuela Cotacachi Ecuador (Photo Swis Stockton)

VI Plans for Subsequent Reporting Period

By December the SANREM-Andes team plans to have laid the framework for presenting a preliminary Futures Scenario to selected inhabitants of the Nanegal area The comparative study of landscape images produced by the ethnoecology team (Rhoades & Nazarea) will be added to the institutional analyses prepared by the Iowa State University team (C Flora & J Flora) Data collected from Auburn University's water quality/quantity monitoring team (Duncan & Deutsch) and the landuse change investigation (Carroll) will be used to model biophysical aspects of the landscape The biophysical models and socio-ecological analyses will form the basis of the first projections of potential future environmental conditions for use in subsequent Futures Scenarios workshops

Individual Activity Reports

Comparative Ethnoecology of Fragile Lands in the Andes

Lead Institution - University of Georgia

Introduction

The Ethnoecology project looks at "human drivers" (cognition and behavioral) underlying landuse change Only by incorporating the "mental models" of various stakeholders into the decision making change process will sustainability be achieved During 1998-99, the ethnoecology team continued with its investigation at several scales of research among different stakeholder groups Since demographic changes are one of the main driving forces (especially migration and mobility), work started in Phase I has been continued and expanded to include Cotacachi and Golindrinas (two new research sites) Research looking at the role of ethnicity, age, socioeconomic status, and gender began through the development of methods and tools which will explicate the "mental models" of different groups In conjunction with CIAT, a methodology of "shared vision modeling" has been advanced and is now being applied in the field An impact study was undertaken in Ecuador with a team of anthropologists as a part of the "Lessons Learned" exercise of SANREM Two international level conferences were organized, a number of national symposium were held, several graduate students were supported, and active participation took place in several planning meetings for the Year of the Mountain (2002)

Objectives

- Completion, analysis, and write-up of ethnoecological migration study in three zones along the Guayllabamba Watershed,
- Publication of "Comparative Ethnoecology of the Cotacachi Cayapas Ecological Reserve" (monograph) and several articles in refereed journals,
- Refinement of socio-economic and ethnoecological data for inclusion in "shared vision modeling", especially migration and perception data,
- Completion of graduate student field reports on deforestation processes, migration, and water issues (Cotacachi),
- Literature review on climate change and land use in the Andes,
- Interdisciplinary linkage with the social capital, landuse, and aquatic resources team to design the integrated assessment model based on Phase I data

Methods

- Questionnaire on migration and perception of environment administered at several locations in Guayllabamba watershed,
- Oral histories, thematic apperception tests, and community workshops on deforestation and landuse,
- Archival research on climate change and land-use,
- Ecological analysis to determine analogous watershed solutions in the Andes for extrapolation,

- Interdisciplinary development of "integrated assessment" model for Natural Resource Management

Outputs

1 Ethnoecological Migration Study Accomplished through analysis of 750 questionnaires, write up of several articles for possible publication submission, and further refinement of the migration work A thesis was written on Cotacachi (see publications/MA Thesis of Gabriela Flora) In May 1999, a graduate student, Mr Eric Jones, returned to the field and has followed up migrants from their areas of origin and fates in the study areas

2 Publications of "comparative ethnoecology" and several articles The monograph is scheduled to appear in the fall, 1999 Articles are listed in the attached publication list
3 Refinement of socioeconomic and ethnoecological data A series of workshops were held on the "shared visioning modeling approach" of SANREM-Andes (in conjunction with CIAT) As a result a methodology has been developed of creating stakeholder scenarios of the future (different groups) which, in turn, are to be compared to future scenarios (projected versus desired future conditions) These, in turn, are to be used as a learning platform for community sustainability goals The socioeconomic data of the ethnoecology project forms part of the "local cultural modeling process"

4 Completion of graduate student field reports One thesis (Flora on migration in Cotacachi) and two graduate student reports (Stockton on ethno-hydrology for Cotacachi and Diamond on perceptions of pasture succession in Nanegal) were completed and presented at professional meetings

5 Climate change activities A graduate seminar on climate change was conducted by R Rhoades for students working in the SANREM project Several papers were written and presented at national meetings Dr Rhoades organized a special session on climate change at the Annual Meeting of the American Anthropological Association in which several papers on climate change in Latin America were presented

6 Interdisciplinary Linkage and data integration The "shared vision modeling" framework mentioned above which was developed during the year serves as the format for data integration

7 Master's thesis completed In the Cotacachi migration study a questionnaire, modified from a questionnaire previously administered in Nanegal was given to 276 informants from 17 of the 43 UNORCAC (*Unión de Organizaciones Campesinas Indigenas de Cotacachi)* communities in Cotacachi This sample represents approximately 20% of the entire population of the selected communities, and is the basis of the Master's thesis submitted by Gabriela Flora Contrary to expectation, "circular migration" (which involves extended stay at distant work sites) tends to strengthen the inhabitants' attachment to the home community and at the same time reduces the impact on local resources

Summary of Results

A Sample Data

A sample of the data collected during Year 1 research is listed here Table 3 is a breakdown by community of the number of people surveyed for the Phase I Impacts Report, Table 4 reports the primary means of support for families, and Table 5 reports the agricultural practices which changed as a consequence of SANREM education The majority of agricultural changes fall into two clearly defined groups adoption of crops combining beans and cane stubble and short cycle crops in general, given the local climate and economic situation these were the best options open for residents The bean and cane stubble option was particularly welcomed by residents as it was novel and allowed for the maximum use of available space in the cane fields

Table 6 is taken from the Master's thesis prepared by Gabriela Flora One-half of the respondents indicated that agriculture or some aspect of the natural environment was the single most important factor that would influence their decision to live in the area The clear implication is that preservation of the natural environment would be a high-priority concern for the inhabitants of Cotacachi

Table 3 Breakdown of persons surveyed for the Phase I Impacts Study

Community	Total Population	Number of Families	Number Surveyed	Percentage of Sample
Chacapata	313	56	20	35 7
La Perla	376	80	31	38 7
Palmitopamba	449	96	32	33 3
Playa Rica	278	48	20	41 6

Table 4 Sample data reported in Impacts Study

I Principal activity related to sustenance of the family unit		
Source of income	**Frequency**	**Percentage**
Agriculture	31	30 1
Agriculture Laborer	17	17 5
Sugar Cane Growing	12	11 7
Business	10	9 7
Cane Processing	8	7 8
Employee	8	7 8
Short Cycle Crops	6	5 8
Livestock	3	2 9
Timber	3	2 9
Animal Production	2	1 9
Laundry Woman	1	1 0
Other	2	2 0

Table 5 Example of an impact of SANREM activities at the farm level

Cropping systems implemented as a result of technical assistance received		
Cropping system	**III Frequency**	**Percentage**
Beans in cane stubble	11	33 3
Short cycle crops	13	39 4
Organic fertilizers and pesticides	3	9 1
Improved seeds	2	6 1
Reforestation	2	6 1
Pastures	1	3 0
Citric trees	1	3 0

Table 6 Sample table from Flora (1998)

I Positive characteristics of area named by Interviewees			
Characteristic	**Males (%)**	**Females (%)**	**Total (%)**
Infrastructure	32 8	34 3	33 5
Agriculture	31 1	20 2	26 2
Natural Environment	21 0	29 3	24 8
Relations with People	21 8	17 2	19 7
Tranquility	17 6	15 2	16 5
Organization	16 8	9 1	13 3
Other	6 7	13 1	9 6
Nothing	3 4	6 1	4 6
Total	N=119	N=99	N=218

B Publications

Flora, Gabriela 1998 *Circular Migration and Community Attachment in the Highland Indigenous Communities of Cotacachi, Ecuador* Master's Thesis University of Georgia Athens, GA

Nazarea, Virginia D , R Rhoades, M Piniero, L Burton, L Borgcayao, G Flora, R Del Rosario, and E Bontoyan 1998 Culturally Significant Plants and Culturally Relevant Indicators Windows to Local Perceptions of Environment and Development in Economic Growth and Natural Resource Development Are They Compatible? Malaybalay, Bukidnon SANREM CRSP

Nazarea, Virginia 1998 *Cultural Memory and Biodiversity* University of Arizona Press, Tucson

Nazarea, Virginia D (ed) 1999 *Ethnoecology Situated Knowledge/Located Lives* University of Arizona Press, Tucson

Nazarea, Virginia D 1999 A View from a Point Ethnoecology as Situated Knowledge *In* V Nazarea (ed) *Ethnoecology Situated Knowledge/Located Lives* University of Arizona Press, Tucson

Nazarea, Virginia D 1999 Lenses and Latitudes in Landscapes and Lifescapes *In* V Nazarea (ed) *Ethnoecology Situated Knowledge/Located Lives* University of Arizona Press, Tucson

Nazarea, Virginia, R Rhoades, E Bontoya, and G Flora 1998 Defining Indicators Which Make Sense to Local People Intra-Cultural Variation in Perceptions of Natural Resources *Human Organization* 57(2) 159-170

Rhoades, Robert E and V Nazarea 1998 Local Management of Biodiversity in Traditional Agroecosystems A Neglected Resource *In* Wanda Collins and Calvin Qualset (eds) *Importance of Biodiversity in Agroecosystems* Lewis Publishers, New York pp 215-236

Rhoades, Robert E (nd) Un Planteamiento de Ecologia de Paigaje par la Sustentabilidad en last tierras altas Tropicales La Experiencia de SANREM-CRSP en Ecuador *In* Special Journal for III International Conference of Sustainable Mountain Development in the Andes Centro Panamericano de Estudios E Investigaciones Geographicas (CEPEIGE) pp 22-32

Rhoades, Robert E 1999 Participatory Watershed Research and Management Where the Shadow Falls *Gatekeeper Series* No SA81 London ILED

Rhoades, Robert E and Jack Harlan 1999 The future of Ethnoecology *In* V Nazarea (ed) *Ethnoecology Situated Knowledge / Located Lives* University of Arizona Press

Rhoades, Robert E , Bill Hargrove, Dennis Garrity, and Constance Neely (in press) A Landscape/Lifescape Approach to Sustainability in the Tropics The Experience of the SANREM CRSP at three sites *Journal of Soil and Water Conservation*

Rhoades, Robert E , V Nazarea, E Bontoya, and G Flora (1999) Defining Culturally Relevant Indicators of Sustainability What are we waiting for? *Human Organization* 58(2) 219-220

Stockton, Swis "The Political Ecology of Small-scale Potable Water System Development in Highland Ecuador" (unpublished manuscript)

C Presentations, Conferences, and Workshops

Bret Diamond "People, Pastures, and Policy Balancing Conservation and Sustainability in Northwest Ecuador" Paper presented at the meeting of the Society for Applied Anthropology, Apr 20-24 Tucson, AZ

Rhoades, Robert E 1998 Sustainable Agriculture and Natural Resource Management in the Andes Plenary Keynote Address, III International Symposium on Sustainable Mountain Development Quito, Ecuador, December 14, 1998

Robert Rhoades Conference Organizer, International Conference "Operationalizing Integrated Conservation and Development Strategies Lessons Learned Linking People, Projects, and Policies in Tropical America " Quito, Ecuador (with SUBIR and USAID-Ecuador) May 12, 13, & 14, 1999

Robert Rhoades Conference organizer III International Symposium on Sustainable Mountain Development Quito Ecuador December 12-14 1998

Robert Rhoades Session Chair, Workshop on Sustainable Agriculture and Natural Resource Management, III International Symposium on Sustainable Mountain Development Quito, Ecuador December 12-14, 1998

Impacts Discussion

Due to the significant number of publications from the project, the SANREM-Andes project is well known in development circles One paper on lessons learned in participatory watershed research and management has been distributed to 7000 individuals in developing countries The paper on "culturally relevant indicators of sustainability" has stirred a global debate on the importance of culture in sustainability research Dr Virginia Nazarea conducted an ethnoecology class in Georgia in conjunction with scientists at the ARS Southern Piedmont Soil Conservation Center (Watkinsville, GA) by looking at the more culturally salient aspects of landuse change in Oconee County, Ga This same methodology is being applied in Ecuador

Plans for Subsequent Reporting Period

During the period May-December, there will be a full team in the field in Ecuador working on a comparative study of seven types of images of the landscape as well as in-depth "memory banking" research Publications have been prepared in Spanish to facilitate local community interaction

Partners and Collaboration

Andean Collaborators and Institutions

UNORCAC (Community Leaders of 44 Communities of Cotacachi Canton, Ecuador)
Community Leaders and Members, 4 communities of Nanegal Parroquia (Quito Canton), Ecuador
Rocio Alarcon, Ecociencia
Universidad San Francisco de Quito
Nanegal citizens water quality monitoring organization
Fundacion Maquipucuna
Community Leaders and Members, Cotacachi, Ecuador
Ana Maria Ponce, CONDESAN, Centro Internacional de la Papa, Lima, Peru
Fernando Larrea, Heifer Project International, Quito, Ecuador
Sara Baez and Marta Ordoñez, Terra Nueva, Quito, Ecuador
Jatun Sacha
Fernando Guerrero and Ana María Larrea, Instituto de Estudios Ecuatorianos
Ron Knapp, Centro Internacional de Agricultura Tropical (CIAT)
Ing Segundo Arrango, Excecutive Director, Proyecto de Dessarrollo de Los Pueblos Indigenas y Negros de Ecuador (Prodepine)
Juan Hidalgo Alguilera, Centro Panamericano de Estudios E Investigaciones Geograficas, Quito, Ecuador

U S Collaborators and Institutions

Tom Carroll, George Washington University
Tony Bebbington, University of Colorado
Robert Rhoades and Virginia Nazarria, University of Georgia
Bryan Duncan and Bill Deutsch, Auburn University
Jeff Alwang, Virginia Polytechnic Institute and State University
Ron Carroll, University of Georgia
Constance Neely, University of Georgia

Shree Nath, University of Georgia

Problems encountered and steps taken to resolve them

With the $200,000 budget for year 1, research focus was shifted to community-based learning tools for negotiating sustainability issues A great deal of leveraging has been carried out with FAO, CIAT, Kings College of London, Catholic University in Ecuador, ICIMOD, and the Global Mountain Initiative

Integrated Institutional Management

Lead Institution - Iowa State

Introduction

Social capital is intimately tied to the community resources utilized in policy decision support systems at the local level, and the capacity of local organizations to make and carry out decisions The development of reliable measures of such community resources is a central aspect of this research activity Field efforts were curtailed because the budget was not approved until the last 3 months of the fiscal year Still, important progress was made in gathering baseline data and writing up results from Cotacachi, the new site for Phase II of the Andean portion of SANREM In addition, Phase I work produced a number of paper presentations and publications during the first year of Phase II

Objectives

Three objectives were set for this year

- Assess impacts, synthesize knowledge gained, and reflect on the relation of project structure to outcomes for the Ecuador site in Phase I,
- Determine the key relationships between social capital, organizational capacity and other community resources (particularly environmental capital) in a new site, and
- Develop, refine, and scale up decision-support tools as a means of generalizing what is learned from research in a particular site

Methods

In-depth interviews with individuals chosen on the basis of present or past involvement in local organizations is our primary data-gathering tool In collaboration with Drs Thomas Carroll and Anthony Bebbington, and with joint funding from SANREM and the Danish government, Mary García Bravo completed data gathering for a study of social capital and organizational capacity within UNORCAC (the United Peasant Organizations of Cotacachi), an indigenous secondary-level organization in the northern Ecuadorian highlands In addition to in-depth interviews with current and past leaders of UNORCAC, 25 interviews were carried out with leaders in five communities that are affiliated with UNORCAC, in order to assess the nature of their ties with the secondary level organization Mary García completed a monograph on the history and organizational structure and activities of the organization, titled "UNORCAC Organizational and Grassroots Processes" (see Papers Prepared/Presented below) The monograph provides information about the organization that is useful to the entire SANREM-Andes team It is planned to have a draft of a paper containing the results of the quantitative and qualitative data gathered about UNORCAC by the end of August 1999

The Ecuadorian team carried out a rapid appraisal of the Cantón of Cotacachi, based primarily on written assessments carried out by NGOs that had worked or are currently working in the area Knowledge of the area resulting from development work carried out by the institutions with which the various members of the team are affiliated was also an important input into the monograph, which is being published by Abya-Yala Press (See Báez, et al , 1999, under Publications) The next step is to write a research note on using

existing assessments as a substitute for, or complement to, rapid reconnaissance methodologies

During the past year, SANREM personnel participated in three important conferences that focused on a Latin American, Andean, and Ecuadorian audience, respectively In all three cases, results from Phase I were presented The first, held in Lima, was the III Latin American Farming Systems conference The second was the III International Conference on Andean Sustainable Development, held in December 1998 in Quito It was designed to lead into the Year of the Mountain in 2002 The second conference was jointly sponsored by USAID-Ecuador, SUBIR/CARE, and SANREM, also in Quito The topic was integrated strategies for conservation and development The meeting was well attended by Ecuadorians, and gave the sponsoring organizations considerable exposure within the Ecuadorian development, environmental, and academic communities SANREM personnel gave three of the six plenary presentations Phase I results were also presented at professional meetings in the U S

Outputs

Cotacachi has much in common with other highland cantones of Ecuador, but it is not typical in all respects There was no thoroughgoing land reform in Cotacachi Thus, indigenous people have even less land per family than occurs in some indigenous areas of the more thoroughly studied central highlands The majority of the population of the cantón is mestizo, although indigenous people make up a very substantial minority of the population and predominate in the villages of the highlands It is one of a handful of municipalities that in 1996 elected an indigenous mayor That was in part a result of the organizational power of the indigenous secondary-level organization, UNORCAC, and of the national indigenous federations (UNORCAC is affiliated with one, the mayor with another, which causes frictions between the two) and because the mayor appealed to both indigenous and mestizo populations in his campaign UNORCAC, throughout its 20-year history has emphasized culture and identity in building a strong organization [3] Rather than becoming a development organization, it has emphasized interest-group politics as a way of obtaining better services and infrastructure Now, with an indigenous mayor and with governmental decentralization (although few financial resources have so far come with the theoretical right of greater autonomy at the local level), UNORCAC is finding that interest group politics is less effective—partly because of the resources of the state are shrinking, and partly it has to share its role as champion of indigenous members of the cantón with the mayor Preliminary results from the research on organizational capacity suggest that the organization depends too heavily on outside funds (some 19 persons receive partial or complete salaries from grants) and needs to seek ways to generate its own resources The development of a strategic plan along with income generating capacity, would allow the organization to weigh more objectively the advantages or disadvantages of seeking a particular externally funded project

[3] G Flora s study of circular migration in Cotacachi (Masters thesis supported by SANREM through University of Georgia) shows a strong desire on the part of the indigenous population to remain in the area and although many spend most of the year working elsewhere they identify their village as their true home

In brief terms, this is the context, based on SANREM research, in which local decisions about natural resource management are and will be taken One important problem is lack of sufficient water for drinking, let alone irrigation The large landowners control much of the surface water that comes from snow-capped Cotacachi mountain UNORCAC has fostered the growth of a number of potable water systems, but still over half of the villages are without potable water This issue is one that involves state, civil society, and the private for-profit sector An emerging issue is the flower industry, which is growing in the area, but raises questions of pollution, and worker safety In the semi-tropical part of the cantón, a Mitsubishi-owned firm sought to engage in gold mining, but the local residents and the new mayor opposed it because of the potential for mercury pollution, among other contaminants The mayor made a trip to Japan, invited by Japanese environmental groups, and the project was put on hold (The Asian depression may have also been a factor) Finally, the issue of reforestation also holds promise for study UNORCAC, along with the regional electric company and the Food and Agriculture Organization of the UN, is conducting a reforestation project in 14 communities of Cotacachi, but many peasants do not see how reforestation benefits them Following policy and decision-making from the local to the national and international levels, with emphasis on the linkage (or lack thereof) between levels, should be very instructive

Summary of Results

A Studies completed

- Completed an analysis of the past diagnostics in Cotacachi, which will be published in July in Quito
- Completed an analysis of UNORCAC, the secondary indigenous organization in Cotacachi That analysis is being shared with UNORCAC as they decentralize their organization
- Completed surveys of UNORCAC members in four different communities in Cotacachi to determine impact and social capital of the organization

B Publications

Báez, Sara, Fernando Guerrero, Mary García, Ana Maria Larrea, and Fernando Larrea Capitales Comunitarios y Propuestas de Desarrollo Local Ediciones Abya-Yala, Quito, Ecuador, forthcoming, 1999

Flora, Jan L (With Mary Garcia Bravo, Cornelia Butler Flora, and Segundo Andrango Bonilla) "Community Sustainability in an Ecuadorian Buffer Zone Environmental and other Forms of Capital " In Robert Rhoades, ed Bridging Landscapes and Lifescapes Participatory Research and Sustainability in an Andean Region, Longman, forthcoming, 1999 (Will also be published in Spanish by Ediciones Abya-Yala, Quito, Ecuador)

Larrea, Fernando, Cornelia Butler Flora, Martha Ordóñez, Sandra Chancay, Sara Báez, and Fernando Guerrero "A Typology of Family Production Strategies for Sustainable Agriculture and Natural Resource Management" In Robert Rhoades, ed Bridging Landscapes and Lifescapes Participatory Research and Sustainability in an Andean Region, Longman, forthcoming, 1999

C Papers Prepared/Presented

Flora, Cornelia Butler, "Creación de incentivos sociales para la conservación de la biodiversidad" ("Creating social incentives for biodiversity conservation") Plenary presentation at International Conference on Operacionalización de Estrategias Integradas para la Conservación y el Desarrollo (Operationalization of Integrated Strategies for Conservation and Development), Quito, Ecuador, May 12, 1999

Flora, Jan L "Creando capacidad local y nacional para proyectos integrados de conservación y desarrollo" ("Creating local and national capacity for integrated conservation and development projects") Plenary presentation at International Conference on Operacionalización de Estrategias Integradas para la Conservación y el Desarrollo (Operationalization of Integrated Strategies for Conservation and Development), Quito, Ecuador, May 12, 1999

Flora, Jan L , Mary García Bravo, Cornelia Butler Flora, and Segundo Andrango "Capital social comunitario y manejo de capital natural en una zona de amortiguamiento cuatro comunidades de Nanegal," (Community social capital and natural capital management in a buffer zone four communities in Nanegal parish) Presented at International Conference on Operacionalizacion de Estrategias Integradas para la Conservación y el Desarrollo, Quito, Ecuador, May 12-14, 1999

Flora, Jan L , Mary Garcia Bravo, Cornelia Butler Flora, and Segundo Andrango B "Capital Social, Acción Colectiva, y Capital Medioambiental Cuatro Comunidades en la Micro-Region de Nanegal" ("Social Capital, Collective Action, and Environmental Capital Four Communities in a Frontier Region of Ecuador") III International Conference on Andean Sustainable Development, Quito, Ecuador, Dec 9-14 1998

Flora, Jan L , Mary Garcia Bravo and Cornelia Butler Flora "Social Capital and Social Infrastructure in Four Communities in a Frontier Region of Ecuador," Rural Sociological Society, Portland, OR, August 8, 1998

García Bravo, Mary, "La UNORCAC Proceso Organizativo y Gestión," ("The United Peasant Organizations of Cotacachi Organizational and Grassroots Processes"), Quito Ecuador, January 1999

Larrea, Fernando, Cornelia Butler Flora, Martha Ordóñez, Sandra Chancay, Sara Báez, and Fernando Guerrero "Una tipologia de las estragegias productivas familiares y su relación con la conservación de la biodiversidad" (A typology of family production strategies and their relation to biodiversity conservation," presentation at International Conference on Operacionalización de Estrategias Integradas para la Conservación y el Desarrollo (Operationalization of Integrated Strategies for Conservation and Development), Quito, Ecuador, May 12, 1999

Larrea, Fernando, Cornelia Butler Flora, Martha Ordóñez, Sandra Chancay, Sara Báez, and Fernando Guerrero "Una tipología de las estrategias productivas familiares para la agricultura sustentable y el manejo de recursos naturales" Tercer Simposio Latino Americano sobre Investigación y Extension en Sistemas Agropecuarios Superación de la Pobreza Rural para el Desarrollo de las Capacidades Locales Lima, Peru, August 19, 1998

Impacts Discussion

A Who has the project impacted and how?

The institutional project thus far has had an impact on UNORCAC as they are undergoing a reorganization to decentralize the organization The results of the institutional analysis, survey with community members, and the meta-analysis of the previous diagnostics of Cotacachi is being fed into their development plan

The meta-analysis has been presented to the alcalde of Cotacachi for the canton to use its planning Given the fiscal crisis in Ecuador, the recommendations from the meta-analysis, with their focus on local resources that can be recombined in more effective ways, is proving very timely

B How has the project contributed to SANREM's programmatic goals?

In our analysis of the linkage between goals of economic and environmental sustainability on the part of grass-roots organizations, we are identifying major disconnects Understanding the lack of overt attention to environmental issues will help with the SANREM goals of supporting sustainable policy decisions

Plans for Subsequent Reporting Period

In a visit the Floras made to Ecuador in May 1999, over a several day period the collaborating individuals and institutions worked out what we hope is a realistic, but demanding, plan of work with clear timelines for at least the next two years The centerpiece of the proposed work is being carried out in collaboration with the Management Entity as an assessment of natural resource management policy and decision-making priorities, beginning at the local level (specifically Cotacachi, Ecuador) and working up to the provincial, national, Andean, and global levels A literature review and assessment will take place within this fiscal year

The Floras will travel to Peru and Ecuador in August In Peru, they will further design the e-mail conference in collaboration with CONDESAN and determine ways to expand the methodology The Ecuadorian-based team will identify local decision-making priorities and perfect the local issue-identification methodology during the next six months

Partners and Collaboration

Our Ecuadorian partners are Heifer Project, International, Terra Nueva, and Instituto de Estudios Ecuatorianos Our Peruvian partners are CONDESAN (*Consortium for the Sustainable Development of the Andean Ecoregion*) and CIP (*Centro Internacional de la Papa*) The Institutions team is developing its methodology in collaboration with the ME We have worked with the Universidad Catolica's GIS group to provide them with the appropriate data sources to work with the modeling project

Ecological Consequences of Land-Use Changes in the Andes

Lead Institution - University of Georgia

Introduction

Every land use decision carries secondary biophysical consequences Some decisions, such as switching among similar crop types (e g , banana to plantain), have minor biophysical consequences Others, such as converting forests to pasture or perennial polycultures to chemically intensive annual monocultures, have major biophysical consequences These consequences include effects on biodiversity, soil erosion, soil fertility, and sediment loading in streams and rivers, and land-atmosphere heat transfer, among others We are using information gathered during SANREM's phase one and collecting new information in order to broadly understand the socioeconomic drivers of land use decisions but primarily to model important aspects of biophysical consequences of land use change over the past decade The primary effort embraces the following historical changes pasture-forest, forest patch spatial patterns, slump erosion (small to large landslides), polyculture-monoculture, field size, and crop mixes

Objectives

- Examination of the links between specific land uses and their biophysical consequences

- Through the use of computer models, and, to a lesser extent multi-objective decision making, to model the relationship between the socioeconomic drivers of land use change with the biophysical consequences of such change

- The development of land-use change models that emphasize biophysical consequences and designed to have general utility to decisions-makers

Methods

The research activities described here follow two main thrusts 1) work carried out as part of a Ph D dissertation (Rebeca Justicia, Ecuadorian), and 2) assessment of the response of aquatic biodiversity to land use change

Outputs

Doctoral Research activities

- Revision of existing nutrient cycling models and their adaptability to the region The models reviewed include Van Veen and Frissel's model, Phoenix, NCSoil, Papran, EPIC and CENTURY All the existing models have been developed to simulate temperate conditions, including CENTURY However, CENTURY has been found to adequately simulate long term soil organic dynamics under tropical conditions
- Review literature and partial parameterization of CENTURY with local data
- Acquisition and digitization of soil maps in 1 50,000 scale for the Nanegal region
- Review, correction and standardization of existing geographic digital information for the Nanegal Area including vegetation cover for 1969 & 1990, contour lines, roads, rivers, towns and geomorphology

- Partial creation of a digital elevation model of the region
- Review literature to carry out the analysis of stakeholder's land-use management objectives & characterization
- Review literature about ecosystem spatial modeling environments Acquisition of ALES (Automated Land Evaluation)

Aquatic Biodiversity activities

Several groups of macroinvertebrates are sensitive to changes in water temperature, dissolved oxygen, suspended sediments, and other physical parameters Land use affects these parameters, and therefore affects macroinvertebrate communities Consequently, aquatic insects can serve as biological indicators for monitoring projects that may impact rivers The community composition of aquatic insects in the Nanegal region of northwestern Ecuador was examined The aquatic insect communities in streams draining landscapes affected by pastures and farming were compared with communities in reference streams draining completely forested landscapes of the Maquipucuna Reserve Preliminary analysis shows much higher abundance of Diptera and Odonata larvae in streams draining pastures and much higher abundance of Trichoptera in streams draining forests Among the Diptera are blood-sucking species and vectors of diseases This work was reported at the recent meeting of the North American Benthylogical Society

Summary of Results
We anticipate the aquatic biodiversity project resulting in a thesis which should be available this fall The land use study is still work in progress

Impacts Discussion
A Who has the project impacted and how?
The results of the biodiversity project will be used in local environmental education programs in schools in northwestern Ecuador This effort is being facilitated by the Fundacion Maquipucuna

B How has the project contributed to SANREM's programmatic goals?
A major SANREM goal is to understand the effects of land use change on biodiversity The ongoing study on land use change in the Nanegal region will contribute to our understanding of how farmers' land use decisions affect two major components of biodiversity forest fragmentation and soil productivity More specifically, we examined how conversion of forest to agricultural land has affected the biodiversity of streams

Plans for Subsequent Reporting Period
It is expected that farmers will be sensitive to relative short term alterations of soil organic matter and nutrient cycling – major consequences of land use change – because of their dependence on soil productivity However, in this area of relatively young colonization, neither locals nor scientists understand well the long term behavior of the nutrient cycling system The optimization model that Ms Justicia is designing will address this issue and place an aspect of nutrient cycling, long term nutrient balance will be examined as a maximized-parameter in the optimization for sustainability The other

aspect she will pursue is an evaluation of what are best, average and bad soils for each of five land uses from the farmer perspective, and from measurements of soil parameters such as soil type, pH, temperature, compaction, moisture, bulk density, nutrients and soil organic matter content, and landscape parameters such as slope and availability of water sources

Partners and Collaboration

Our Ecuadorian collaborating institution is the Fundacion Maquipucuna, which holds the primary responsibility for the management of the Cotacachi-Cayapas Reserve

Water Resources Management and Environmental Education in Two Andean Watersheds

Prepared by Sergio S Ruiz-Córdova, William Deutsch, and Bryan Duncan, Auburn University

Introduction

All activities of the SANREM CRSP at Auburn University (AU) are coordinated through the International Center for Aquaculture and Aquatic Environments (ICAAE), in collaboration with the Department of Fisheries and Allied Aquacultures (FAA) The Principal Investigators from Auburn are Dr Bryan Duncan (Director of the ICAAE and FAA Professor) and Dr William Deutsch (Environmental and Training Specialist, ICAAE and Sr Research Fellow, FAA) Biologist Sergio S Ruiz-Córdova joined as Bilingual Training Specialist of the Water Resource Management and Environmental Education work plan for Ecuador Mr Billy W Earle (Administrative Assistant, ICAAE) handles the financial accounting of the Auburn University work plan Auburn University has been an active consortium member since the inception of the SANREM program, and has participated in writing the Global Plan, Board of Directors and Global Technical Committee memberships and training/facilitation at orientation sessions and workshops Our primary technical contribution to the SANREM consortium has been in the area of aquatic resource management and environmental education, that started in the Philippines and now has been extended to Ecuador

Objectives

Three objectives were selected for this year

- Increase the capacity of local citizens to monitor and assess selected water quality parameters which are indicators of environmental health
- Increase the capacity of local government units, community groups and the general public to formulate water resource management plans and policies to protect and restore their environment
- Integrate the lessons learned from the Ecuador experience with those of the Philippines and U S to illustrate globally applicable principals of community-based water resource management

Methods

Six person-trips to Ecuador were completed by Auburn University personnel between June 1st 1998 and May 31st 1999 towards accomplishing the objectives for that period

Bryan L Duncan, William G Deutsch and Sergio S Ruiz-Córdova spent seven days in Ecuador from September 9 to 15, 1998 participating in activities in three locations the Nanegal area, Cantón Cotacachi and city of Quito In the Nanegal area Auburn University personnel met leaders from the communities of Playa Rica, Chacapata, Palmitopamba and La Perla, made presentations and discussed water issues AU

personnel also did field visits to the drinking water systems of these communities and conducted physical, chemical and bacteriological testing In the Cotacachi area UNORCAC leaders were met, presentations made, and data obtained on a previous visit discussed Sites along the drinking water system of the community of Turucu were visited Discussions were held with the Mayor of the City of Cotacachi Economist Auki Tituaña Males

In Quito AU personnel visited the University of San Francisco de Quito (USFQ) and met the Dean of the School of Environmental Sciences Dr Hugo Valdebenito Bill Deutsch made a slide presentation "SANREM Community based Water Quality Monitoring in the Philippines " Faculty members Carlos Valle, Maria de Lourdes Torres, David Romo and Kelly Swing (AU graduate) were met A lunch meeting was held with the Chancellor of the University Dr Santiago Gangotena González (AU graduate) Met ECOCIENCIA leaders and researchers Rocio Alarcon and Carlos Carrera, and their facilities were toured

Sergio S Ruiz-Córdova spent eleven days in Ecuador from November 29 to December 9, 1998, participating in the following activities In the Nanegal Parish he conducted a two day water resource management workshop with members of the five communities participating with the SANREM program Playa Rica, Chacapata, Palmitopamba, La Perla and Nanegal Drinking water systems and other springs were visited at those communities Physical, chemical and bacteriological testing done by the local citizen monitors was supervised In Cotacachi he met UNORCAC leaders and presented and discussed data obtained on a previous visit He conducted a two day water resource management workshop for members of the UNORCAC communities He met with monitoring groups and evaluated their data as part of a quality control/quality assurance program, addressed their problems, answered questions, made suggestions and provided additional supplies or equipment as necessary Two UNORCAC members were instructed on the basics of computer data entry leading to the development of an initial database and on-site data management In Quito Mr Ruiz-Córdova participated in the III International Symposium, "Sustainable Mountain Development, Understanding Ecological Interfaces for Management of Andean Cultural Landscapes" He gave a slide presentation "Community Based Water Quality Monitoring Lessons from the Mountains in the Philippines and Ecuador "

Bill Deutsch and Sergio S Ruiz-Córdova spent ten days in Ecuador (April 12 -21, 1999), participating in the following activities/meetings In the Nanegal Parish met leaders of the communities of Palmitopamba and La Perla to discuss water quality monitoring activities and other issues Visited the Maquipucuna Natural Preserve leading to the possibility of testing sites inside the preserve to serve as undisturbed references Other SANREM activities are apparently involving personnel from Maquipucuna, therefore joining efforts to accomplish some activities could help integrate SANREM projects in different fields of work In Cotacachi AU personnel met UNORCAC leaders A two-day water resource management workshop for both chemical and bacteriological monitoring was conducted in Cotacachi with members of the UNORCAC communities Met CODELSPA (Defending San Pablo Lake

Committee) leaders (presided by Richard Sandoval) and learned about community projects towards the preservation and management of the San Pablo Lake in San Pablo, near Otavalo Talks focused on the possibility of expanding the water quality monitoring program to the area surrounding the lake CODELSPA has been working a number of years with the communities located around San Pablo Lake where they have acceptance by the people Over one hundred people were attending a workshop, concerning San Pablo Lake issues, which was held in San Pablo on the dates of our visit CODELSPA leaders understand the importance of the water quality of the lake for different purposes and they foresee the participation of citizens in monitoring water quality in different sites in the lake and the streams flowing into and out of it In Quito we visited the Pontifical Catholic University of Ecuador (PUCE), and met the Director of the Environmental Studies Department Dr Juan Hidalgo We also met Eng Patricio Solis, Professor of Remote Sensing and Natural Resources Management, and his student Aurelio Vicuña, to discuss possible collaboration with the water quality workplan They are more involved in projects concerning the use of geographic information systems and the landuse However, since water is a vital part of any ecosytem they saw a strong connection between their land use efforts and our aquatic resource management program The PUCE has also a strong biology program and students with interest in water resources will be available to participate with SANREM's Water Resource Management and Environmental Education work plan for Ecuador

Meetings in the Nanegal area in September 1998 brought together about 60 people (34 adults and 23 school children, including 28 women) Water issues were presented and discussed with emphasis on waterborne health problems and water scarcity Ten sites were tested for chemical and bacterial quality and Dr Hector Ballesteros delivered results of bacteriological tests to the communities within five days Five of the samples presented *E coli* and all but one had coliforms to some degree The only sample completely clean was the one taken from a house at Palmitopamba receiving water treated with chlorine Results from this sampling indicated several potentially unsafe situations that needed to be addressed Physico-chemical analysis showed measurements in the desired range

Meetings in Cotacachi in September 1998 brought together 22 UNORCAC community leaders including eight women, headed by their president Rafael Guitarra Following the training in water quality monitoring and bacteriological testing conducted there in March 1998 water quality monitoring activities started in September 1998 They sampled for six chemical parameters, at eleven sites on water distribution tanks serving 26 UNORCAC communities Data collected during September in Cotacachi were similar to those taken in March Julian Pillaluisa and Mario Landeta, from UNORCAC, took over the coordination of the water quality monitoring activities and showed excellent leadership Bacteriological testing from five sites along the water distribution system from Turucu yielded no *E coli* and few counts of other coliforms Results were far better than those from March when the *E coli* counts were far above safe levels

A workshop in the Nanegal area in December 1998 brought together 15 people (including five women) from the five communities Playa Rica (6), Chacapata (2), Palmitopamba (3), La Perla (2) and Nanegal (2) Nine sites were tested for physical-chemical quality and 17 sites for bacterial quality Hector Ballesteros delivered results of bacteriological tests to the communities within thirty days All but five of the samples presented *E coli* and other coliforms to some degree Samples from three sites were completely clean, two taken from the Nanegal system after being treated with chlorine, and the other one from Carlos Ayala's spring in Playa Rica Results from this sampling indicated several potentially unsafe situations that needed to be addressed Physico-chemical analysis showed measurements in the desired range

Meetings in Cotacachi in December 1998 brought together eleven UNORCAC community leaders (no women), headed by Rafael Guitarra Data collected during September - November in Cotacachi from ten communities were similar to those taken in March Bacteriological testing from four sites yielded no bacteria at all in two of them, no *E coli* but few counts of other coliforms in water from the Chumabí system, and counts of *E coli* and other coliforms above safe levels in the water from the Yanayacu stream Results from this stream showed a very unsafe situation considering that several families from the Chilcapamba community are using this water for human consumption since their water system is not operating

Bacteriological testing from sites along the water distribution systems from twelve communities indicated that 66% had no *E coli*, but counts of other coliforms were present in all but one of the samples *E coli* counts in samples from the community of Arrayanes averaged 1,500 colonies in 100/mL of water sample that is almost three times above safe levels for whole body contact

Outputs

Chemical and bacteriological testing have been conducted mainly from drinking water at community houses and distribution tanks This focus happened because that is the priority concern of the Ecuadorians in both areas of SANREM activity in the Andes A total of 89 water quality samples have been reported (most for 1998), for chemical including six parameters and 146 for bacteria In the Nanegal area 18 sites have been tested for chemical and 27 sites for bacteriological water quality Sites in this area are located within the five communities Nanegal, Palmitopamba, La Perla, Chacapata and Playa Rica In the Canton Cotacachi 16 sites scattered among 14 communities were tested for water quality and bacteria during June 1998 - May 1999 Contamination by coliforms bacteria (including *E coli*) was identified at 18 sites in Nanegal as well as at five sites in Cotacachi Water chemistry and bacteria was tested at one small stream in Chacapata as part of the ongoing monitoring program

Our partners from UNORCAC in Cotacachi, Eng Mario Landeta and Mr Julian Pillaluisa, submitted summary tables of all water quality samples they have analyzed, and since the beginning of the program in that area seems that they have improved their leadership skills to the point that UNORCAC is giving them other responsibilities

Summary of Results

Significant Findings

Results from the bacteriological surveys conducted from June 1998 to May 1999 are attached to this report It identified potential problems with drinking water at all communities from the Nanegal area as well as at the communities in Canton Cotacachi Coliforms bacteria were found in drinking water sampled at all but four communities in Cotacachi (community drinking water system tanks) *E coli* bacteria were found in water of all five communities in the Nanegal area as well as at five communities in Canton Cotacachi This may be related to the condition of the spring source (water from 13 spring sources were tested) in addition to the condition of the pipes which convey the water to the community houses and the containers used for water storage Four samples from the Nanegal area and five from Canton Cotacachi were completely clean These samples came from water previously treated with chlorine (distribution tanks or houses) except one originating from a small spring in Playa Rica Results from every survey was presented to the community leaders in each location

The bacteriological surveys, conducted this year, revealed that the drinking water supply system of several communities have sections that are contaminated with coliforms bacteria in concentrations that are probably dangerous for human consumption People in both SANREM locations are aware of the possibility and potential of waterborne diseases but seeing simple tests like the bacteriological ones we are using prompts them to try to do something to solve the problems or to prevent them

Community members who attended our meetings and/or workshops have indicated that bacteriological and chemical testing of drinking water is the primary motivator to participate with these programs

Training Activities

Meetings in the Nanegal area on September 9th to 11th 1998 brought together about 60 people (34 adults and 23 school children, including 28 women) These meetings in this area were introductory and no training was involved directly although some testing was conducted as demonstration for chemical and bacteriological properties of drinking water Meetings in Cotacachi with UNORCAC leaders and water quality monitors on September 12th to 14th 1998 were focused on presentation and discussion of data obtained since previous trip, and taken by the monitors, lead by Eng Mario Landeta and Julián Pillaluisa Discussed with them some monitoring problems and techniques exchange one water quality testing kit and endowed a new one to the organization for a total of two Emilio Bonilla and Jorge Arutingo from the communities of Turucu and Santa Barbara lead us to visit the drinking water collecting tanks for their communities in order to test (for chemistry and bacteria) various sites from springs to houses

Training activities conducted during the second trip of this year to Ecuador involved the first water quality workshop in the Nanegal area on December 1st to 3rd 1998 to 15 participants, (including five women) from the five communities Playa Rica (6),

Chacapata (2), Palmitopamba (3), La Perla (2) y Nanegal (2) Field trips were accomplished to visit sites at all communities and supervised monitors in the field during the actual water testing On December 5th and 6th 1998 a water quality workshop was conducted for ten UNORCAC leaders and water quality monitors Mario Landeta was present and collaborated with the workshop supervising and guiding trainees during the "hands on" section of the workshop He also presented data collected by the monitors since September 1998 which was interpreted and discussed in order to get more understanding and familiarize with the goals of these activities
On April 99 during the third visit to Ecuador this phase, continuous daily heavy rains for two weeks of in the Nanegal area made travel and communication difficult and did not allow for the scheduled water quality monitoring workshop Nevertheless, on the last day in that area it was possible to travel to Palmitopamba and La Perla to meet with local leaders and water monitors Eulogio Morales presented data of the physical-chemical analysis taken by Palmitopamba monitors during Dec-98 and Jan-99 Data showed measurements in the range of desired levels Workshops in Cotacachi involved twenty UNORCAC leaders (especially Juntas de Agua Presidents and/or managers) from twelve communities Data from ten communities collected through March were entered into the computer database at UNORCAC, values measured were within the desired range
Mario Landeta and Julian Pillaluisa are still coordinating the water quality monitoring and are doing a great job They and two new people Alfredo Díaz y Alicia Guajan are now part of UNORCAC as promoters and have divided among them the communities to coordinate activities in about ten communities each

Impacts Discussion
The immediate impacts of this activity lie in three significant areas a) local participation and response, b) changes in knowledge, attitudes, skills, and abilities, c) changes in practice, and d) emerging concerns for future quality of resources

A People Involvement and Reaction
Because the good experience locals had of the previous years of SANREM in the Nanegal area, the involvement of people with the Water Resource Management and Environmental Education work plan for Ecuador seemed to be easy People that participated in other projects during Phase I in the area, are very happy to see SANREM coming back to their communities Positive impacts left by SANREM personnel during Phase I are helping when introducing new people and new ideas on water resources management to the communities In the Cotacachi area few members of the communities have continued to stay involved with the SANREM work plan since the first meeting concerning water issues in December 1997 Since then thirty new monitors became certified in workshops this year UNORCAC leaders have swapped positions and though some leaders have departed the organization is open and prompt to get involved and continue the water quality monitoring program

Meeting with the major of the City of Cotacachi Economist Auki Tituaña Males was very positive He was an UNORCAC member and supports most activities the organization proposes and having the leadership of the city offer his mediation to establish relationships with other governmental and non-governmental organizations working in the area in similar projects

Approximately 200 people from the Nanegal area, Canton Cotacachi and Quito have attended meetings and workshops this year Conversations and comments suggest that the work plan is generally well received by the communities and by scientists from the Andean region

The Department of Health representative in Palmitopamba expressed interest in the bacteriological tests but has not attended any of the training sessions Conversations with her indicated the possibility of cooperation to reduce waterborne disease problems Data from the surveys has not been presented or discussed with her

B Changes in Knowledge, Attitudes, Skills, and Abilities
Our water quality workshops and fieldwork are revealing strong interest by the community members, both in Nanegal and Cotacachi, in testing drinking water quality The bacteriological tests with higher amounts of colonies generally are associated with poor sanitation at the collecting tanks and springs, as well as in water storage containers in the houses There have been two documented cases of improvement in the infrastructure because the SANREM water quality monitoring activities in the Canton Cotacachi Bacteriological tests of water samples from the community of El Batan in March 1998 showed being highly contaminated with coliforms However, similar test conducted in April 1999 showed great improvement and just few coliforms present Community members and Junta de Agua operator commented the cleaning work and fencing done in the collecting tank after being shocked by the observation of the bacteria plates from their drinking water compared to bottled water and to drinking water from other communities Similar situation occurred in the community of Turucu Tests from March 1998 showed large amounts of *E coli* contamination but since then, the Junta de Agua operator and other community member worked on improving the conditions of the water collecting tank During the September 1998 trip we visit the facility while during reconstruction and the tests conducted then revealed great improvement with no *E coli* at all and very few other coliforms They had expressed their dislike for the use of chlorinating and had quit doing the procedure with the potential problem of acquiring waterborne diseases Turucu people were pleased to know about the quality of their water before and after the improvements in their drinking water collecting tank, and of the fact that they don't have to chlorinate their water in order to drink it with confidence

C Changes in Practice
Citizen teams have continuously monitored water quality across the landscape of Cotacachi for nine months in an ongoing attempt to detect general trends on a large scale The data has not yet revealed patterns or distinctions among micro watersheds that will offer the potential for the communities to proceed with management plans for conservation and restoration In the Nanegal area the water quality monitoring has just started hence data analysis has not began

An agricultural irrigation specialist from the Canton Cotacachi had notice about our workshops on chemical and bacteriological testing and expressed interest in working with us and implementing changes and repairs in the water supply system, based on our data

D Emerging concerns

The research of this year substantiated some degradation of streams and springs both in the Nanegal area as well as in the Canton Cotacachi landscape (especially as indicated bacterial counts) These findings should be communicated to the community in such a way that they can then discuss changes over time and whether or not they perceive their aquatic ecosystems are sustainable This could be a fruitful source of community indicators of sustainability

Partners and Collaboration

Most of our original partners continued to make significant contributions to the research USFQ participation in our work plan this year was minimal but expressed interest in continuing with the plan through the second phase A similar situation occurred with ECOCIENCIA whose researchers showed great interest in participate and or collaborate with our work plan They have an undergoing project in the Mira River watershed (north of Cotacachi and Nanegal) that includes chemical and biological assessments very similar to our chemical monitoring and to our bioassessment, proposed to start in the third year of work in Ecuador ECOCIENCIA has good GIS and macroinvertebrates laboratories that could be use and incorporated to the facilities available to SANREM in Ecuador

The Committee for the Defense of San Pablo Lake (CODELSPA) also made the invitation to participate and start a Lake Watch program with the communities located around the lake CODELSPA has good collaboration with other universities (including Trent in Canada and PUCE in Quito) but they lack water resources management specialists focused on community based projects CODELSPA had limnologists and biologists coming to work in the lake but merely "scientific research", without citizens participation However, more than one hundred people were present at a meeting called by CODELSPA from all the communities surrounding the lake, and their presence was a sign of willingness to collaborate and participate as well as to show their concern for the lake that has drop almost one meter during the last fifteen years

The people in Cotacachi that have volunteered for training and monitoring have remained active for the last months and have shown the level of interest and commitment that rural communities have in understanding and managing a natural resource

These types of relationships have the potential to outlive SANREM and make a water resource management program sustainable

Bacteriological survey results were presented and discussed with community representatives in the Nanegal area and with community members and UNORCAC leaders in Cotacachi There is an opportunity to strengthen partnerships with USFQ or PUCE to systematically monitor bacteria in drinking water, identify problem areas in water distribution systems (e g points of contamination in pipes, springs, storing containers, etc) and minimize waterborne diseases in the community

The SANREM/Ecuador Environmental Education work plan now has excellent partnerships in place with support at the local levels There are needs to clarify the plan with all the partners and facilitate the contribution of all work plans to formal and informal educational activities in Ecuador Likewise, the work plans need to coordinate with other SANREM activities taken place in Ecuador to maximize the use of resources and also to avoid confusion or a break in protocol

Problems encountered and steps taken to resolve them
Motivation of volunteer monitors is a constant challenge of our work plan As part of motivation and partnership building, monitoring groups from all the communities hopefully have seminars and meeting-workshops with PUCE staff (Aurelio Vicuña, Patricio Solis) and other locals (Hector Ballesteros) that will help them build their confidence and conciseness for monitoring and plan for the future

We need to continue training some of our work plan partners in data management, quality assurance protocols and computer graphing so that there is a faster turnaround of results for the community and continuous capacity building in-country We are perfecting email and ftp transfer of data from Ecuador to Auburn University and vice versa, and transmission so far is basically successful

There still needs to be more of a local assessment of the work plan and documentation of its progress and problems Presently, this is primarily left to the U S -based PI who relays personal observations while on site and data sent from the partners Our work plan should schedule a Monitoring and Evaluation session with all the interested partners, which should result in more self evaluation and process documentation by the local work plan partners and the communities

IV. Southeast Asia Project

Southeast Asia Project Summary

I. Introduction

The goal of the SANREM-Southeast Asia project is to assist in the creation and successful application of decision-support tools for natural resource management and planning (NRM) at both a community and a watershed scale By decision support tools we mean materials, including research findings and simulation models, that 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 These tools are essential to the achievement of the Agenda 21 target of sustainable development Some examples of NRM questions faced by local decision-makers are

- What are the economic and environmental causes and consequences of sedimentation in dams and waterways?
- What interventions will best help preserve acceptable water quality across a watershed?
- What are the socially acceptable rates of deforestation or soil erosion in a watershed, what will it cost to achieve them, and how will the costs and benefits be distributed?
- What are the local economic and environmental implications of price changes caused by national or international market trends or policy reforms?

The SANREM research strategy is built upon the cornerstones of participation, interdisciplinary collaboration, intersectoral (or multistakeholder) cooperation, and research at a landscape scale The project brings together experts from US and Southeast Asian universities, local and national government officials, regional and international agricultural research centers, and US and Southeast Asian NGO groups

SANREM has been active at its Philippine research site in Lantapan municipality, Bukidnon province, since 1993 However, the project's methodologies and findings are much more broadly applicable in the Philippines, elsewhere in Southeast Asia and beyond Among Southeast Asian countries, similarities are defined not merely by geography, but by common experiences that have helped shape trends in natural resource use and the logic of local NRM strategies These experiences include rapid economic growth, market development enhancing commercial opportunities for upland farmers, and rapid or impending decentralization and devolution of NRM responsibility and authority from central to local governments, NGOs and community groups The recessions experienced by many Asian economies in 1997-99 have generated another set of common policy challenges for regional NRM planners

Successful NRM in a specific locality depends critically on the commitment and

participation of its residents--the primary resource managers--and of community-level organizations, both formal (government and non-government groups) and informal With the support of key provincial and national agencies, SANREM's partners have devoted considerable effort to education, information exchange and forms of participatory research intended to promote environmental awareness and an appreciation of links between environmental and other phenomena in Lantapan Activities in this domain include community-based water quality monitoring, farmer-managed crop and technology trials, continuous feedback and consultation through community meetings and seminars, and project-level participation in the design of a municipal natural resource management and development plan (NRMDP) and municipal land use plan

NRM is also heavily influenced by conditions in a much broader economic and policy context Locally-based NRM strategies cannot be sustained if national markets and policies send contradictory signals An important component of our strategy is thus to engage in information exchange and capacity-building not merely locally, but also among national and even regional research and policy institutions At these levels our goal is to promote the design and adoption of development and environment policies that are consistent with the needs and aspirations of primary resource managers such as farmers and local planners, and of the communities in which they reside

Through Asian regional networks and the parent SANREM CRSP program we also engage in information exchange with other projects and policy makers addressing similar problems in countries beyond the Southeast Asia region and at the global level

II Project Objectives

- To develop methods, tools, and institutional capacity to support sustainable agriculture & natural resource management policy design, issue analysis, planning, and implementation at the landscape/lifescape scale
- To develop methods for assisting decisions made at global, regional and national levels on broader issues related to sustainable agriculture and natural resources
- To develop methods to facilitate exchange of natural resource management information and knowledge within and across multiple scales

III Progress

For detailed activity reports see section following this summary

Activity Set 1 Research

Major Achievements

- Construct prototype watershed model and present it for discussion in various forums, both in Lantapan/Malaybalay, Los Baños and at Southeast Asian regional meetings
- Inventory of provincial and municipal resolutions and ordinances relating to agriculture and environment, preliminary analysis of the compiled resolutions and ordinances
- Initial discussions at local and provincial level defining policy issues, data needs and feasible methodologies

- Continuing data gathering and analysis in economics, land use, water quality and soils
- Documentation, presentation and preparation for publication of results

Activity Set 2 local, national and regional network building and information exchange

Major Achievements
- SWOT analysis of NRMDP process in Lantapan, as first step towards replication
- Initial efforts to promote LGU-to-LGU sharing of information and experiences replication sites (Baungon and Manolo Fortich municipalities) selected
- Inauguration of regional information exchange and network building in Indochina
- Kapihan sa Malaybalay (provincial seminar) on watershed modeling techniques and applications
- Co-hosting of international methodology conference on "Environmental services and land use change bridging the gap between policy and research in Southeast Asia"
- Hosting international workshop on "Devolution and local management of natural resources"

Activity Set 3 capacity building and training

Major Achievements
- Formation of tripartite institutional relationship (SEARCA-IIRR-CMU) to design and implement training and capacity building strategies at local level
- Training needs analysis (TNA) conducted in six barangays in the municipalities of Lantapan and Valencia, all in the province of Bukidnon

Activity Set 4 Administration and management

Major Achievements
- Annual planning meeting to provide a venue for work plan holders to report Year 1 Activities
- Field visits, orientation of new partners, exploration of possibilities for future collaborations at local level
- Seminar at USAID-Washington
- Proposal for a presentation to Asia Pacific Association of Agricultural Research Institutions (regional ministerial meeting)
- Project web site established at http //aae wisc edu/coxhead/sanrem/tdd

IV How the Activities are Integrated

Continuing research at the Philippines site is necessary as a means of developing, testing and applying integrated economic and environmental analyses for the purpose of informing NRM strategies at all scales Our research and related activities in Lantapan are explicitly designed to serve our Southeast Asian regional objectives by providing the project with a laboratory for empirical research and the distillation of scientific and policy lessons This base provides the project with a firm empirical foundation for

methodological and policy innovations in Southeast Asian and global research and policy arenas Our plan of activities in Phase II expressed this with concrete proposals to create linkages and exchange information from the site across the region at three levels researcher-to-researcher, policymaker-to-policymaker, and LGU-to-LGU (local government units), through educational programs and cross-site visits coordinated by Southeast Asian research institutions and NGOs In Year 1 we made very significant progress towards the goal of regional integration, notably-- though not solely-- through our co-hosting of two international workshops in Chiang Mai, Thailand

Lessons from the Philippines have significant policy import for transitional economies in Indochina and even, in the current context of economic crisis and increased pressure on upland and forest resources, for more advanced economies such as Thailand Rapid advances in decentralization and the granting of increased autonomy to local governments throughout the region only underline the importance of a locally-based, participatory methodology such as that consistently espoused in the SANREM-SEA project Each of the workplans addresses a specific component of site-based research, "scaling" or training activities within the broader goal of a regionally integrated project

In Year 1 we made very significant progress towards the goals of methodology development at the local level and of regional integration, notably-- though not solely-- through our co-hosting of two international workshops in Chiang Mai, Thailand

V Progress Toward the Five Year Indicators

The project has met all its major objectives for Year 1, and in addition has successfully prepared and passed review of activity plans and workplans for Year 2

Individual Activity Reports

Decision Support Tools for Upland Resource Managers

Integrated Watershed Modeling for Decision Support and Policy Planning

Introduction

This workplan seeks to improve natural resources management (NRM) by providing a computer-based decision support tool targeted for use by local, provincial, and national policy makers in the Philippines The workplan makes extensive use of data collected during SANREM Philippines Phase I and seeks to integrate these data in a logical and scientifically consistent manner, using a watershed as a unit of analysis and aggregation The model is primarily oriented to answering questions regarding the potential impacts of changes in national, provincial, or local policies on household welfare and environmental outcomes A major goal of workplan activity is to develop a heuristic decision support tool that can be adapted for use in other areas of the Philippines and Southeast Asia

Objectives

The workplan has two specific objectives

- To develop a model that can be used to evaluate, measure, and forecast the potential impact of changes in relevant economic policy variables on erosion rates on representative farms and likely sedimentation damages at downstream receptor sites

- To assess the potential transferability of the model from Lantapan to other sites in the Philippines and elsewhere in Southeast Asia

Methods

In support of Objective A, a conceptual model of economy-environment linkages in the Lantapan watershed was developed Key economic variables, resource constraints, and erosion outcomes were identified A list of required data to implement the model was compiled and identified for use Statistical analysis is ongoing, and is being carried out to summarize data from Phase I activities in a form suitable for use in translating the conceptual model into a computer-based model

Based on the conceptual model, a simple prototype computer-based model has been constructed using STELLA™ The model links economic policy variables to land use decisions and water quality outcomes Where possible, relevant and available biophysical data from the Lantapan watershed has been used to parameterize the model Where this has not been possible, gaps have been filled using data from other sources

Simulations based on representative national-level policy changes have been conducted

In conjunction with other workplans, we are also in the process of identifying a set of potential policy instruments that are locally-based These will be incorporated into future versions of the model Refinement of the model and sensitivity analysis is ongoing

In support of Objective B, a list of relevant and necessary data for model construction is being developed

Outputs

- Model construction was initiated based on socioeconomic data collected during Phase I

- Shively met with researchers at Texas A&M to assess potential collaboration on replication efforts (12/98)

- A series of meetings were held in Los Baños with other Phase I workplan holders to discuss potential use of other Phase I data (2/99)

- A concept paper describing a prototype policy model was presented in the Philippines at PCARRD, DA-BAR, and the Kapihan sa Malaybalay A simplified version of a single-household policy model was also demonstrated in these settings (2/99)

- Discussions were initiated with GOLD, the Ford Foundation, and an NGO watershed coalition regarding potential collaborations focusing on locally based NRM policy making (2/99)

- Farms in Manupali were visited, geo-referenced and mapped Data were cross-referenced with soil and land use data to refine model definitions of representative zones and farms, and weights for impact aggregation (5/99)

- A more fully developed version of the February '99 model was described in both a paper and a poster presented at the ICRAF conference in Chiang Mai The model was also made available for demonstration and testing (6/99)

Impacts Discussion

Workplan activities have had an impact on decision makers at the local, provincial, and national levels (esp within the Department of Agriculture)

Impacts to date include an improved understanding of economy-environment linkages and the role of economic policies in encouraging more sustainable use of agricultural resources and reducing downstream damages associated with upland activities

Plans for Subsequent Reporting Period

- Further refine the computer model in terms of representative households, hydrological processes, and range of potential policy instruments incorporated in model The computer model will be disseminated among workplan investigators for discussion (This will be based on the July 1999 model presented at the ICRAF workshop in Chaing Mai) We have tentative plans to hold a meeting in North

America in late 1999 at which the model and gaps in data will be critically assessed by a team consisting of G Shively, I Coxhead, B Deutsch, G Buenavista, and D Midmore

- Seek further input from researchers and policy makers in the Philippines regarding ways to make the policy modeling efforts relevant to the needs of decision makers
- Develop a list of relevant policy simulations in conjunction with local, provincial, and national-level policy makers
- Conduct policy simulations with the model and report these in paper and seminar format
- Assess feasibility of delivering a computer-based tool for local decision-makers and critically assess technical capacity and potential training needs at the local level
- Place a junior research staff member in residence in the municipality of Lantapan to assist with transfer and training of decision support tools

Partners and Collaborators

This research makes use of data collected during SANREM Phase I and directly complements Phase II workplans that focus on analysis of specific economy-environment, identification of potential technologies or policies, and exploration of policy-related and natural resource management-related questions Research complements watershed function research of ICRAF's global Alternatives to Slash-and-Burn (ASB) program, and complements workplans focusing on scaling-up activities at the regional level Workplan principle investigators are G Shively (Purdue University), A Rola (UPLB), V Espaldon (UPLB/SEARCA), and H Francisco (UPLB) All but H Francisco remain as PIs in the year two workplan

Collaborating partners in year one included A Sumbalan (Bukidnon-PPDO), Hon C Rubio (Mun of Lantapan), I Coxhead (UW-Madison), V Amoroso (CMU), R Brioso (NAPACOR), and N Clarke (Texas A&M) The composition of the set of collaborating partners will change in year two, and will include A Sumbalan (Bukidnon-PPDO), Hon C Rubio (Mun of Lantapan), I Coxhead (UW-Madison), V Amoroso (CMU), E Ponce, (DA-BAR), E Queblatin (GOLD), and J Salas (NGO Watershed Coalition)

Problems and Interventions

The potential integrity and usefulness of the watershed model rest on two key issues First, the workplan requires that sufficient data were collected in the Lantapan watershed during Phase I to facilitate construction of a model that represents activities and outcomes in the watershed The team's ability to acquire and process data from Phase I remains limited Significant steps are being taken to gain access to data that are currently not available Second, the workplan requires that key economic policy variables can be reliably linked to recent historical patterns of land use so as to provide a reasonable basis for forecasting potential impacts from future changes in economic variables To address these issues, tentative plans have been made to hold a meeting in North America in late

1999 at which the model and gaps in data will be critically assessed by a team consisting of G Shively, I Coxhead, B Deutsch G Buenavista, and D Midmore

Environmental Management Planning and Development Policy Analysis in Lantapan

Hon Narciso Rubio, Mayor, Municipality of Lantapan
Dr Antonio Sumbalan, Provincial Planning and Development Officer, Province of Bukidnon
Dr Ian Coxhead, SANREM/SEA Principal Investigator

Introduction

The primary goal of SANREM-SEA Phase II research at the Lantapan site is to integrate biophysical and economic findings from previous research in the Upper Manupali watershed in order to create decision-support tools for natural resource management and planning at both a community and a watershed scale While other workplans are conducting research and modeling with the aim of providing data and analytical tools, this workplan is the primary vehicle for the implementation of policy analysis and environmental planning exercises for the benefit of the community This work is conducted in support of the Lantapan Natural Resource Management and Development Plan, a plan developed in accordance with the mandate of the Philippine Local Government Code of 1991 during Phase I Our goals are to enable the integration of economic development and environmental/natural resource management at both barangay and municipal level in Lantapan, and also to demonstrate the value of this approach to other municipalities and localities This is in keeping with the emphasis in SANREM Phase II of extending lessons learned in the upper Manupali watershed to upland watersheds elsewhere in the Philippines and Southeast Asia

Objectives

- Improved capacity for local-level policy analysis in the context of natural resources management and economic development

- Analysis of current policy issues and instruments relating to natural resources management, as inputs to community-level debate

- Documentation of results and evaluation of progress, for the purpose of institutionalizing processes and methodologies and generating usable insights for other municipal units

Methods

This research activity makes use of a watershed model incorporates and integrates information gathered in previous and ongoing SANREM-sponsored research The completed model will capture the interrelationships of biological phenomena (resources of soil, water, flora and fauna) as impinged upon by human activities, and also the human welfare implications of induced and autonomous biological changes It will thus reflect an interdisciplinary and intersectoral approach to the analysis of the landscape (watershed) and the lifescape (community), in keeping with SANREM cornerstones and the principles of responsible and responsive local governance Development of the

model, and its integration with site-level data on soils, hydrology, and so on, is the prime responsibility of the workplan led by Purdue U and SEARCA/UPLB

Several specific issues of concern to the Lantapan community and local government present themselves as candidates for the types of analysis that we envisage undertaking These include the following questions

- How will natural resource management planning, and specifically the development of a municipal land use plan (MULP) affect the economic viability and environmental sustainability of Lantapan residents and the local government?
- How will the possible entry of agribusiness corporations, especially those planning to introduce intensive crop and livestock raising operations (such as chicken breeder farms, piggeries and large-scale potato cultivation), affect agricultural sustainability in Lantapan?
- What are the appropriate environmental policy responses to these proposals, and with what instruments might such responses be implemented?
- How do we create appropriate water user fees for various types of users? What percentage of user fees raised should be allocated for maintenance of water quality and quantity? What policies should be implemented to ensure equitable access to water?

We work with the model developers to ensure that the tool they generate is capable of helping address these questions-bearing in mind that other types of issue are likely to require addressing during the course of the project Our approach is to undertake ex ante analysis of the economic and environmental implications of proposed changes, developing "welfare" measures that take account of both types of measure, and to design and experiment with programmatic and policy interventions that maximize such a welfare measure We will rely heavily, although not exclusively, on the WCM as a simulation tool

Outputs

- Discussions among project partners aimed at identifying major environment-development tradeoffs and the best means to address them

- Lantapan Municipality NRMDP and municipal land use planning strategies devised and implementation planned

- Interactions with provincial and other municipal units and with external agencies such as the USAID funded GOLD (governance and local democracy) project on implementation strategies

Impact Discussion

The NRMDP, the major activity under this workplan, is getting under way As it does it has begun to generate community-level discussion of environmental problems and their relationship to economic development strategies both at the individual level and at the level of the community This discussion has generated several specific policy questions

addressed to local planners, including those regarding the scope of local powers with respect to natural resources Part of the task of answering these questions can be accomplished by reference to (even very simple) versions of the watershed model being developed in the Purdue-SEARCA-UPLB workplan

The activity so far has helped to raise, and to better focus, community-level discussions of resource and environmental issues It has also provided a vehicle for local design and implementation of the NRMDP and municipal land use planning initiative These activities are core SANREM goals in Lantapan

Partners and Collaborators

Our direct collaborators are the leaders of the watershed modeling workplan Increasingly, the NRMDP is drawing the local government into less formal partnerships within the Bukidnon political and administrative structure -- for example, through exchanges with other municipalities engaging in similar exercises

Water Resource Management and Education

William G Deutsch, Jim L Orprecio, Janeth Bago-Labis, Allison L Busby and Estela Cequiña

Introduction

This report summarizes the activities of the Water Resource Management and Education work plan for the period June 1, 1998 through May 31, 1999 (Phase II, year 1) Since its inception in 1993, the work plan has been designed to train and equip local community members of the Manupali River watershed to monitor various physical, chemical and biological parameters of surface and drinking water quality across the landscape A people's organization (Tigbantay Wahig, Inc) formed in 1994 as a result of this work, and they have been the primary participants in the water data collection

Results of Phase I and Interim Phase research have been disseminated to a variety of audiences (teachers, students, officials, and the general public) and findings and recommendations have influenced the direction of the Natural Resource Management Plan of the Municipality of Lantapan

At the SANREM CRSP/Philippines 1998 Annual Conference, it was decided by the program coordinators and other participants that this work plan should continue from June 1, 1998 into Phase II without hiatus, because of the value of the data to the program In particular, the water quality and quantity data are necessary for the development of a planned watershed model Also, the months of June-November 1998 are critically important for determining changes in stream flow and other conditions as the El Niño phenomenon dissipated and the severe drought in Lantapan ended

A work plan covering the June-November 1998 was submitted and approved, with the following objectives Funding for the next, six-month period (December-May) was later approved, so monitoring group development and data collection continued through May 1999 The research was also augmented by funds from HPI/Philippines

Objectives

- Monthly monitoring of total suspended solids, stream discharge estimates and water chemistry samples at four river (bridge crossing) sites

- An analysis of inorganic and organic components of TSS for all samples collected in Phase I, with photo documentation of all TSS filter samples prior to analysis

- Frequent readings (at least twice monthly) of four stream gauges installed in phase I, with estimates of stream flow changes (especially extremes) to establish hydrographs Special effort will be made to document the discharge and duration of flash floods

- Documentation of stream conditions when sampling and during other special conditions, such as flooding Documentation of articles or personal accounts of water

issues, such as the effects of drought and flooding, in Lantapan and surrounding municipalities

- Data transfer from the Philippines to Auburn University for analyses, correlation with weather data and preparation for data entry into a watershed model

- One trip to the Philippines (November 1998) by the Principal Investigator to conduct training and feedback workshops with the community, coordinate data summary and report writing with in-country partners, and other activities related to the work plan (e g , possible re-establishment of SANREM research ties with the National Power Company, etc)

- Periodic meetings of HPI work plan partners with the Tigbantay Wahig monitoring group for group strengthening and capacity Continued participation of a TW representative on the Municipality of Lantapan Natural Resource Management Council

- Writing outputs to include a final report of research findings, and a draft book chapter (Dr Cornelia Flora, editor, Advances in Agroecology series of the CRC Press/Lewis Publisher Series on Interactions Between Agroecosystems and Rural Human Communities) entitled "Philippine Rural Communities and Water Resources in the Face of Land Use Changes and El Niño Drought "

Methods

Methods used for monitoring the chemical, physical and biological parameters of water were done according to Standard Methods protocols, and other protocols that have been approved by the U S Environmental Protection Agency for use with citizen volunteers of the Alabama Water Watch Program A brief summary follows

Water chemistry variables of pH, total alkalinity, total hardness, turbidity, dissolved oxygen and temperature were measured monthly at four rivers with a LaMotte Chemical Company water test kit, using colorimetric techniques

Total suspended solids (TSS) were measured with a Fisher Scientific filtering apparatus and Gelman glass fiber filters that were pre- and post-weighed on an approved Metler balance TSS measurements were made during base flow, monthly at four rivers, and also during selected rainfall events In rainfall events, six samples are collected in each river at 30-minute intervals

Stream discharge was determined by making two measurements The cross-sectional area of the site was measured by determining depth along a transect at 1-m intervals across the stream, and calculating the combined area of each stream segment The stream velocity was determined by measuring the time required for an orange to float a known distance (10 m) of the stream channel Nine trials were done in different parts of the stream channel to get the average velocity The cross-sectional area (square meters) was multiplied by velocity (meters per second) to estimate stream discharge (cubic meters per

second)

Collection of TSS samples was done concurrently with the monthly stream discharge sampling activity The TSS and stream discharged data are utilized to estimate soil export (mg/L TSS multiplied by cubic meters/sec discharge to obtain kg/sec soil export)

Outputs
During the 12-month study period, the TW monitoring group collected 318 TSS samples, 24 water chemistry samples and 44 stream discharge samples (June 1998 through April 1999, May samples have been collected but data have not been submitted for summary) Data are missing for some months because of a lack of supplies (e g , filters for TSS), or because of funding delays A more detailed summary of data collection is presented in the attached activity report of HPI

All data except for May 1999 were checked by HPI staff, entered into a computer database, and emailed to AU for summary, graphing and interpretation All data received by AU were tabulated, and several summary graphs were produced of TSS, stream discharge, rainfall correlation and soil export estimates Several photos of rivers and monitors were taken during the report period

Janeth Bago Labis HPI/Philippines Field Assistant presents TSS data emphasizing different behaviors of each river The Philippines (Photo Jim Orprecio)

Some of the objectives of the proposal were not met, including all or part of objectives 2, 3, 6 and 8 The TSS filters of previous years are in storage at CMU, but were not analyzed for inorganic/organic components as planned Some of the sample filters were destroyed accidentally or to reuse the plastic dishes they were stored in Stream gauges were not checked periodically as planned Instead, stream discharge was measured according to the methods outlined above, on a monthly basis, along with TSS measurements No contact was made with NPC personnel to restore collaboration with them, similar to a previous relationship between SANREM and Beth Cruz for NPC reservoir research (Pulangi IV reservoir) The planned chapter for the book edited by

Cornelia Flora was not written, although a manuscript documenting this information is still planned

Institutionalizing the community-based approach to water resource management is an important goal of the work plan This was accomplished, in part, during the report period in a variety of ways including

- Monthly Meetings of the TW Monitoring Group with HPI staff, and others
- TW participation in the NRMP meetings of Lantapan
- TW Attendance at workshops and conferences (e g , IIRR, Cavite workshop with
- G Buenavista, etc)
- TW officer and member demonstrations of sample collection, and presentation of
- data/information to several visiting groups from within and outside of the
- Philippines (e g , visit of WELLS study tour groups composed of provincial and
- municipal planning officers, NGO and community leaders, and elected municipal
- officers from the Sarangganı province, in May 1999)

In addition to SANREM-funded, research activities, a livestock, income-generating project supported by HPI/CODEL was launched in January 1999 for the Tigbantay Wahig group The project entitled "Fish Culture and Goat Rearing Project" hopes to further strengthen the capability of the Tigbantay Wahig organization while providing them opportunity for income generation

Summary of Results

The essence of the work plan design and results of Phase I activities were presented in oral and manuscript form at the SANREM CRSP/Philippines 1998 Annual Conference in Malaybalay ("Community-Based Water Quality Indicators and Public Policy in the Rural Philippines," In Economic Growth and Natural Resource Management Are They Compatible?)

The work plan results were also featured in a United Nations report entitled "Success Stories in Sustainable Development," and listed on the UN website This recognition was primarily the result of presentations of the work plan that had been made at the USAID-sponsored conference entitled "Lessons Without Borders," held in Chattanooga, TN in 1997

The manuscript form of the work plan presentation that was made at the Malaybalay conference in June 1998 was modified for inclusion as a chapter in a book entitled Environmental Indicators and Public Policy Book editor, Dr Mary Durfee of Michigan Technological University, invited the chapter, and it is presently under editorial review by the University of Akron Press While under review, copies of the manuscript have been distributed, by request, to researchers at Iowa State University, the Free University of Amsterdam, FAO/Rome, five country directors in the Asia/South Pacific Region of HPI and others

Several of the summary graphs and tables of Phase II, year 1 research were shown at the SANREM workshop in Chiang Mai, Thailand, June 1999, during a presentation of Bill Deutsch entitled, "Environmental Prophets and Predictive Models Water Monitors of Mindanao, Philippines " Additionally, several photos and a more complete description of group meetings are presented in the attached Activities Report of HPI

Impact Discussion

With the very visible activity of the TW and the active participation of the TW officers in the Natural Resource Management Council of Lantapan, the local government and several private business ventures in Lantapan became aware of the work that the TW is doing Water quality and quantity data have been requested to make various planning and business decisions in the municipality

Because of the interests that several NGO and GO groups have shown in the result of the TW work, the officers and members have realized that their data of the past five years is vital to the management of the community natural resources During their last officers' meeting, it was realized by the TW that the information that they have can be welded as power ("information is power"), and that they have become "environmental prophets "

Members of Tigbantay Wahig water quality group Jim L Orprecio and Janeth Bago Labis with Bill Deutsch The Philippines

The municipal government through its NRMC approached the TW for their assistance in organizing TW chapters in each barangay The officers are wary that if this organizing of chapters is done hastily and without proper training, that new groups may destroy the gains and reputation that were painstakingly developed by the TW/HPI/Auburn collaboration This situation and request will be addressed over the next several months The main challenges/problems encountered during the study period were

- Funding delays, and a relatively low budget
- Miscommunication or lack of communication among work plan partners, SANREM coordinators and the ME, and
- Uncertainties within the LGU, TW and general public regarding the future of the NRMP and SANREM's continued presence in Lantapan

These obstacles were largely overcome with a strong sense of partnership and accomplishment among the work plan partners, resulting in a lot of unfunded-effort (especially that of the TW and Dr Cequiña at CMU) Additionally, HPI financed a portion of the research and virtually the entire community goat/fish project During the study period, the HPI/International Office personnel (Robert Pellant, Asia/South Pacific Regional Director, key donors and others) became more aware of the work plan and how lessons learned may help other HPI projects As a result, HPI has funded an effort to make other country directors aware of the project

Bill Deutsch and Jim Orprecio met with five other HPI country directors and representatives (China, Nepal, India, Indonesia and Thailand) for a two-day "brainstorming session" in Chiang Mai, Thailand in June 1999 The group began planning for a several-day workshop, to be held in Lantapan in September 1999 for several other HPI directors and staff, with the potential of greatly extending the SANREM Landscape/Lifescape approach and community-based environmental assessments (particularly as this relates to livestock projects), throughout Southeast Asia and globally As SANREM soon phases out of Lantapan-based research, and is expected to end in 2003, it is hoped that the concepts and approaches of this work plan continue in Lantapan and beyond, to partly serve as a SANREM legacy HPI and AU plan to collaborate in "parallel" and "post-SANREM" activities, and will continue working with SANREM to the degree that mutual goals and program funding dictates

Partners and Collaborators
Auburn University, William Deutsch (PI) and Allison Busby

Heifer Project International/Philippines, Jim Orprecio (co-PI) and Janeth Bago-Labis

Central Mindanao University, Estela Cequiña

Tigbantay Wahig, Inc , Madronio Magsakay, President, Serafin Billones, Vice President and others

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Bioeconomic modelling of changes to traditional vegetable production practices in the Manupali watershed - with extensions to other southeast Asian watersheds

D J Midmore, CQU, Australia

Introduction

In line with the Phase II focus in SE Asia on providing the tools for optimal natural resource management decision-making processes, the activity within this project continued to add to the necessary database for simple scenario-building models The data supplement the extensive data base created during Phase I and the Interim Phase, and are of great potential value as a long term data set Medium term model predictions for annual cropping, and agroforestry, can be matched against real data, adding weight to the value of modelling as a decision support tool While the outputs are primarily aimed at farm-level adoption, they can be amalgamated to assist with watershed, regional, and national decision making

Objectives

- Provide evidence for or against the thesis that full and/or partial conversion of vegetable farms to agroforestry will lead to sustainable use of soil and water resources, and satisfy the income demand by upland farming families
- Provide model parameters for inclusion of such evidence into a watershed model
- To monitor the changes in the practice of vegetable production, and the adoption of participatory-led research-substantiated innovations
- To provide a robust model for prediction of impacts due to changes in upland vegetable production practices on farm scale income generation and resource management (In year 3/4)

Methods

The introduction of farmer-sanctioned production practices aimed at conserving the soil resource in vegetable and other annual production systems was begun in Lantapan in 1995 Much data are at hand, and provide information on change of soil quality due to the continuous cropping of vegetables Small-scale monitoring, particularly of soil erosion and runoff in plots recently (early - 1998) submitted to agroforestry, is ongoing, and essential to provide information on (a) the possibility that agroforesty rehabitates soils (e g , recycling of deep-set nutrients), and contains erosion, and (b) that agroforestry provides income to compensate for loss of vegetable production Changes in soil physical/chemical properties will be monitored at the end of two years, and growth rates of trees is quantified on a two or three times per year basis both in the research site and on other sets of agroforestry experiments set up in 1995 These will be compared with current model predictions of growth rate and income generation

All data collected to date will be compiled into a simple decision support model (spread-sheet based) in order to compare the robustness of the new production technologies in the face of price variations for vegetable/timber commodities The data will provide input for a watershed model, to be used at the municipality level

Outputs

Preliminary data looking at reduction in farm gate prices (as a possible consequence of vegetable trade liberalization) would suggest that a 20% price reduction would induce the major proportion of annual cropping enterprises to seek alternative commodities Returns from trees alone would not match the rates of return that annual cropping enterprises are accustomed too Agroforestry (trees and vegetable/corn), with intercropping for the first year, would only be financially more viable than annual cropping if yields in the latter declined annually at 20%, and prices were also reduced by 20% due to competitive import of vegetables These analyses were presented at the ICRAF Methodology workshop on Environmental Services and Land Use Change, in Thailand (May, 1999)

- The impact of such changes on financial returns can be modelled as indicated above, the impact on soil erosion and soil quality awaits further data from the 1998-established agroforestry erosion plots
- Data are still being collected, and will be incorporated into the Watershed Model, alongside data from Ian Coxhead and Bill Deutsch, during year two of the second phase
- The change in practices amongst vegetable farmers will also be monitored in year 2, and may be undertaken as a cooperative effort with other impact assessment instruments to be used in the watershed
- The outputs to date in terms of modelling are preliminary, and require sensitivity analyses, and further data, before impacts on resource management can be ascertained

Impact Discussions

- The project (in the second phase) has to date only impacted other researchers/project personnel, for the modelled outputs are considered too preliminary for wider dissemination Impact from the first phase will be quantified during year two

- The project is providing suitable inputs to the interdisciplinary and intersectorial watershed model, the focal point for evaluating the implications of change that impact on the lifescape within the watershed

Plans for Subsequent Reporting Period

Continue data collection in agroforestry, present paper at the 1st National Tree Farmers Congress (General Santos, Mindano, October 99), develop the integrated watershed model in the US

Partners and Collaboration

For year two the Philippine counter part will be Dr Antonio Daño from the DNR (Ecosystems Research and Development Bureau) This is in line with the push towards adoption of policy at the local and regional level, and adds valuable currency to the validity of the outcomes During the sixth Annual Planning Meeting (May, 1999) a meeting was agreed to be held in the US between Midmore, Shively and Deutsch, to operationalise the data input from the biophysical research into the watershed model All

data at hand were passed to G Shivelly, more are to follow Steps are underway, through the person of Michael Ngugi (ICRAF research fellow based at Songco), to bridge the gap between the CQU and ICRAF projects The informal offer has been made to Michael to undertake PhD studies using ICRAF and CQU research sites - hence tying the two major data sets on agroforestry performance together

Automatic Weather Station Workplan

Introduction

The principal activity of this workplan is to monitor weather elements using automatic weather stations (AWS) These are installed at three different levels of the watershed in order to provide a detailed description of climatic conditions at these locations The AWS were installed in December 1993 and has continuously provided hourly and daily averages of meteorological variables such as air temperature, relative humidity, rainfall intensity, solar radiation, wind direction and speed and soil temperature at three depths

Objectives

The weather-monitoring network was established with the following objectives

- To provide detailed information about local climatic conditions
- To assist and provide necessary weather information to other SANREM workplan holders and to contribute to watershed modeling efforts
- To promote awareness among farmers and local development planners on the role of weather in planning agricultural operations and other activities

Methods

The data recorded in data loggers of AWS is downloaded monthly by the Research Associate, Mr Teodoro A Maribojoc, and processed at Central Mindanao University Copies of this information are tabulated and prepared for dissemination Regular on-site maintenance work is done to ensure the validity and quality of data being recorded by the AWS

Outputs

Monthly weather summaries are prepared for each station and monthly means are computed for the whole watershed Specific data format is also given out upon request At the end of the year an annual summary is compiled together with a brief analysis of observed variables Printed copies of the report are submitted to the SCO and disseminated to various users such as the local government of Lantapan, SANREM workplan holders, government agencies and private corporations

Summary of Results

Annual Rainfall

The effect of the El Niño phenomenon is very evident on the registered annual rainfall of the three AWS The three-year mean annual rainfall (1994-1997) is about 40% higher than the 1998 annual rainfall Individual station observations indicate that the effect is more pronounced in the lowland Differences in the annual rainfall range from 28 to 50%, with the Kulasihan exhibiting a difference of 50% Figure 1 1 shows this abnormal situation

Monthly Rainfall

On a monthly basis, our records indicate the absence of any rainfall for the first two months of the year followed by very minimal rainfall during the next three months In

effect, the dry season was extended from five to eight months The onset of rainy season was observed only during the first three week of June This is one month later than the usual first or second week of May

Moreover, the rainy months were interrupted by a brief dry spell in August, which is supposed to be the wettest month of the whole landscape This situation was further aggravated by below-normal rainfall of October and November Figure 1 2 will show this observation

Air Temperature and Relative Humidity
Extreme air temperature variations in the area were not much The effect of elevation of air temperature is dominant Our tabular values (Table1 1) this element show that the air temperature at Bulogan and is about 22% lower than at Kulasihan while at Alanib it is only 13 5% Maximum air temperature (34 4°C) was observed during the month of April while minimum air temperature (14 1°C) was observed on March As compared to the three-year mean, air temperatures are about the same

The contrast of air moisture content or relative humidity (RH) in the morning and afternoon observations in our monthly tabulation (Table 1 2) is very obvious RH as high as 100% were observed in the morning and as low as 40% in the afternoon This is particularly true in the lowland On the average, air temperature was more moist (86 1%) all over the landscape as compared to the longer mean observation of 79 1%

Solar Radiation
Total solar radiation intercepted by the surface decreases with increasing altitude This variation, however, is not more than 10% This could be attributed to more cloud cover in the higher altitudes More solar radiation is intercepted during the months of March and April as a result of minimum cloud cover during these months It is least during the month of February for all stations The distribution of this element is shown in Table 1 3

Soil Temperature
Following closely the behavior of solar radiation, the mean monthly soil temperature variations depths of 5, 20 and 50 cm , are also minimal Maximum soil temperature are usually observed during the months of April and May, for all stations, and lowest during the months of January and February The effect of altitude on this element is also evident It decreases with increasing altitude For example, at a depth of 5 cm at Kulasihan, the mean temperature is 35 4°C, at Bulogan, only 26 4°C This is about 25% lower Table 1 4 shows these variations

Impact Discussion
The AWS network provided detailed information about local climatic conditions to SANREM workplan holders, local government unit of Lantapan and other government agencies The Department of Agriculture (DA) and National Irrigation Administration (NIA) used the information for their feasibility studies and planning activities Graduate and undergraduate students of CMU used our weather data for their researches and correlation studies Even private corporations such as DOLE Philippines Inc and

Bukidnon Sugar Milling Company have utilized weather information for their corporate plans

Plans for Subsequent Reporting Period
There is immediate need to rehabilitate the three AWS by procuring necessary replacement parts The maintenance of our stations will be provided by counterparts from PAGASA as soon as the signing of our MOA is completed With the smooth operation of our AWS assured, we intend to expand our activities to include an information drive on the significance of our meteorological information in relation to farming and other activities For this purpose, we need to package certain meteorological information and disseminate this to farmers through the regular scheduled Barangay assemblies in the Municipality of Lantapan

Identification of Partners

Principal Investigator	Prof Lucio L Laurente CMU, Musuan, Bukidnon
Research Associate	Mr Teodoro A Maribojoc CMU, Musuan, Bukidnon

Problems Encountered
In the course of our operations, the following problems were encountered

- Deterioration and malfunctioning of AWS sensors and data loggers
- Data processing and quality control
- Procurement of spare parts of Automatic Weather stations

The projected life span of AWS sensors and parts is at most five years Since these were installed in 1993, some sensors and data loggers are already showing signs of "aging"

Data processing used to be handled by our UGA partners, Dr Ian D Flitcroft and Galen Harbers With their separation from our workplan we were left to our own resources We have not undergone the planned training on data processing and quality control We are rather fortunate, however, that the computing facilities of CMU are at our disposal

Since the AWS model is not distributed locally, we expect some problems related to replacement of defective parts

In order to address these problems we sought the assistance of the site coordinator Dr Gladys Buenavista and SANREM/CRSP SEA Manager Dr Roger Serrano Arrangements were made with PAGASA to provide technical assistance in the Maintenance of our AWS A MOA has been prepared for this purpose With regards to the procurement problem, SANREM CRSP/SEA Regional Director, Dr Ian Coxhead, verbally assured us that a contact person in the U S would be identified to assist us in the procurement of spare parts

"Scaling": Local, National, and Regional Network Building and Information

Adaptıng and Transferrıng Lessons Learned from Manupalı Watershed to Other Crıtıcal Watersheds ın Southeast Asıa

Introductıon

The project ıntended to provıde early groundwork for later adaptatıon and regıonal transfer of fındıngs and specıfıc watershed management approaches and tools developed as part of the SANREM research program ın the Manupalı Watershed, Phılıppınes (an expected output of Phase I and early Phase II efforts) The Southeast Asıan Mınısters of Educatıon Organızatıon Regıonal Center for Graduate Study and Research ın Agrıculture (SEAMEO-SEARCA) ıs mandated to promote sustaınable natural resource management ın the regıon As a result, fındıngs of research ın Lantapan are of potentıal value to other SEAMEO member countrıes, ıncludıng Lao PDR, Vıetnam and Thaıland These countrıes provıde a locus for research on natural resources management wıthın a broad varıety of socıocultural, economıc and ınstıtutıonal settıngs Thıs project sought to ıdentıfy other crıtıcal watersheds ın Southeast Asıa whıch would best suıt the scalıng up of lessons learned from the Manupalı Watershed, the sıte of the Sustaınable Agrıculture and Natural Resource Management - Collaborative Research Support Program (SANREM-CRSP) Phase I

SEARCA envısıons to contrıbute the development of a mechanısm for adaptıng and transferrıng lessons learned from Manupalı to other crıtıcal watersheds ın Southeast Asıa (ı e Lao PDR, Vıetnam and Thaıland)

Objectıves

The project was specıfıcally aımed to accomplısh the followıng

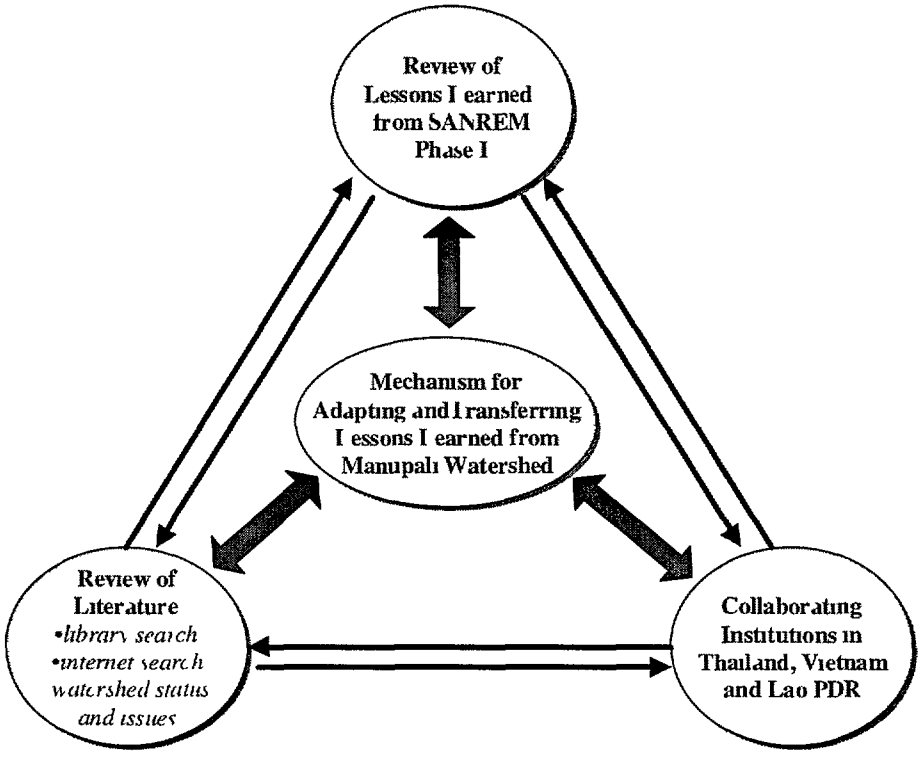
- To provıde a mechanısm for the ıntegratıon of bıophysıcal, socıocultural, economıc and ınstıtutıonal factors that would be useful to watershed management at dıfferent levels (local, regıonal, natıonal) on selected Southeast Asıan countrıes,
- To facılıtate predıctıon of the long term ımpacts of dıfferent human actıvıtıes on the bıophysıcal characterıstıcs of crıtıcal watersheds and theır potentıal to provıde ecosystem goods and servıces, and
- To contrıbute to sustaınable natural resources management of crıtıcal watersheds ın the regıon vıa concepts methods, and approaches learned from the Manupalı experıence

Methods

The Phase 2 Year 1 workplan has three maın components (a) revıew of lessons learned from the Manupalı Watershed, (b) revıew of lıterature of the status and ıssues of

watersheds in Thailand, Vietnam and Lao PDR, and (c) research and development priorities of collaborating institutions from the three target countries (Figure 12)

Figure 12 Conceptual framework of the research project



The team reviewed the documents of SANREM Phase I to enable the researchers to have an in-depth understanding of SANREM, being a new workplan holder Understanding of lessons learned also came from the discussions and review of Manupali experience with the other workplan holder (Capability Building with CMU, IIRR and SEARCA) The team focused on the *Development of Sustainable Production Systems for Different Landscape Positions in the Manupali River Watershed, Bukidnon, Philippines Soil and Water Resource Management and Conservation, Participatory Landscape Appraisal and the NRMDP for Municipality of Lantapan* A mini-data bank was also kept for quick reference and information access

The research efforts were also focused on identifying critical watersheds within each country The project team initially conducted an in-depth review of literature on watersheds in the three target countries, namely Thailand, Vietnam and Lao PDR A series of library search were done in academic institutions and various international offices, which implemented watershed management projects/programs A number of related references (references which can be downloaded) were also sourced from the Internet

The project has already done initial communications to potential partners in the region The team is awaiting response from them for validation and confirmation of research commitments

Summary of Results

The research results cover the following components

A Lessons Learned from the Manupali Watershed

Review of SANREM Project Reports and discussions with previous (and present) partners confirmed the observation made during the May 1998 conference One of the highlights is the need to integrate the various products of research activities into a mechanism that would be relevant to sustainable natural resources management The formulation of the Natural Resources Management Development Plan for Municipality of Lantapan is a powerful methodology for optimizing SANREM research program results The gap however is the capability building for natural resources management of local government units, formal and informal community leaders, and the community at large as a whole An underlying concern, here, however rests on enhancing the ability of the local government and local communities to incorporate issues like biodiversity conservation and watershed protection in local development planning Corollary to this is the need to develop and refine existing tools for natural resources management at the local level

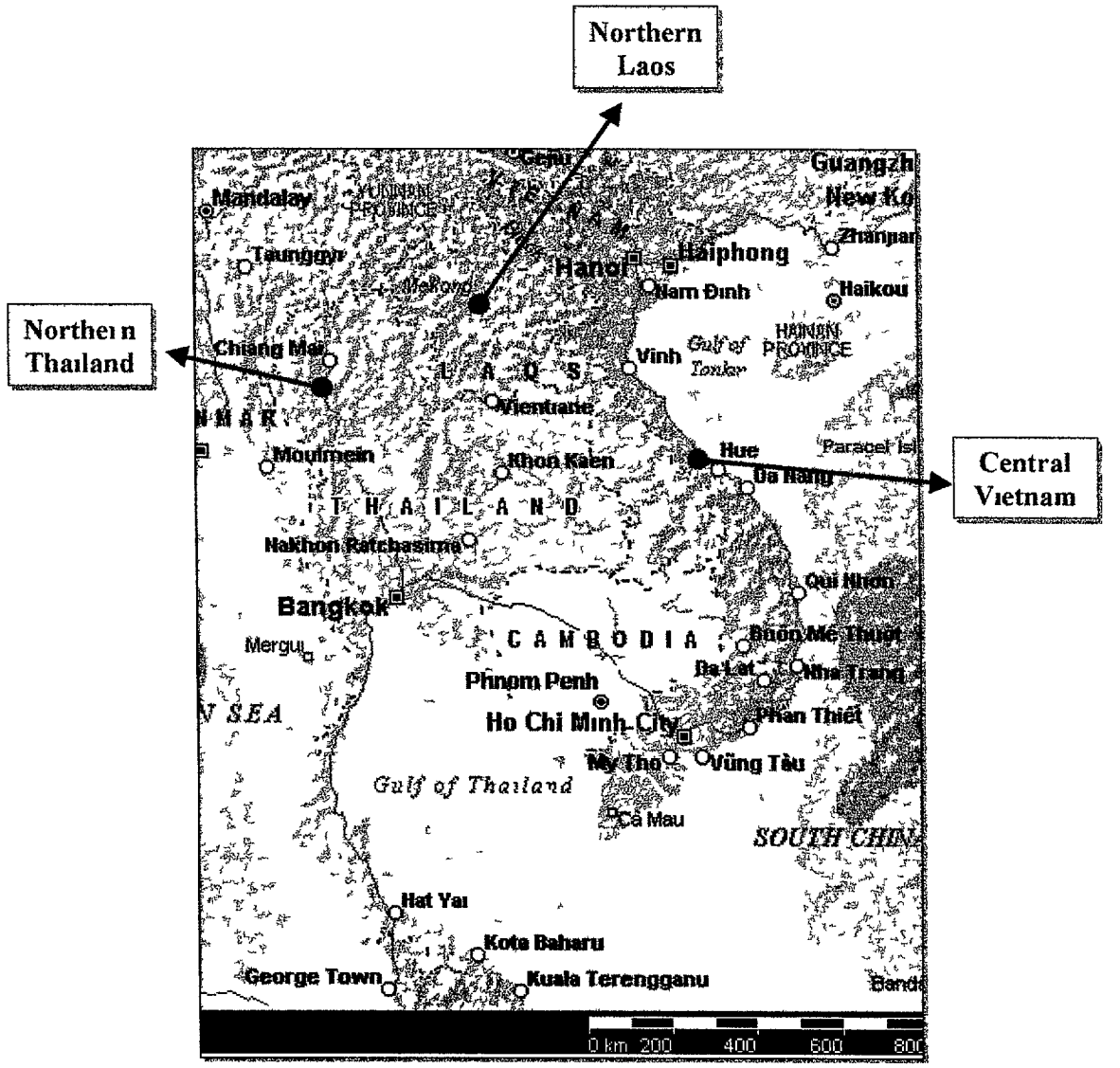
B Review of status of watershed in selected countries (Thailand, Lao PDR and Vietnam)

Extensive review of status of watersheds in the three countries pointed the research team into the "hot spots" for watershed management (Figure 13) They are considered "hot spots" because these are the regions where forest resources are concentrated and where active upland farming and/or fishing communities are located It is expected that with this condition, the need for rationale management of watershed resources is most critical (full details on the status, issues and prospects of watersheds in three countries can be found in the full report)

1 Thailand

Thailand has 25 major river systems Over the last two decades, the watersheds of these river systems play a very crucial role specifically in boosting agricultural production of the country

Figure 13 Proposed adapting and transferring sites in the three countries



a Major Problems and Issues on Watershed Management

Among the major problems and issues seen in the literature review were the following

- **Decreasing forest cover** In the early 1960s, more than 50 percent of the country was covered by forest, however, in 1997 this significantly declined to only 20 percent

- **Shifting cultivation** The population of hill tribes living in the watersheds, who mostly practice slash and burn farming, was estimated to reach more than half a million in 1990 (Nalampoon 1995)

- **Agricultural expansion** As per government policy to eradicate the planting of opium in the highlands, programs, which promoted the cultivation of erosive high value crops that, were aimed to increased farm income of hill tribes (Nalampoon 1995) This led to the expansion and intensification of vegetable cultivation in upland areas The year-round planting of vegetables resulted to the high utilization of water by hill tribes upstream, which contributed to inadequacy of irrigation water for lowland farms

- **Highland-lowland interactions** The relationship between the highlands and the lowlands can be emphasised in the context of mountains being the source of primary products for lowland economies and societies, and the uncompensated transfer of resources such as timber, biodiversity, and water, have yielded little benefit to highland communities but rather create negative effects locally *(Myint and Hofer 1998)*

- **Establishment of hydroelectric dams** in the country results to flooding of intact forests, decrease in biodiversity, forced the relocation of upland inhabitants and diversion of river waters thereby adversely affecting important river basins to a number of inhabitants (Hubbel 1994a)

- **Lack of a clear common masterplan for watershed development** At present, there is still no comprehensive piece of legislation, which deals with an integrated utilization, development, management, and conservation of natural resources in the entire watershed (Wongbandit 1997)

- **Gaps in Watershed Management in Thailand** Thongmee and Boonyawat (1997) classified the gaps relating to watershed management in Thailand into four major areas which are (a) Administrative, (b) Technological, (c) Education and Training and (d) Quality and Quantity of Manpower

b Why northern Thailand?

- On the restoration of watershed areas, the northern region of Thailand was given the highest priority by the Royal Thai Government (Nalampoon 1995) This region is predominantly mountainous and forested, encompassing 59 percent of the total forest cover in Thailand (UNEP 1997)

- Hill tribes who practice destructive shifting cultivation in the highlands are concentrated in the northern region

2 Vietnam

The country has a total land area of 33 1 million hectares, with about two-thirds of which was classified as mountains and/or hills It has a number of river systems that play crucial roles in the socio-economic and environmental protection aspects of major

watersheds Vietnam has six major rivers that support irrigation, drinking water and hydro-electric power plants (Hong Sy Dong 1995)

a Major Watershed Problems and Issues in Vietnam

- **Deforestation** By the end of 1993, the country's estimated forested area was 9 4 million ha This was already smaller than the total deforested area, which stood at 11 4 million ha in the same period Despite this scenario, the forest cover was continuously decreasing at a rate of 200,000 ha per year (EIU 1994a)

- **Population Pressure** The upland watershed areas currently sustain more than 20 million people (Hoang Sy Dong 1996) This high population can be attributed to high population growth rate and immigration of people from lowland to upland areas

- **Policy Issues**

  The 1988 Land Law - Through the *1988 Land Law*, the government opted to formally allocate a large share of the watershed areas to individual households While the state owns the land, citizens have gained usufruct rights to it As of 1993, the Ministry of Forestry granted 4 5 million ha of land distributed among 400,000 households (Talbott and Morris 1993)

  The Forest Protection Law
  Despite the forest protection law, which was passed in 1992, including a ban on log/timber export and declaration of protected areas, reports showed widespread evidence of continuous log and timber exports on a massive scale (EIU 1994a)

- **Decrease in agricultural land resources** With the high agriculture dependency and high population growth, the land area for every Vietnamese was estimated to be less than 0 42 ha Only 0 1 ha of which was used for agriculture With the decrease in land area per capita, land resources are also subject to soil erosion, degradation of fertility and lesser fallow period (Le Thao Can 1995)

- **Forest clearing for crop cultivation** About 70 percent of resource degradation in the forest areas was due to lowland migrants who practice inappropriate agricultural methods on sloping lands and unsustainable logging activities (EIU 1994a, Talbott and Morris 1993)

b Why the Central Highland Region of Vietnam?

Of the total remaining timber stock, about 46 3% of this was in the Central Highland region making it one of the main focus of natural resources management in the country

3 Lao PDR

The northern and eastern parts of Lao PDR have dominantly rugged topography About 89 percent of the country is classified as mountainous More than 60 percent of the total

area has slopes steeper than 30 percent while about 30 percent has elevations between and only about 11 percent are considered flat to gently sloping

a *Problems and Issues in Lao PDR*

- **Conflicting interest between state and upland inhabitants** Since the government is concerned with watershed protection and rehabilitation, they formulated policies that prohibit slash and burn because of its adverse effects on forest lands This puts tremendous pressure on upland people to regulate their traditional practice (UNDP 1997)

- **Deforestation** Lao PDR has the highest deforestation rate per capita in the world The country's forest cover had declined from 70 percent in 1950 to 45 percent in the early 1990s (Talbott and Morris 1993) Annual forest reduction stood at approximately 150,000 ha (Chanthaphone, et al 1997)

- **Dam Construction/Establishment** An international financial institution, is preparing to support a hydroelectric dam project in the Mekong region of Southeast Asia that will decimate the fisheries, forests, economies, and water supplies of thousands of local people, and threaten endangered wildlife (Probe International 1997)

b Why Northern Lao PDR?

The main watershed areas of the country have a high concentration in the northern region This region also houses big watershed management programs/projects which include the project in joint undertaking between the UN Capital Development Fund, UN Development Program and the Provincial Government of Sayaboury

C Publications (Country Watershed Profiles)

1 Yao, R T , Espaldon, V O , dela Cruz, A E and Macandog, D M Watersheds in Thailand Status, Issues and Prospects Country Watershed Review of Literature No 1 SEARCA SANREM Project on Adapting and Transferring Lessons Learned from the Manupali Watershed to Other Critical Watersheds in Southeast Asia SEARCA, Los Baños, Laguna p7

2 Yao, R T , Espaldon, V O , dela Cruz, A E and Macandog, D M Watersheds in Vietnam Status, Issues and Prospects Country Watershed Review of Literature No 2 SEARCA SANREM Project on Adapting and Transferring Lessons Learned from the Manupali Watershed to Other Critical Watersheds in Southeast Asia SEARCA, Los Baños, Laguna p5

3 Yao, R T , Espaldon, V O , dela Cruz, A E and Macandog, D M Watersheds in Lao PDR Status, Issues and Prospects Country Watershed Review of Literature No 3 SEARCA SANREM Project on Adapting and Transferring Lessons Learned from the Manupali Watershed to Other Critical Watersheds in Southeast Asia SEARCA, Los Baños, Laguna p5

Impact Discussion

It is difficult to predict the impact of this workplan at this early stage However, our initial communications with prospective partner institutions show high level of interest and willingness to support in this undertaking At the least, it is expected that the results of this workplan will lead to the crafting of an appropriate mechanism for the adaptation and transfer of lessons learned from Manupali to other watersheds in the region

Plans for subsequent reporting period

It is proposed that after the completion of the literature review, the team will focus on linkage establishment with the collaborating institutions It includes consultation and validation meetings and workshops with partner institutions It is expected that after these meetings, the team (expanded) will come up with specific and refined research foci, which are relevant to different socio-political and economic context of participating countries in the region Signing of Memorandum of Agreements with partner institutions will also be needed to formalize the work relationship The schedule of activities is shown in Table 7

Table 7 Gantt Chart of Years 1 and 2 activities

Activity		Year 1				Year 2			
		Q1	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*
1	Team building								
2	Review of literature								
3	Linkage establishment (consultation meeting, signing of memos, initial workshop)								
4	Workshop on refining research foci and research methodologies								
5	Data collection								
6	Data analysis								
7	Workshop on Research Results								

Research activities for different countries are henceforth tentatively proposed, subject to validation and consultation meetings with the partner institutions (Table 8)

Table 8 Proposed research activities for the three Southeast Asian countries

Country	Proposed Research Activity
1 Northern Thailand	Watershed Modelling
2 Central Vietnam and Northern Lao PDR	Community Based Natural Resources Management - Assessment of the decision making behavior and patterns related to natural resources management - Enhancing capacity for community participation (and local government) in natural resources management - Sustainable agriculture practices for the uplands

A Workshop on Research Foci and Methodologies will be conducted during the second quarter of year two In this workshop, the highlights of SANREM Phase I will be presented as well as the status of the selected, specific watersheds by the collaborating institutions Presentation and discussion of specific research foci will be conducted Methodologies for the research will draw from the methodologies developed and used successfully in the Manupali watershed Data collection and data analysis methodologies will be agreed upon during the workshop

For the proposed watershed modeling activity, an orientation on the model that is expected to be developed will be conducted with the partners Again, the team will agree on the type of data that will be collected Application of the model will be conducted by partners Research results of the different country teams will be presented in a small workshop At the end of this workshop, final reports will be drafted for submission to SANREM

How has the project contributed to SANREM?
This workplan has provided the broader context of the replication activities in SEA and provided a guide as the project moves forward

Partners and Collaboration

Thailand
-Kasetsart University
-Asian Institute of Technology
-Chiang Mai University
-Royal Forest Department

Lao PDR
-National University of Laos
-Ministry of Agriculture and Forestry

Vietnam
-University of Agriculture and Forestry
-Ministry of Agriculture
-Ministry of Forestry

Replicating Models On Institutional Innovation For Devolved, Participatory Watershed Management

ICRAF

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 pointing the way to accelerated progress The Lantapan natural resource management process and experience is a significant advance in municipality-led NRM planning It 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 Our work with municipal government and other SANREM partners has resulted in a model of municipal-level natural resource management planning and implementation that has received national attention

This workplan is conducting a replication program for this model to the seven municipalities surrounding the Mt Kitanglad Nature Park within the province of Bukidnon This replication program will hopefully evolve a new model for systems in Protected Area Management We will analyze, evaluate and compare the performance of this model in municipalities with similar biophysical, socio-economic-political and institutional conditions while testing and fine-tuning the processes and assessing the impacts of implementation We will package the results of this analysis and impact assessment into modules that serve as a decision-support system that assist local governments and community stakeholders to further improve the processes of natural resource management planning and implementation We will communicate these to broader levels, nationally and regionally in Southeast Asia

During the first year of the workplan, priority focus was given to analyzing the planning processes adopted by the Local Government Unit (LGU) of Lantapan in developing the plan Surveys and self-assessment workshop were conducted A working team at the local level was organized as pool of resource persons and advocates during the replication activities in the other sites This forms part of our plan to implement an LGU-to-LGU model of sharing information and experiences Linkages were set-up with the Integrated Protected Area Management and the Protected Area Management Board (PAMB) We are now replicating the NRM model and the experiences of SANREM in facilitating multi-stakeholder collaboration in research and development in the context of a Protected Area Management System

Objectives
The goal of the workplan is to provide tools for decision-makers and stakeholders to better integrate environmental knowledge with technical and institutional innovations to enhance the management of natural resources at the local government level

Our experience in development research, through actual facilitation of NRM processes in eight municipalities, will form the basis towards achieving the above goal

The objectives of the workplan are

- Conduct an in-depth analysis of current methods in Lantapan's NRM planning, assess its impact to the local government's development and investment planning and policy-making, as well as, the performance of the plan's implementation at the municipal and barangay levels
- Replicate the NRM model in Lantapan to seven other municipalities in Mt Kitanglad area that eventually lead to a new model on preventive system for protected area management
- Analyze, evaluate, assess and compare the performance of the NRM model in these different municipalities and develop them into modules that serve as decision-support to local governments in pursuing local NRM planning and implementation
- Communicate these modules to wider community stakeholders and government officials for wider adoption and implementation

Methods
Broadly, the methods used in this workplan involve applied research and technical facilitation Specific methods are identified on a per activity basis For example,on process analysis of the NRM model in Lantapan, we conducted survey using structured questionnaire forms, self-assessment workshop and personal interviews with key technical persons involved in the NRM planning

In technical facilitation, we provide learning sessions with the Natural Resource Management Councils (NRMC) of the respective municipalities The methods in Lantapan serve as a template, but modifications to suit the conditions of the LGU were applied This forms part of a process of adapting the Lantapan NRM methods in other sites Assessments and comparative analyses will be done towards the third year of the workplan

Outputs
Objective 1
1 a A survey was conducted among NRMC members to analyze the process experienced in developing the NRMDP The survey responses revealed that the members' held a favorable impression on the effectiveness of the NRMDP planning process The assessment of whether the planning processes adopted by the NRMC can be replicable to other sites was based on three indicators the degree to which they were participatory, their reliability/validity, and their simplicity The NRMC participation was correlated with the strength of LGU leadership and support This implies that local government

leaders play an essential role in drawing out local support and action for natural resource management

1 b A self-assessment workshop was conducted to review the events undertaken by the NRMC members in the entire planning process They were asked to review the chronology of events within specific time frames, and categorize them into the steps in planning During the workshop, the members also made a list of their important accomplishments and from there, identified some characteristics of an ideal NRMC Further, they agreed to refer these characteristics as criteria for grading their own performance The members listed some success factors, as well as constraints in performing their tasks in NRM planning Interestingly, it appeared that money was neither a major constraint nor a success factor in planning Instead, they identified the LGU leadership, planning methods and technical inputs as success factors, while their major constraints were time and overlapping responsibilities Computing their individual grades and their means, the members rated the performance as a council as average, in relation to their expectations in NRM development

1 c Personal interviews were conducted with the technical persons who participated in the planning sessions They were Agricultural Technicians, Provincial Planning and Development personnel, Foresters from CENRO (community environment and natural resources office), Forester and Development Facilitators of IPAS and KIN (Integrated Protected Area System and Kitanglad Integrated NGOs), researchers, and participants from the DENR Regional office In summary, the interviewees were very much pleased with their participation in local NRM planning Generally, they viewed the Lantapan experience as a favorable complementation between their jobs and their mandates

1 d We also conducted a brief survey to assess the interface of the NRMDP planning and implementation This included looking at the LGU budget allocation to implement the plan, as well as the budget allocation of barangay governments to implement some parts of the plan Based on the approved implementing guidelines of the NRM plan, the LGU allocated 20% of their HES budget (Human and Ecology Security) Policy resolutions that support the NRM program are currently being deliberated at the Legislative Council

1 e We organized a local team of resource persons to work with our team in replicating the NRM in other municipal sites We believe the replication workplan could be most effective if the LGU were to share and influence other LGUs We are facilitating an LGU-to-LGU sharing of information and experiences

Objective 2

2 a We prepared and presented two major paper presentations and discussions for establishing strategic alliances with key persons in the municipalities The replication workplan will be carried out with the Municipal Mayors, who at the same time are members of the PAMB The process is being facilitated by the IPAS and Provincial Planning and Development Office

2 b The first replication site was the municipality of Baungon on the northern side of Bukidnon This will be followed by the municipality of Manolo Fortich, is situated in the central part of the Kitanglad area These municipalities possess characteristics that provide important dimensions of interest adaptive research on NRM Baungon is part of the Cagayan watershed cluster, in which a major hydroelectric plant will be established Manolo Fortich is a fast urbanizing municipality which hosts operations of multi-national agricultural corporations like Del Monte Philippines Current meetings with the Sangguiang Bayan (legislative council) and the Mayor of Baungon were held Full implementation of the workplan in this municipality was initiated during the month of June 1999

Impacts Discussion

The project has already impacted the Mayors of the target municipalities, and the full complement of mayors involved in the PAMB, as well as other PAMB members coming from different government and non-government groups This was manifested through the approval of the implementation of the workplan by the legislative councils (Sanggunian Bayan) in the target municipalities

The Department of the Interior and Local Government (DILG) is a national agency with a mandate to assist the empowerment of local governments Implicit in this mandate is to provide an enabling role to local governments to implement the localization of the Philippines Agenda 21 on Sustainable Development Our collaboration will contribute to the ability of this giant national agency to provide assistance beyond their limited means to local governments in NRM planning and implementation

The workplan has contributed to SANREM's programmatic goals on integrating environmental knowledge with institutional innovations These enhance adoption of research-based information for decision-making and policy formulation This workplan will also contribute to SANREM's goal to provide decision-support tools and the capacity-building of next-generation natural resource planners, facilitators and policy-makers

Partners and Collaboration

- **Government Organizations** Collaboration was established with IPAS and PAMB for the implementation of the workplan in the context of a preventive protected area management approach Another collaboration was established with the provincial office of the Department of Interior and Local Government (DILG) The Regional Office of DILG has assigned a provincial personnel to participate in the local team of resource persons who will work with ICRAF's technical facilitators in implementing the workplan
- **SANREM Partners** We also collaborate with SEARCA and CMU-BIDANI scaling-up workplan through their capability-building component for the LGU's capability building needs in NRM planning

Problems Encountered and Steps Taken

The wide geographic scope of work area is a problem However, we initially resolved this by selecting a subset strategic municipal locations from the far north (Baungon), to the central area (Manolo Fortich), with the base municipality in Lantapan, which is located south of the Kitanglad area

Capacity Building and Training

Capability Building for Natural Resource Management at the Local Level

Introduction

Natural resource management (NRM) is the rational utilization and conservation of land, water, and forest resources at farm-household and community levels for continuously improving livelihood and human development (Sharma 1998) Experience has shown that NRM becomes even more beneficial by adopting a community-based approach Community-based resource management has been conceived as *a process by which people themselves are provided the opportunity and/or responsibility to manage their own resources, define their needs, goals and aspirations, and make decisions affecting their well-being* (Fellizar 1993)

As such, the overall goal of this work plan was to assist local institutions and different stakeholders of the Manupali Watershed develop and enhance their capacity for natural resource management and planning for the watershed Capability building for NRM in the Manupali Watershed is a process consisting of four major components training needs analysis, development of training materials, implementation of the actual training course(s), and monitoring and evaluation This work plan covered only the training needs analysis (TNA) portion The results of the TNA provided the context for the overall NRM plan implementation The activity generated information necessary to formulate a sensitive NRM curriculum for the potential trainers at the local level

This paper reports the results of the TNA conducted in the municipalities of Lantapan and Valencia and a total of six of their barangays, the province of Bukidnon, and the Region from January to May, 1999

Objectives

The training needs analysis had the following objectives

- To identify the target participants and their corresponding strengths and weaknesses in natural resources management and planning,
- To determine the needs of the community, the needs of the organization through the barangay, municipal, provincial and regional levels of governance, and the prospective trainees that can be addressed by training programs, and
- To provide recommendations for a curriculum for NRM and an appropriate delivery design

Methods
A summary of the research process and methods used is shown in Fig 14

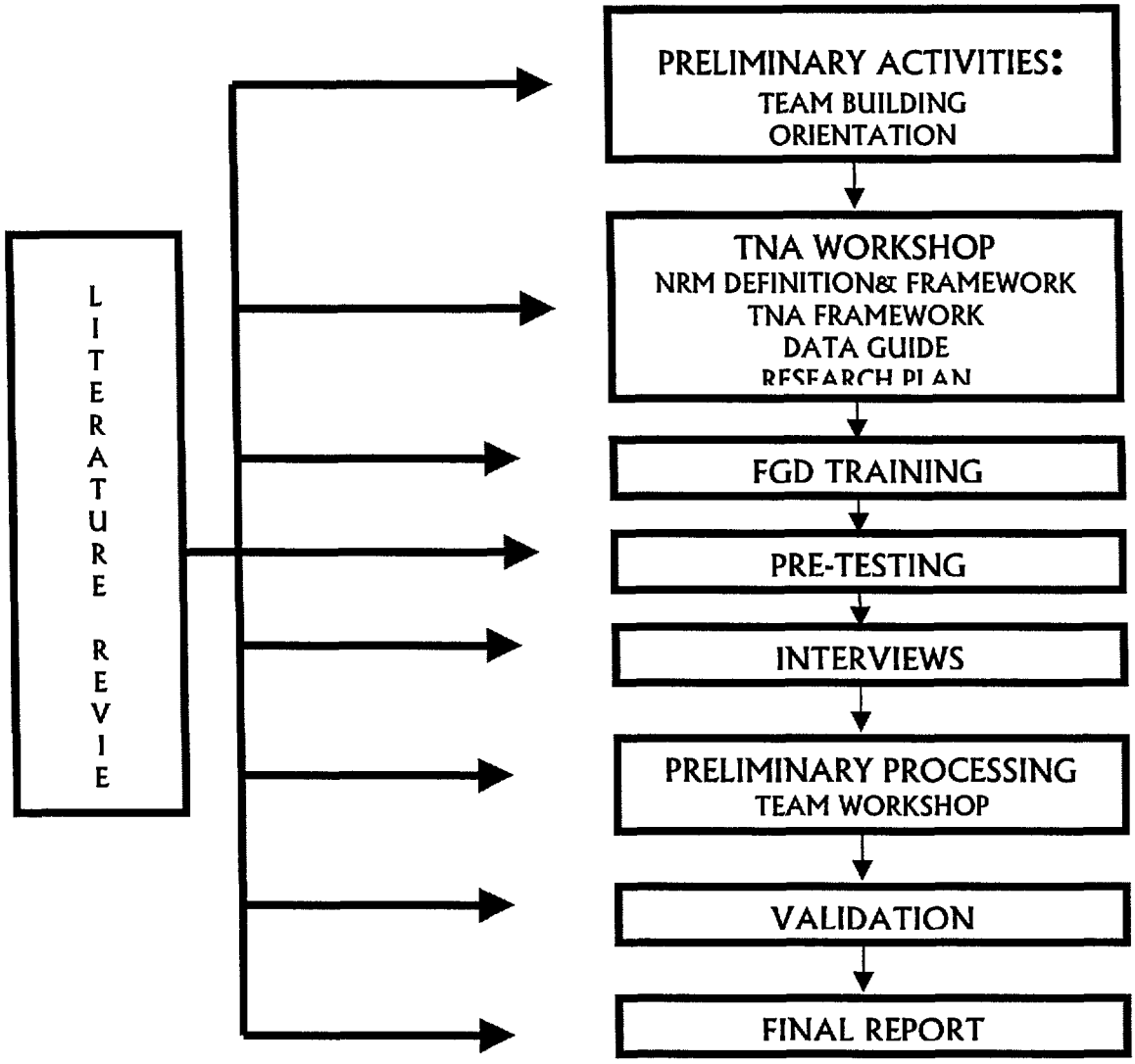


Fig 14 Summary of the research process

Outputs
A Identification of target participants and their corresponding strengths and weaknesses in natural resources management and planning

The basic effort towards building the capacities at the local level is to train local trainers These target local trainers include the following

- Local government executives

- Career professionals in the LGUs and the line agencies
- Farmers
- Faculty and personnel of CMU

During the validation, several more issues were raised with regard to target participants/trainers and community partners in natural resource management

- Not all municipalities have an Environment and Natural Resource Officer (ENRO) Who should be trained in NRM? Who should make the decision as whom to train?
- There are different modalities for the implementation of NRM activities Different communities have expressed different preferences for an NRM partner DILG, NIA, church-based groups, Barangay Nutrition Scholar (BNS)
- A committed person or informal leader in the community can be assigned as environmental person and be made part of the BDC This can help towards consistency of environmental efforts in the area

A tool/instrument will be developed to identify the person or group who could be the NRM point person in the community This will be done in the planning meeting on follow-up activities

1 Determination of the needs of the community, the needs of the organization through the *barangay*, municipal, provincial and regional levels of governance, and the prospective trainees that can be addressed by training programs

The mandate, vision and objectives have been found to be congruent from the regional level down to the communities, with the corresponding systems and structures to meet their mandate and achieve their vision The plans, programs and projects, likewise, of the various agencies and local government units had elements of NRM However, as articulated by the respondents themselves, what is needed is to heighten the clarity, depth and breadth of their awareness of NRM There is a need to highlight the holistic nature of NRM and its being a concern that cuts across a multitude of issues

There is also a need to integrate NRM in 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 In addition, coordination in planning and implementation of the various plans and programs has to be enhanced Though framework and management plans exist at the various hierarchies, these are general in nature and still need the proper support plans to be operationalized

The time of planning and implementation likewise has to be coordinated with the allocation and release of resources The lack of resources or delay in their release has been cited as a common cause for delayed or non-implementation of programs/projects Creative fund management and capital build-up schemes are apparently needed

Results have also shown the major role of municipal governments in the implementation of plans, programs and projects, particularly those relative to NRM Municipalities have

the mandate to impose sanctions on groups or individuals who do not adhere to the policies of the government

The *barangays* are the most basic level at which plans are formulated and implemented However, due to a dearth of technical knowledge and skills, they are not able to put into place projects they believe are most appropriate for them The municipal governments have to extend technical assistance to these communities on plan formulation, project implementation and simple monitoring and evaluation

3 Provision of recommendations for a curriculum for NRM and an appropriate delivery design

The training curriculum developed has been designed to move from a theoretical grounding to skills development in the context of natural resource management as follows

i UNDERSTANDING NATURAL RESOURCE MANAGEMENT
- Concepts, Theories and Approaches
- Examples of NRM Programs Implementation
- NRM Issues in Bukidnon

ii OPERATIONALIZING NRM ISSUES AND TOOLS
- Mechanism for Coordination and Planning
- Participatory Monitoring and Evaluation
- Sustainability of NRM Initiatives (Policy and Institutional Support)
- Information and Education Campaign (IEC) for NRM Advocacy

iii SKILLS DEVELOPMENT
- Participatory Planning Process (e g , Community Land Use Planning)
- Soil and Water Conservation
- Agroforestry
- Farm Techniques
- Livestock Management
- Waste Management
- River Protection

These would be in the form of training-workshops, using existing NRM documents and development plans as workshop materials Farm visits and study tours will support the training-workshop Furthermore, to ensure that the capabilities of those at the local level would be developed, the Central Mindanao University is seen as the local partner institution that shall house the trainings

Impacts Discussion

At this point in time, the TNA has no real impact yet on the people to be trained or on the management of the watershed itself The effect of the TNA was to simply broaden the awareness of people at various levels of governance in the Manupali Watershed that NRM is indeed a concept worth understanding The TNA has also raised expectations that a training program would indeed be done to operationalize or improve NRM in their areas The real impact will come after the trainings have been conducted It would be seen if the TNA led to a training curriculum truly responsive to the needs of the Manupali Watershed

The training of local trainers would strengthen the prospect of ensuring the sustainability of NRM interventions in the watershed The training will help in the replication of institutional innovations that have been developed in SANREM This would also provide a venue for the integration of SANREM research results into information support mechanism for policy- and decision-makers in the Manupali Watershed

To maximize resources and optimize results, the team will link up with other SANREM work plan holders in the area with training components The team will also link up with GEM on its capability building component Furthermore, capability building for indigenous peoples in the area is necessary Links have to be established with ICRAF on this matter

A planning workshop is thought best to be undertaken involving the team, GEM, ICRAF, the Lantapan and Valencia municipal mayor and other individuals or groups who may want to help NRM trainings come to fruition in the Manupali Watershed

The proposed activities for Year Two, which will also be discussed in the planning meeting, cover the preparation of training materials, including their the pre-testing and finalization, the conduct of the actual training courses, and monitoring and evaluation of the impacts of the courses

Technical And Institutional Innovations To Evolve Agroforestry Systems For Sustainable Agriculture And The Management Of Protected Ecosystems In The Framework Of A Watershed Model

ICRAF

Introduction

At least 10 per cent of tropical broad-leaved forests had been lost in the decade from 1980 to 1990 (FAO/UNEP, 1988) During that decade, however, many new parks and other types of nature reserves were established in the tropics The total tropical biome under protection is now estimated at 6 per cent (Sayer, 1991) In many parts of the tropics, however, increased population pressure on land is so great that options for establishing new parks and reserves or maintaining the ecological functionality of established reserves are rapidly disappearing This results in the loss of invaluable faunal and floral species to which these reserves are the only habitat

Because of the enclaves of human settlements within and adjacent to the Kitanglad Nature Park (KNP), there are serious problems of agricultural encroachment and harvesting of wood and other forest products Experience has shown that in situations like this, legal protection or government-imposed restrictions alone, as evident in the KNP and other protected areas in the Philippines, are rarely sufficient to guarantee the continuing integrity of protected areas (Sayer, 1991) New, credible, and innovative approaches are needed to bridge the gap between the immediate needs of local people (whose lives may be dependent on protected area systems) and the long-term objectives protected systems are meant to serve

This project employs the principles and practices of buffer-zone agroforestry as an approach to conserving and protecting the Manupali Watershed (MW) and the KNP Agricultural systems that include a large number and variety of trees provide the soil and watershed protection functions required in buffer-zones, and come closer to providing habitats for a diversity of faunal and floral species than other systems In high rainfall areas with steeply-sloping and nutrient-poor soils, as is true with the MW, tree crops and tree-dominated agroforestry systems are the most stable forms of land use other than natural forests

The goal of this project is participatory development of complex agroforestry systems and component technologies, and employment of farmer-driven landcare approaches for grassroots community resource management It aims at providing more robust insights and recommendations as inputs to the public and non-governmental sectors to improve the effectiveness of human and financial resources targeted to develop sustainable agricultural systems and conserving natural resources in threatened watersheds

Objectives

Project objectives fall into 2 broad categories (BC) These are

BC 1 0 To broaden and deepen our knowledge base on the effective and cost-efficient technological innovations and farmer-driven landcare approaches for fostering, expanding and sustaining smallholder participation in and adoption of conservation farming in upland watersheds (contributes to SANREM-CRSP local objectives 1d,1e,1f)

BC 2 0 To build and nurture an enabling environment for the establishment, development and management of smallholder tree-based production systems as viable enterprises, and as an alternative to government-driven approach to reforestation of deforested watersheds (contributes to SANREM-CRSP local objectives 1c,1d,1e,1f)

Methods

The investigations of conservation farming practices, and the evaluation of agroforesetry tree species performance across elevations in the watershed, employ standard agronomic methods and experimental designs The methodology for farmer-participatory field experiments on natural vegetative strips (NVS) systems and ridge-tillage, and the modeling approach to mapping extrapolation of site by species data are fully discussed in Garrity and Mercado, 1998, and Booth,1996)

Experimentation with and facilitation of the farmer-led Landcare approach to conserve natural resources, has been conducted based on the successful experience of the evolution of the Landcare Landcare Association This community-based knowledge-sharing approach is central to our research and extension methodologies to expand and enhance adoption to conservation farming and other component agroforestry technologies It is an embodiment of an alternative way of initiating and nurturing wide-scale participation of grassroots organizations in the management of natural resources The steps involved in the development of landcare organizations are described in detail in Garrity and Mercado (1998)

PRA (participatory rural appraisal) (Chambers, 1994a, 1994b) methodologies (using visualization, interviewing and group performance) were employed and have proven valuable for understanding local perceptions of the functional value of resources, the processes of agricultural (forestry included) innovation and the complexities of social development

Outputs

(Specific objectives are followed by corresponding outputs in italics)

BC1 0

Specific objective 1 2 Conduct focused on follow-up surveys of 120+ farmers who had established and are practicing NVS and ridge-tillage, during training and field exercises carried out in Phase I to provide the next phase of farmer-driven landcare group innovations

A set of focused follow-up surveys has been completed Results indicate, among other considerations, that a total of 192 smallholders have established NVS and are practicing ridge-tillage in 10 of the 14 villages of Lantapan The current figure includes an increase of 72 farmer adopters in the period covered by this report (June,1998-June 1999)

Specific objective 1 4 Set up a data collection system for monitoring the activities of past and current adopters and to further examine their perception of benefits and constraints to adoption as a basis for refining the approaches

A monitoring process was developed and activities of past and current adopters have been documented Initial analyses of some of the information gathered point to the need to first of all undertake further participatory technology development and research work on enriched NVS These are natural vegetative strips into which selected tree species are introduced for soil stabilization and enrichment, and income-generating purposes

Three farmer-participatory and researcher-managed trials were established, involving Acacia aulacocarpa and Grevillea robusta as experimental tree species Because NVS are largely composed of grasses (which naturally have shallow root systems), they are susceptible to landslides during heavy rains The introduced species are known for their deep tap-root systems (particularly, G robusta), and phosphorus mineralization (G robusta), nitrogen-fixation (A aulacocarpa) and excellent wood properties for fuel and timber (A aulacocarpa,G robusta) Within 3-5 years under optimum soil conditions and appropriate management regimes, farmers could begin to thin or prune these trees to meet their fuelwood needs

The second finding is that documenting the benefits and constraints of conservation farming technologies as perceived by adopters alone is not a strong basis for refining our approach, if the views of non-adopters and those who abandoned their NVS views are not captured and considered We are poised to begin interviews with such farmers for this purpose

BC2 0

Specific objective 2 1 Develop better production/collection and management methods and techniques for improved tree germplasm

Three of the 12 sites of the species trials (established in Phase I) have been developed (rogued, pruned) to serve as quality tree seed production areas for farmers

Two formal trainings (of the 6 planned) have been conducted for farmers and students (Elem, High Schools) on the appropriate collection and handling (cleaning, drying, storage) of tree seed (for timber trees) and vegetative propagules (for fruit trees) The entire vegetative propagation aspect of these training sessions was conducted by a farmer trainer who had received training from ICRAF

Working with the self-seed production and distribution association of farmers in Lantapan, ATSAL (Agroforestry Tree Seed Association of Lantapan), 253 farmers have been trained in the establishment of tree nurseries and plantations, employing the landcare approach

Establishment of 19 nurseries was facilitated to further develop and enhance efficient seed propagation methods and techniques, and plantation management (tree planting and

maintenance) skills in local schools (elem, secondary) and among farmers These nurseries continue to serve as avenues where farmers train fellow farmers and for the production of thousands of seedlings (of the preferred species mix) by farmers themselves (as individuals, households, or group of households) to meet tree-planting and cash needs In addition to markets for farmer-produced/collected seed, there are now markets for farmer-produced seedlings in Lantapan and other municipalities of Bukidnon Farmers have established dozens of woodlots, most of them on idle lands on steep slopes within the watershed, from seedlings cultured from their own nurseries

Specific objective 2 3 Complete the species and provenance trials on the watershed elevation transect and adapt the Booth species-site adaptation model to extrapolate results to the entire Mindanao area as a basis for species diversification

Statistical and related analyses of trial results (Phase I) were completed Three journal papers and extension bulletins are being prepared to share the results with the scientific community and put results into the hands of farmers (with whom we had already discussed our findings in detail in several assemblies) These products are also being shared with, NGOs, NGAs (national government agencies) (LGU, DENR, IPAS, etc), GEM (Growth with Equity in Mindanao) and a host of other clients and partners in Mindanao, the other major islands of the Philippines and beyond

Another set of provenance trial involving 5 tree species (Acacia aulacocarpa, A crassicarpa, Eucalyptus grandis, E pellita and G robusta) was established at 4 new sites (elevations)

Appropriate user- (farmer)-friendly propagation methods and techniques for six (6) endemic and indigenous tree species (Castanopsis javanica, Kati-e (local name), Lithocarpus illanosis, Polyscias nodosa and Shorea contorta) were developed and are being further tested in ICRAF's mini-central nursery at the Centre's research site office in Songco, Lantapan Because of the experience of pest and disease problems associated with "exotic forestry" in the Philippines, an on-farm species mix that includes endemic and native trees becomes an imperative for a sound and credible forest protection and management endeavor

Three hundred seedlings of S contorta (White lauan), a Dipterocarp (one of the most valuable indigenous tree species with which we are involved in propagation studies), had been planted (re-introduced) on a steeply-sloped land along a river bank (at about 1120 meters above sea level) within the upper watershed area

Impacts Discussion

People/Organizations

The activities pursued as presented this report have had significant impact on farmers, students and NGAs A large percentage of the human population in rural Philippines are farmers and it is in these areas where the nation's critical watersheds and protected areas are found Greatest efforts should therefore be brought to bear towards developing robust

and simple approaches and methodologies to capacitate farmers and local institutions to meet natural resource conservation and development imperatives

Keyed to these efforts is the participatory development of integrated agroforestry systems and component technologies and institutional innovations through which to channel these technologies so as to broaden and sustain their acceptance and practice among farmers in particular These being agroforestry technologies, trees are central to their design Our research, training and technology dissemination activities, therefore, are principally geared towards nurturing a tree-planting culture on-farm by farmers in an attempt to conserve and protect the MW and KNP which are among some of this nation's invaluable and threatened ecosystems

The project promotes a farmer-led tree-planting culture and the conservation ethics it engenders by (1) improving farmers' ability to make quality tree seed and seedlings available to themselves for their tree-planting requirements, (2) making seed and seedling production an income-generating activity, through pertinent training and the application of results of a marketing research (ICRAF conducted in Phase I on trees and tree products in Lantapan) , and (3) diversifying the species base on-farm (indigenous ,exotic, endemic) to minimize risk (pest, disease, changing climate,etc), and to cope with changing markets needs

Students

On a High School campus, we have assisted construction of a nursery where students take turns to propagate seedlings (of E torilliana,E robusta and Albizia lebbekoides) for the school's mini-forest project In each of 2 schools (elem, secondary), a species trial was established (in Phase I) Forest conservation classes are being held on these trial sites and many students who had completed their Elementary and High School education in these schools are currently engaged in tree planting on their parents' farms (two teachers had planted trees on their land), as a result of what they have learned in the nursery and trial sites

Generally, almost all High School graduates in Lantapan do not enter college and a good number of students who do enter High School drops out In a situation like this, the only place such kids could learn about conservation is in elementary and secondary schools In our experience, it has been quite easy to get kids to learn about and appreciate conservation if engaged in nursery management and tree-planting activities The trial plantations and nurseries serve as awareness creation approaches for these kids

We also have realized that the age range of the majority of adult farmers working with us in nurseries and the trial plantations is 40-65 (inclusive) This means that within a decade or 2, probably very few of these farmers will be farming Those who will be alive by then may not be strong enough to manage nurseries or engage in any useful activity for that matter These nurseries and trial plantations on school campuses will help sustain the tree planting culture ICRAF encourages by educating the youth, the future leaders of this nation The youth is also, in this way, being tapped to educate their parents who we may not be able to reach

NGA's and NGO's

Although preliminary at the time, a host of NGAs and NGOs have requested for the results of the species x elevation (species diversification) trials The LGU of Lantapan asked for a list of promising species from the trials, and this was provided The LGU intends to use this information in the selection of the appropriate species mix for its watershed and ravine rehabilitation project under the municipality's natural resource management plan The local offices of the DENR and the Integrated Protected Areas Systems office had requested for the results of the trials as well We have discussed our trial results in a forum held for that purpose in Malaybalay These national agencies are interested in the trial results to help them choose the appropriate tree species to establish through nurseries in each of the buffer-zone villages These will produce seedlings for park boundary delineation

We hosted visitors from a federation of nation-wide NGOs known as UNAC The group spent a day of discussion at our Songco site examining our landcare approach to fostering grassroots participation in the management of a threatened natural resource base The set of activities discussed under this caption, not only strengthen rural institutions and organizations, they also mobilize civic, political and institutional support for conserving and protecting the MW and KNP, which constitute Bukidnon's threatened natural resource base

Project's Contribution to SANREM-CRSP'S Programmatic Goals

Development of decision-support tools for natural resource management and planning at both community and watershed scales is the primary goal of SANREM-CRSP's Phase II Programme In addition to developing soil conservation and related resource management technologies, and the approaches and methodologies to expand and enhance their adoption through participatory processes, this project continues to carry out site-based research to build a solid empirical foundation for technical and institutional innovations that are requisites to achieving SANREM-CRSP's global research and policy objectives

A second set of key contributions to programmatic goals is this project's commitment (continuity) to research and its direct linkage with farmers Farmers influence the MW landscape by deciding on the types of crops (trees included) to plant in the area, and the crop sequences to follow These choices indirectly influence the micro-climate and the biotic environment The types of crops introduced determine ground cover, which in turn influence soil conditions and erosion (Almekinders et al, 1995) By working directly with farmers on the landscape scale, this project is improving their landuse practices towards protection and conservation the landscape This is a sound and practical approach to sustainable agriculture and natural resource management

Partners and Collaboration

In his closing remarks at the SANREM-CRSP's planning meeting (8-10 June, 1999) in Malaybalay, Philippines, Dr Ian Coxhead spoke of the unique opportunities this Programme has, and the need to work with other SANREM-CRSP partners, National Government Agencies (DENR, DA,IPAS, PPDO,etc), NGOs and other USAID-funded

bilateral programs such as GOLD and GEM He also talked about overlaps among workplans, which he correctly said are a source of confusion in our various tasks and the perceptions of the program by our clients These key observations make partnership and collaboration a necessity in the interest of efficiency and better coordination In SANREM-CRSP, this project intends to work with the "Soils" and "Water Quality" workplans We are planning to further nurture and broaden our working relationship with the two USAID bilateral programmes , GOLD and GEM

Plans for Subsequent Reporting Period

- Conduct a focused and sampled survey on non-adopters (including those who had abandoned their NVS and the practice of ridge-tillage) and prepare a paper to fully discuss and share results
- Develop at most 2 trial sites (of the Phase I species trials) to serve as quality seed production areas for farmers
- Carry out at least 3 formal trainings of selected farmer trainers on vegetative propagation of promising fruit trees and seed collection and storage
- Organize and conduct 2 workshops for selected wood purchasing and processing industries and selected tree farmers in Lantapan
- Complete the final drafts of 2 technical papers on results of Phase I species trials
- Begin data collection on plant growth (diameter, height) and site factors (physical and chemical characterization of soils, landuse history, etc), and maintenance of the new species and conservation farming (enriched NVS) trials
- Complete the final write-up of the marketing paper on trees and tree products by tree farmers in Lantapan
- Working with the ICRAF-UPLB Watershed Modeling of Run-off and Erosion Study team, we will update the landuse maps prepared earlier in Phase I to serve as an input in determining landuse changes across the landscape in, at most, 2 buffer-zone villages

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V. West Africa Project

West Africa Project Summary

I Introduction

A major distinguishing landscape characteristic of the arid and semi-arid region of West Africa is the cultural, socioeconomic, and biophysical integration of livestock and agriculture (including agroforestry) The complex interactions and dynamics of the human population and their crop and animal systems affect natural resource management in virtually every community within this vast region These systems include nomadic, transhumant and sedentary agro-pastoral systems Because these systems by their nature must compete for the same natural resources (i e , water and land), the potential for conflict always exists

Presently, increasing human population pressure and poverty, newly evolving social organizations, and increasing variability in weather and climate are further complicating what has historically been a very delicate, though sustainable, balance among natural resource users in the region There appears to be a general and accelerating rate of degradation of the fragile natural resource base in areas where there is greater competition for natural resources However, in areas where viable community-based natural resource management approaches are evolving, these negative trends are being counterbalanced Nevertheless, the situation remains very fragile It is essential that natural resource management institutions and strategies be adapted and diffused to concerned stakeholders throughout the region This will assist not only in improving natural resource management within the region but also in identifying potential conflict "flash points" and providing information on conflict avoidance techniques

This report documents the activities and results of the SANREM West Africa (SANREM WA) project for Year 1 (1998-99)

II Project Objectives

SANREM WA objectives focus on developing methods, tools, options, and techniques that facilitate resolving NRM issues where there are conflicts of regional interest between pastoralists, agro-pastoralists, and sedentary farmers that may be exacerbated by weather and/or climate variability The Project has begun its initial activities (primarily)[4] in the Mopti Region of Northern Mali (Commune of Madiama) but is also moving rapidly to involve other principal stakeholders throughout the region To further the regional objectives, and at the same time, reinforce the objectives of other USAID-sponsored activities in the region,

[4] See activity report No 2

SANREM WA closely coordinates all activities with networks and institutions such as the Institut du Sahel, the NRM Research Pole, CILSS, etc The project is also actively developing collaborative relationships with national and regional NGOs (CARE)

West Africa Year 1 activities have included

- Conflict Prevention and Resolution in Agro-Pastoral Systems Resulting from Climatic Change in Northern Mali (Lead – Washington State University, IER)
- Cattle and Manure Management Strategies to Increase Soil Phosphorus Level in Western Niger (Lead – University of Wisconsin, ILRI)
- Modeling Community Socioeconomic Linkages and Growth Toward Sustainable NRM Agro-Pastoral Systems Under Environmental Stress and Conflict (Lead – Virginia Tech, CARE, IER)
- Regional Workshop on Agro-Pastoral Systems in Conflict (Lead – Virginia Tech, INSAH)

Details on these activities are found within this report

III Methods

During this first year, project methods have focused on project organization and orientation for the Phase II effort Although some aspects of conflict management have always been implicit in the NRM focus of SANREM research, the explicit consideration and treatment of conflict in the development of NRM tools and strategies represents a new departure for SANREM In addition to these challenges, the project also had to seek the accommodation and modification of the methods and approaches of ongoing SANREM-supported Ph D research that began in Phase I

IV Output

For detailed activity reports see the section following this summary

To effectively organize and orient the project given the new conflict dimension, the following activities were undertaken

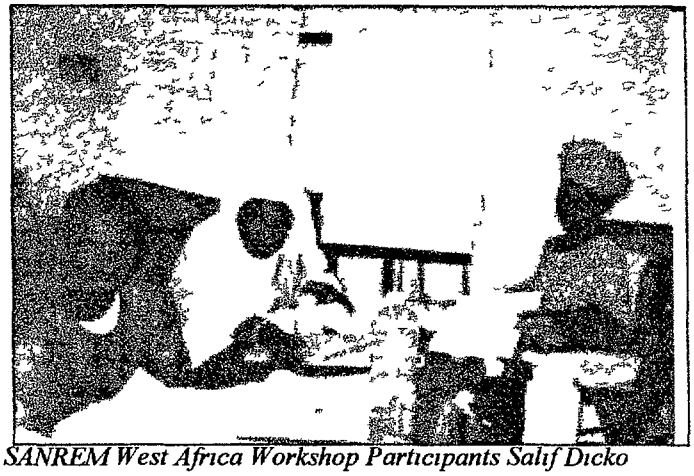
1 Following consultations with regional partners in West Africa during a preliminary SANREM workshop in Bamako, Mali in March of 1998, it was decided to launch a major effort to review the literature and experience of conflict and natural resource management in agricultural and pastoral systems of the region With the support of the Global ME and leftover funding from the interim period, a four-person multidisciplinary, multi-institutional, and international team was formed to conduct the review beginning in May 1998 Two members of this team spent three months in the Sahel region gathering gray' and other literature, interviewing resource persons in five countries, and synthesizing results The two members remaining in the US were responsible for gathering, reviewing, and synthesizing international literature on the theme As a result of this effort, the team prepared a draft background synthesis

document[5] along with an accompanying annotated bibliography[6] in October/November 1998

2 In order to build consensus among principal SANREM partners concerning future directions of the project, a moderated e-mail conference on 'Planning and Coordination of the SANREM WA Program' was held throughout November and December 1998 The purposes of the conference were three-fold
   a To provide a forum to introduce and discuss future program directions This included the presentation and discussion of the background synthesis document and discussion of ongoing/proposed SANREM WA activities
   b To coordinate the various proposed modeling efforts
   c To structure collaboration among partners for the PLLA (participatory landscape/lifescape appraisal)

   Some 35 participants from 14 different US and West African institutions and organizations participated in the conference A greater understanding of general strategies and consensus on project tactics evolved during the course of the conference Most notably, agreement on a strategy and timeline for the PLLA was reached

3 Under the leadership of Washington State University, a PLLA workshop to acquaint partners to SANREM methodology and to organize the PLLA exercise was held in Bamako, Mali from January 25-27, 1999 (see activity report No 1) Just previous to this workshop, a three-member SANREM advance party visited the Mopti region, met with potential SANREM partners and stakeholders, and arranged logistics and invitations for the workshop



SANREM West Africa Workshop Participants Salif Dicko Aicha Maiga and Marie-Cecille Sidibe Kebe (Photo Julia Earl)

[5] Moore, Keith, et al "Conflict and Natural Resource Management in Agricultural and Pastoral Systems of Arid and Semi-Arid Regions of West Africa A Review of the Literature, Key Informant Perspectives and Lessons Learned", Virginia Tech, November 1998 This draft was later revised as a result of the subsequent e-mail conference and translated into French

[6] Moore, Keith, et al, "SANREM West Africa Bibliography NRM and Conflict in Agro-Pastoral Systems", Virginia Tech, October 1998 Additional updates of this bibliography have been published

4 Multidisciplinary, multi-institutional, international teams conducted the PLLA from February 1-14, 1999 [7]

5 Immediately following the PLLA, Daniel Kaboré began his SAM field work, remaining in Mali until mid-April (see activity report No 3) As well as serving the needs of Kaboré's Ph D research, the data gathered will serve as part of the SANREM WA baseline information

6 Based on the results of the PLLA, a 'Call for Proposals and Expressions of Research Interest' was issued on February 23, 1999 to all participants of the e-mail conference requesting proposals in three general areas NRM and agricultural systems intensification, NRM and livestock production system intensification, and, formation and support for a commune-level NRM advisory committee As a result of the call and subsequent proposal evaluations and combinations/modifications, the final list of activity workplans submitted for Year 2 in March included
   a WAF-99-01 Coordination and Management of West Africa Regional SANREM Project
   b WAF-99-03 Cattle and Manure Management Strategies to Increase Soil Phosphorus Level in W Niger
   c WAF-99-04 Modeling Community Socioeconomic Linkages and Growth Toward Sustainable NRM Agro-Pastoral Systems Under Environmental Stress nd Conflict
   d WAF-99-05 Workshop on Conflict and NRM Emerging Lessons and Directions from West Africa (Funded through 'Global Issues')
   e WAF-99-06 Creation and Support of a Commune-Level NRM Advisory Committee
   f WAF-99-07 Testing and Demonstrating Natural Resource and Conflict Management Technologies and Practices to Increase Food Security and Income Generation in Madiama Commune, Mopti Region, Mali

   With revisions, these workplans were accepted at the end of April

7 At the end of March, Michael Bertelsen and Daniel Kaboré of Virginia Tech, and Ms Sissoko Haoua Traoré of IER led a two-day workshop on SANREM (Regional Workshop on Agro-Pastoral Systems in Conflict – see activity 4) in Cape Verde Participants of the workshop included the 9-member coordinating committee of the NRM Research Pole and INSAH representatives

[7] Synthese du Diagnostic Participatif Realise a Madiama et Nerekoro du 1er au 14 Fevrier 1999 Julia Earl et al SANREM CRSP University of Georgia February 1999 An executive summary in English was also prepared and circulated In addition trip reports by Constance Neely/Julia Earl and Jim McKenna were prepared and circulated A progress report by WSU was also prepared and circulated

8 During a site visit in May by Michael Bertelsen and Keith Moore, Virginia Tech and the Institut d'Economie Rurale (IER) concluded and signed a Memorandum of Understanding for the implementation of SANREM-WA Phase II activities in Mali[8] Lasine Diarra was identified as the primary SANREM-WA contact person for IER in his role as Program Leader for the IER NRM and Production Systems Teams (ESPGRN) He will transmit to Amadou Kodio, CRRA/Mopti ESPGRN Leader, and all messages concerning research activities in Madiama Preliminary arrangements were also initiated to transfer the SANREM WA Ford Bronco from Plan International (Burkina Faso) to IER The specific objectives and modalities for the SANREM-WA 1999-2000 Workplan were discussed with the ESPGRN in CRRA/Mopti and with CARE/Djenne The agreed implementation strategy involves close collaboration between VT, CRRA/Mopti, WSU, and CARE/Djenné A methodology and tentative execution plan for the initiation and support for the Natural Resource Management Advisory Committee (NRMAC) was established under the supervision of CARE/Djenne

9 Beginning in late May, Oumarou Badini of WSU traveled to Mali to coordinate IER and set up the equipment needed to collect the data for the biosystems models The equipment (solar powered) was installed in farmers' fields and will collect information on such items as rainfall, sunlight, and humidity A second objective of this trip was to establish the status of research on alternative NRM methods, both in agroforestry and wetlands management Dr Badini also coordinated commune committee development with CARE and CRRA/Mopti He returned to the US on June 25, 1999

V Summary of Results/Impacts Discussion

Good progress is being made in all activity areas of SANREM WA Although it is too early to assess project impact, after the Year 1 the SANREM WA project is on track for delivering the following impacts during the expected life of project

- 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)

- 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 locals)

- 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)

[8] A detailed Trip Report was prepared and circulated

- 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)

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

- 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)

VI Partners and Collaborators

SANREM WA is collaborating with the global project (decision-makers needs assessment, regional/global information system development, TAMU modeling efforts) and other USAID projects, most notably the NRM InterCRSP and the CBNRM project in Senegal

Inter-project activity collaboration is coordinated through the regional project management team at OIRD/Virginia Tech The primary means of integrating activities and partners/collaborators will be through the activities of the commune-level NRM advisory committee IER and Care are jointly involved in setting up and coordinating the committee meetings The Center for Holistic Management will be involved in some of the training of the committee as well as IER and Care staff

At the regional level, SANREM WA will continue to work with the Institut du Sahel (INSAH) and the NRM Research Pole Through INSAH, the project will coordinate with other CILSS entities including the CILSS headquarters in Ouagadougou, Burkina Faso and AGRHYMET in Niamey, Niger The Coordinating Committee of the NRM Research Pole serves as the regional technical advisory committee for the project

VII Problems encountered and steps taken to resolve them

Transportation to the Commune of Madiama has been very expensive We are working with the Global ME to transfer title of the SANREM WA vehicle previously used in Burkina Faso to IER Transfer and use of this vehicle through IER will allow us to pay only for gas and driver per diem Communications with IER/Mopti have been problematic We have now established a communications protocol with IER/Bamako and IER/Mali that should serve to reduce these problems

Funds to support SANREM WA activities for Year 1 were not received until February of this year In order to move project activities forward, particularly the Malian PLLA in January, OIRD/Virginia Tech was compelled to support the project from its general overhead account

VIII Plans for Subsequent Reporting Period

Collaborative fieldwork and monitoring will continue An MOU between Virginia Tech and CARE-Mali will be signed The first meetings of the Commune NRM Advisory

Committee will be organized and initial Committee training and project reporting will begin A baseline survey of the Madiama Commune will occur US and Malian partners will participate in holistic management training workshops Ph D research and training will continue

Individual Activity Reports

Conflict Prevention and Resolution in Agro-pastoral Systems Including Issues Associated with Variable Weather and Climatic Change in Northern Mali

Washington State University, IER

Introduction

This was a period chiefly of preparation and planning, centered on the PLLA (Participatory Lifescape/Landscape Appraisal) The process began with an e-mail conference held in November and December over the Internet Our partners from Africa as well as those in the United States participated in this In January many of the same participants held a workshop in Bamako, Mali, to plan the PLLA in detail and select a research site in northern Mali The place chosen was the commune of Madiama, made up of about a dozen villages near Djenné The villagers are agro-pastoralists and sedentary herders Conditions are Sahelian and the pressure on resources is severe, leading to conflict

This Activity is combining and testing two complementary lines of approach that the villagers can adopt to relieve some of this pressure and reduce conflict The first aims at relieving pressure on the resources by improving NRM practices in agriculture and wetlands management Among the accomplishments of this past year were computer runs of preliminary biophysical models measuring the impact of alternative NRM practices on, for example, crop yields and soil erosion

The second line of approach seeks to improve management of the local natural environment and reduce conflict through more effective cooperation among village groups The accomplishment here has been to select methods to be employed and determine in general terms how to integrate them with the biophysical modeling They emphasize close collaboration between villagers and researchers and include networks of user groups and holistic management methods that have been used with success in situations similar to that in Madiama

The technical modeling, the process of collaboration with the villagers, and conflict management and resolution aspects of this activity all tie in with other Activities in the West African program, as explained in detail below

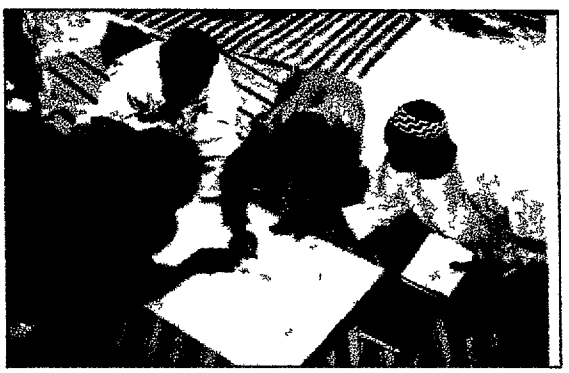
This Activity would be impossible without the partnership of local researchers and institutions The entities we are working with most closely are IER (Institut d'Economie Rurale) CARE (Cooperative for American Relief Everywhere) and ICRAF (International Center for Research in Agroforestry)

Objectives

- To identify the landscape/lifescape factors in the Northern Region of Mali that are most important to preventing and resolving the conflicts endemic to this area, taking into account the issue of global climatic change
- Identify specific tools and processes with most promise for use in identifying, preventing and resolving conflicts within the SANREM mandate, with an emphasis on West Africa Specifically, these include empirical tools, including modeling, and process tools for conflict prevention and management relating to sustainable agriculture and natural resources
- To identify and prioritize follow-up activities (years 2-5) for SANREM's West Africa program, in concert with the other West African objectives and with the emerging SANREM global research agenda

Methods

- Develop SANREM PLLA/Conflict Resolution team in Mali and the US, with other collaborators, as appropriate
- Access and consolidate secondary data and information relating to landscape/lifescape issues in Northern Mali and to associated conflicts and processes utilized in dealing with them
- Where necessary, conduct initial targeted surveys to fill key information gaps, as identified in the West African (Mopti) PLLA
- Utilizing the data consolidated and collected, develop prototype or illustrative empirical model/s, and conflict crisis prevention and resolution tools and processes, adapted to the Northern Mali and larger West African context
- In an action-training mode, bring key stakeholders together, in association with the April 1999 West African SANREM workshop, and use these prototype models as tools to identify research needs and approaches for years 2-5



Tombonkan participants in PLLA study Mali (Photo Keith Moore)

Outputs

Objective 1

To identify the landscape/lifescape factors in the Northern Region of Mali that are most important to preventing and resolving the conflicts endemic to this area, taking into account the issue of global climatic change

Planned outputs

- Interdisciplinary team (US, Malian, Burkina Faso, and potentially other countries) formed
- PLLA planned and carried out (January 1999) and skills increased in use of PLLA and associated methodologies to better understand and address issues of conflict prevention, management, and resolution

Actual outputs/accomplishments

The West African SANREM group achieved Objective 1, as planned, through the PLLA Initial discussions took place in November and December 1998 via an e-mail conference held over the Internet and moderated by Mike Bertelsen of Virginia Tech We then held a three-day workshop in Bamako, Mali from January 25-27, to plan the PLLA in some detail Collaborators described below in Section VI participated in both the e-mail conference and the Bamako workshop

Workshop participants chose sites for the PLLA and the subsequent research Many disciplines are represented among the researchers, among them sociology and anthropology, economics, agronomy, range science and ecology, soil science, agroforestry, biophysical systems engineering The researchers are from Mali, the United States and Burkina Faso (though these last are based in the U S)

Madiama Commune in Djenné Circle of the Mopti Region in northern Mali will be the research area Two representative villages in the area, Madiama and Tombonkan were chosen for the PLLA A subset of the workshop participants then went on immediately to carry out the PLLA over a period of two weeks In the course of their appraisal they added a third village, Nerekoro After completing the PLLA the team wrote and distributed full reports and an executive summary in both French and English

Objective 2

Identify specific tools and processes with most promise for use in identifying, preventing and resolving conflicts within the SANREM mandate, with an emphasis on West Africa Specifically, these include empirical tools, including modeling, and process tools for conflict prevention and management relating to sustainable agriculture and natural resources

Planned Output

- Summary of data and information sources produced specific to the models and tools being considered for use (annotated bibliography)

Actual Outputs

Dr Badini has compiled an extensive bibliography on the is subject of the biophysical models that the researchers will use to gauge the impact, initially, of farmers' current NRM practices on such items as soil erosion, soil fertility and crop yields Later they will use the same models to assess the impact of alternative farm practices on the same variables

The West African SANREM group decided that the chief process oriented, conflict management tool would be the establishment and training of NRM Advisory Committees at the village and commune levels A key aspect of the training will be based on Holistic Management principles, carried out by Sam Bingham and Jeff Goebel They and others have fully documented the methods they employ and have made the literature available

Planned Output

- Results of targeted surveys produced that fill key information gaps in available data/information needed for developing and testing the models and tools

Actual Outputs

We summarize the PLLA results in Section V These will be supplemented by the results of two other surveys One focuses on economic data and has already been carried out by Daniel Kaboré in the course of his research under another Activity (Modeling Community Socioeconomic Linkages and Growth, WAF 98-05) In the other, beginning in June 1999 under next year's stage of this Activity (WAF 99-07), Oumarou Badini is collecting on-farm biophysical data that will relate NRM practices at the farm level to such variables as soil type and rainfall

Planned Output

- At least one prototype or preliminary model developed for empirical assessment of natural resource (landscape/lifescape) conflicts
- At least one prototype "best practices" tool, adapted to West African context, developed for conflict management/resolution

Actual Outputs

In the summer of 1998, Oumarou Badini developed and ran preliminary computer simulations of prototype models that include farm level NRM practices among the variables Examples of practices that he modeled are fallowing, grazing crop residues, burning them and leaving them on the fields

As already mentioned, the West Africa program has determined that it will make use of holistic management techniques to manage and resolve conflicts These techniques have frequently been used in West Africa What we have done this past year is to develop an approach (a "model") that brings these two different activities together into a coherent program It also closely links them to a new Activity, the formation of the Commune NRM Advisory Committee (WAF 99-06) run by Virginia Tech and the same collaborators in Mali

Objective 3

To identify and prioritize follow-up activities (years 2-5) for SANREM's West Africa program, in concert with the other West African objectives and with the emerging SANREM global research agenda

Planned Output

- Key research needs for follow-up in years 2-5 identified and prioritized (specific to this activity and interfaced with other West African Region activities)

Actual Outputs

Research areas have been defined in broad terms with the help of the PLLA, as described in Section V The first priority for this year is to define the research in specific terms – in particular identifying NRM practices that will be tested in farmers' fields The process of making priorities will be collaborative, involving the farmers themselves, local researchers and others (See Section VII on collaborators)

Planned Outputs

- Workshop participants (esp Malian and West African stakeholders) gain experience in use of tools developed and provide input into improvement of tools
- West African "network" of persons interested in the tools and their use in conflicts initiated, as a result of their participation This may lead to testing and further developing the tools in a larger regional context, including their application to existing conflict situations

Actual Outputs

The chief tool employed in 1998/99 was the PLLA All the participants in the Internet conference and the Bamako planning workshop contributed to the development of this particular PLLA and learned from the other participants

Expertise came from two sources in particular Amadou Kodio and Haoua Sissoko, to name only two from among many from IER (Institut d'Economie Rurale), have wide experience in using participatory appraisal methods in Mali Constance Neely and Julia Earl from the University of Georgia, have a great deal of experience from earlier PLLAs conducted in several countries The IER researchers in natural resource management under Lassine Diarra form a key element in this network, as does the team from CARE based in Djenne that is collaborating with the effort in Madiama

The link to regional and other international bodies was established through INSAH (Institut du Sahel), which hosted the Bamako workshop, and ICRAF (International Center for Research in Agroforestry), which participated

Summary of Results

The PLLA team produced full reports and an executive summary The following are salient points

- Villages tend to be homogeneous within themselves in terms of ethnic make-up and the kind of agricultural livelihood that predominates However, they differ from one another in these same characteristics In some the inhabitants are mainly agro-

pastoralists and in others they are sedentary herders The some of the agro-pastoralist villages are dominated by Maraka, others by Sonnike The sedentary herders are Peuhl

- Land use is primarily under the control of agro-pastoralists rather than sedentary herders Most land is used to grow crops, leaving little for grazing
- Fallowing is not widely practiced Soil fertility has become very low In a low rainfall year, 80% of the population in the dominant village is estimated to be food insecure Poverty levels are high
- Manure is used to fertilize crops to the extent that it is available Chemical fertilizers are used on irrigated rice fields
- Water shortages are serious
- Conflict most commonly arises between crop farmers and livestock herders Objects of conflict are damage in fields caused by animals, passages for animals to water and pasture In addition, conflict arises between villages over access to water, pasture, and *bourgou*, a favored animal fodder that grows naturally in wetlands
- The villages have long had procedures, usually managed by their chiefs, for settling conflicts that arise among their own inhabitants The only formal mechanisms for resolving conflicts between villages have been those established by and under the control of the Bamako government

Impact Discussion

Who was impacted and how?

- In the villages there has been no lasting research impact as yet because at this early stage research has not proposed any solutions to their problems

How has the project contributed to SANREM's programmatic goals?

- The involvement of the partners mentioned in the next section in the planning and execution of the PLLA has met all three of SANREM's programmatic goals These are to provide natural resource decisions-makers with (a) access to appropriate data and information, (b) access to appropriate tools and methods to analyze the data and information, and (c) enhanced individual and institutional capacity to make decisions
- The execution of the 1999/2000 work plan will advance these goals further

Partners and Collaboration

- Farmers and herders in Madiama and the Madiama Commune NRM Advisory Committee
- IER, Institut d'Economie Rurale
- CARE, cooperative for American Relief everywhere
- INSAH, Institut du Sahel
- USAID/Mali Governance and Sustainable Economic Growth teams

- ICRAF, International Center for Research on Agroforestry
- University of Georgia
- Virginia Tech
- Washington State University

Collaboration with other Activities

- Cattle and Manure Management Strategies to Increase Soil Phosphorus Levels in Western Niger (WAF 98-03)
- There is no direct collaboration with this Activity in the sense that there are operations that we run together However, the results of the research in Niger will certainly have implications for NRM practices in Madiama and recommendations for NRM practices there
- Modeling Community Socioeconomic Linkages and Growth (WAF 98-05) As we mentioned in Section IV, the data collected in the survey undertaken for this Activity will be crucial in understanding the economic relationships and therefore the conflicts, between different farmer groups and villages in the commune These data will also be important in determining any economic analysis undertaken later (after the 1999/2000 planning period)
- Regional Workshop on Agro-Pastoral Systems in Conflict (WAF 98-06) The results of the PLLA formed the core of the material presented at this workshop

Collaboration with other Projects

Development of Global Decision Support System (GDSS) Texas A & M is developing a suite of economic, environmental and biophysical models the purpose of which is to gauge the impact of changes in technology on agriculture and natural resource use These models are both geo-referenced and linked to one another Neville Clarke and Jerry Stuth came to Washington State University to discuss collaboration, and Bobby Eddleman, an economist from Texas A & M participated in the January PLLA planning workshop in Bamako The biophysical and economic modeling done under three headings, the GDSS, this Activity (98-02) and Modeling Community Socioeconomic Linkages and Growth (WAF 98-05 and 99-04), will provide important opportunities for comparing results and data exchange

Problems encountered and steps taken to resolve them

No particular problems were encountered in field The severest problem was the late start in operations due to late arrival of funds The step taken to resolve this was to act very quickly at the end of 1998 and beginning of 1999 to plan and implement the PLLA

Plans for the Next Reporting Period

The strategy adopted for this Activity is to tackle the problems summarized in Section V in two very different but complementary ways One seeks to relieve pressure on resources and improve food security by improving NRM practices employed by farmers To this end, agroforestry and wetlands management technologies that have proven successful in similar conditions will be tested in farmers' fields or (in the case of wetlands management) commune land The other aims at improving management and reducing conflict through more effective cooperation between villages Here the techniques will be based on holistic management principles that have proven their effectiveness elsewhere Throughout, the work will be approached collaboratively, with the villagers themselves, with researchers in IER and development workers in CARE

The plans for the next reporting period are based on Objective 1 in the 1999/2000 workplan

Objective 1 Establish local NRM groups, identify available practices and establish benchmark characteristics of the area

Methods

- Establish and train NRM groups at the village and commune level to elicit collaboration in program activities using consensus building, holistic management, enterprise facilitation approaches
- In collaboration with IER, ICRAF and other partners, identify natural resource management technologies and practices that have been tested enough to undergo field trials in Madiama commune this year
- Through a sample survey and field monitoring carried out in the research area, establish benchmark characteristics of local natural resource management technologies and practices, taking account of biophysical, economic and process oriented variables
- Creation of a Community Level NRM Advisory Committee (WAF 99-06) Collaboration has been closest here The research on current and alternative NRM practices works with farmers through this committee and at the same time provides an activity on which the committee can initially focus This symbiosis is underlined by the fact that funding for the conflict management and resolution training that is programmed to occur in October 1999 is split between the NRM Advisory Committee Activity (99-06) and the current and alternative NRM practices Activity (99-07)

Cattle and Manure Management Strategies to Increase Soil Phosphorus Level in Western Niger

University of Wisconsin, ILRI

Introduction

Soil fertility depletion on smallholder farms is considered the fundamental cause for the declining food production in Africa (Sanchez et al, 1996, Enyong et al 1999) Results from a Participatory Landscape Lifescape Appraisal (PLLA) in Mali indicate very poor soil fertility as one of the major constraints identified by villagers In addition, Niger's sandy soils are inherently low in soil fertility making nutrient deficiency a major constraint to crop production Even though, ruminants are integrated in nutrient cycling in the agropastoral systems, their contribution is insufficient The purpose of this research is to investigate ways to improve the management of nutrients in agropastoral systems in order to increase soil fertility

Objectives

Three objectives have been identified for this research At this point, data have been collected for one objective and the activities for the two others will be developed in the plan for the next six months

The first objective was to estimate the effect of P supplementation to cattle on fecal phosphorus output and the response of millet to manure (enriched) application compare to direct application of P fertilizers

To improve soil fertility, it is not only necessary to investigate resource management practices at the household level but it is also necessary to explore the bigger picture at the community level In fact, resources such as grazing land, tree fodder, and crop residues are most of the time communally used Nutrient transfer is subject to management practices at the communal as well as the individual level The first objective of the second part of this research is to investigate farmers' perceptions and understanding of soil fertility, to assess how their knowledge in soil typology is used to improve soil fertility and the role of livestock in the management of soil fertility How do farmers define soil fertility? What method do they use to replenish soil fertility? How do farmers view the contribution of different types of soil fertility improvement strategies? How do farmers perceive the role of livestock in soil fertility management?

The second objective is to assess the contribution of communal action in soil fertility improvement Natural resources of the village territory are subject to regulation To an outsider community-based nutrient management is hardly perceived compared with individual management practices What do people do as a community to improve nutrient management? How is access to uncultivated areas regulated? For example, can anyone harvest grass or fodder on uncultivated village land? How is herding arranged collectively? Is there any possibility for similar arrangement for manuring? What does the community think about the way they manage their natural resources? Where do the

community and individual management practices overlap? Which resources could be better managed collectively or individually?

We will combine qualitative and quantitative methods to elicit answers to these questions

Specifics objectives

- To understand farmers perception of soil fertility, the role of cattle in soil fertility management, and how farmers relate fertility improvement strategies to different soils
- To describe present communal management action and its contribution to soil fertility
- To identify the complementary actions between communal and individual's management, and what should be done communally or individually to improve the contribution of livestock to soil fertility
- To identify potential sources of conflicts regarding communal management decision and individual management practices

Hypotheses to be tested

Hypothesis 1 Farmers use their perception and understanding of soil fertility and herd management to increase the fertility level of their cropland

Hypothesis 2 Collective action in the management of natural resources make positive contribution to soil fertility

Methods

An experiment was conducted from February 17th to June 7th in the village of Boundou (a research site of ILRI) Thirty-six cattle from 2 to 3 year-old were used for the experiment An average weigh was taken and used along with the animal's race to form 6 lots (lot 1 to lot 6) of six animals each Two feed supplements (100 g dry mater (DM) millet bran and 500 g DM cowpea hay) were distributed daily Millet bran was given to all animals to facilitate the administration of phosphorus (0 g of P_2O_5 to lot 1 and 4, 15 g to lot 2 and 5, and 30 g to lot 3 and 6 Lot 4, 5, and 6 received cowpea hay Total fecal material were collected for 5 days each month on half of the herd to estimate the impact of phosphorus supplementation on feed intake and on the quality and quantity of manure Vegetation samples were collected at the same period to estimate the quality of available forage Animals were weighed on a monthly basis to estimate the impact of the supplementation on their weight Each lot was tethered on a plot of 8m x 8m for 7days, to allow the deposition of about 6t of manure per hectare for millet production Millet will be planted as soon as it rains

Methodology for second part of research Qualitative interviews and quantitative measurement will be combined to test the hypotheses The qualitative information will be collected using focus group interviews and open-ended questions The goal is to have a group of farmers discuss the concept of soil fertility given their own perception and to describe what they do as a community to manage natural resources Focus group

interviews will help to get information such as calendar of activities around manuring and herding across the year, qualitative ranking of manure, and description of daily activities about labor for manuring or herding Strategies used to improve soil fertility and the importance of livestock in the management of soil fertility as well as general questions concerning decision making process over resources belonging to the community are possible discussion topics Individual farmers (key informants) will be selected for longer interviews on descriptive questions A transect can be used in the field to have a farmer describe the fertility status of his field or to explain manure application in relation with soil type Soil samples will be collected to correlate nutrient content to farmers' management practices

We will document farmers' perceptions of the collective management and individual management of natural resources, and their suggestions of strategies for better nutrient management

Outputs

All data needed were collected Samples are in the process of being analyzed and other information was entered in files Millet productivity will be measured after harvest Conclusion and recommendations will be available in December

- Phosphorus supplementation was conducted on 36 zebus cattle from February to June 99
- Data on weight, fecal output, and estrusa were collected and inputted in computer and are being analyzed
- Data on available forage and the effect of supplementation on animal feeding behavior were collected (3 different periods) as well as samples of feed and fecal materials, are all being analyzed
- 54 experimental plots were planted with millet after carrolling cattle (who have received phosphorus supplement) for seven days
- Survey instrument to assess the contribution of communal action to soil fertility management has been designed
- Survey instrument to assess farmers' perception and understanding of soil fertility and the role of livestock in soil fertility management has been designed

Impacts Discussion

- This project is targeted to provide information to local farmers and to national and international development scientists and policy makers If by supplementing cattle with a small amount of fertilizer we can improve animal condition during the dry season and increase nutrient content in manure, we will be able to increase crop production
- Contribution to SANREM's programmatic goals Soil fertility is one of the constraints facing food security and is also source of conflict With the two others objectives (natural resource management by individual and the community) of the project, we hope to provide information that can be used by SANREM for intervention in Mali

Identification of Partners and Collaboration with other projects/activities
This is a collaborative research between the University of Wisconsin-Madison and International Livestock Research institute (ILRI) This research is being conducted in Niger as part of SANREM graduate student, Brigitte Gnoumou's PhD studies The research is funded by a Rockefeller Foundation ADIA grant and the SANREM West Africa project

Problems encountered and steps taken to resolve them
Farmer interviews planned for May to November 1999 have been rescheduled for January 2000 to May 2000 This has been done to broaden the scope of our research to reach a community level and also to conduct interviews when farmers are less busy with farm work

Modeling Community Socioeconomic Linkages and Growth: Toward Sustainable NRM Agro-Pastoral Systems Under Environmental Stress and Conflict

Virginia Tech, CARE, IER

Introduction

SAM Background The Social Analysis Matrix (SAM) approach traces its ancestry back to 1758 and the Tableau Economique1 of famous French economist Quesnay where the circular flow of an economy was first described In the latter part of the 18th century, another French economist, Léon Walras, added mathematical rigor and expanded the idea into the concept of general equilibrium where all flows of an economy are brought into equilibrium through the actions of markets Formal and continuous measurement of these equilibrating flows at national levels didn't begin in earnest until after the stock market crash of 1929 when developed countries began to recognize the need to develop a comprehensive system of national accounts to better understand the interrelationships within their economies and to use as the major yardstick for measuring economic progress (e g , GNP, NNP) The economy-wide model implicit in the system of national accounts was taken one big step further by Nobel laureate Wassily Leontief, developer of input-output analysis Leontief used data from the national income and product accounts for the US to develop and use fixed-price multipliers to analyze consequences of changes in the final demand for the different sectors of the economy Subsequent to this, input-output models of many developed countries were created and used for similar types of development planning They continue to be a primary tool for regional economic and environmental analyses

SAM development occurred along side of input-output analysis and built on it by adding factor and institutional endogenous sectors to the analysis matrix Primary credit for the development of the SAM approach goes to another Nobel Prize laureate, Sir Richard Stone Stone added economic and social structure that both complemented and completed the production information found in the input-output sectors By providing a comprehensive, time-exposed snapshot of an entire economy, it also created the statistical foundation for a model of the economy from which the impacts of interventions could be simulated It also allowed for significant disaggregation of institutions thereby permitting an analysis of the distributional consequences of policies and other exogenous factors SAM frameworks for analysis have been used quite extensively in development, most notably for planning purposes at the national level Recently, however, SAM analyses in developing country situations have been conducted at the village level Village-level SAM models are particularly promising because they are able to bridge the gap between microeconomic household-production models and macro-level national and regional models such as Computable General Equilibrium (CGE) models used extensively in macro policy analysis A SAM is a particularly complementary framework for CGE since it requires the same basic data and, at the same time, provides a model that can be used to calibrate the CGE

Objectives

Objective 1

Develop a SAM model of a representative landscape/lifescape (community) in Northern Mali that disaggregates the NRM-related economic activities of pastoral and agro-pastoral/sedentary sectors and analyze the dynamics of the economy including the sector linkages and potentials for sector and economy-wide growth in production, income, and employment

Objective 2

Identify high potential sectors for sustainable NRM interventions that may ameliorate conflict by generating greater community-wide growth and development including the identification of priority research and investment alternatives that further high potential alternatives

Objective

Expand the SAM model to the larger, regional area (arid/semi-arid region) and expand the scope of analysis to include environmental accounts The analysis will refine the analysis of the dynamics of the regional landscape/lifescape economy and identify high potential sectors for sustainable NRM at the regional level

Methods

Objective 1

- Participate in the Northern Mali PLLA in order to obtain Project guidance on the specification of the SAM model problem
- Conduct an income/expenditure survey of a representative Northern Mali community experiencing agro-pastoral-related conflict
- Input data, develop the SAM matrix, and related multipliers
- Analyze multipliers and estimate impacts
- Assess usefulness of SAM methodology for commune-level decision-makers

Objective 2

- Inventory sector-level sustainable NRM interventions feasible in the Northern Mali context
- Based on the SAM model, identify highest potential NRM interventions
- Identify additional research needs based on the model and analysis
- Identify other high potential investments based on the model and analysis
- Report results in local (commune), national, and international fora

Objective 3

- Revise SAM model through additional surveys involving a larger landscape/lifescape
- Input data, develop the revised SAM matrix, and related multipliers
- Analyze the model, multipliers and estimate impacts
- Based on the revised analysis, identify highest potential NRM interventions to ameliorate conflict in regional agro-pastoral systems

- Report results in local, national, and international fora
- Link results to other regional and global impact analyses

Outputs

Objective 1

Surveys to collect necessary data for SAM modeling were conducted immediately after the PLLA in February-April 1999 in the Delta region of Mali A survey instrument was developed and pre-tested Enumerators were thoroughly trained during the pre-test period Data are currently being entered and preliminary descriptive analyses are expected to be ready in late July 1999

Objective 2

The PLLA provided substantial background for this objective During the survey, the PI met with IER, local government officials, and CARE-Mali to explain the objective of the SAM study and the relevance of its results for policy-making Involving local institutions ensures that the results will be used by local policy-makers

Objective 3

No progress to report

Summary of Results

A sample of 120 households was selected and interviewed The dominant activity (farming, animal husbandry) served as the critical sampling stratification criterion since principal conflicts are generated through the use of more and more restricted natural resources by these groups Table 1 presents the sample distribution by dominant activity farmers (36%), agro-pastoralists (27%), sedentary pastoralists (19%) and transhumant pastoralists (18%)

Preliminary information from the PLLA and key informants as well as data from the administrative office were used for sample stratification and village selection In each strata, sample members were randomly selected during a general assembly with the villagers

Table 1 Sample distribution by activity and village, Madiama commune, Mopti region, Mali,1999

VILLAGES	GROUP by M A I N A C T I V I T Y				TOTAL
	Farmers	Agro-pastoralists	P A S T O R A L I S T S		
			Sedentary	Transhumant	
Madiama	12	20	0	0	32
Promani	8	5	10	0	23
Tombonkan	9	1	0	0	10
Tatia-Nouna	14	6	4	0	24
Nerekoro	0	1	9	21	31
TOTAL	**43 (36)**	**33 (27)**	**23 (19)**	**21 (18)**	**120 (100)**

In parentheses are percentages to the sample size

Impact Discussion
It is too early in the process to assess impact After analysis of the results, a return trip to Madiama to present the results to the Commune-level NRM Advisory Committee and other stakeholders is planned

Partners and Collaboration with Projects/Activities
This activity complements and interacts with activity WAF-98-02 - "Conflict prevention and resolution in agro-pastoral systems resulting from climatic change in Northern Mali" Results are expected to provide policy/research guidance to the follow-on to this activity in subsequent years The PI also participated in the SANREM Workshop (WAF 98-05) held in Cape Verde Data and information sharing with the TAMU regional modeling effort is also planned

Problems encountered and steps taken to resolve them
The most serious data problem encountered so far involves our concern for and confidence in the head counts given by the livestock herders While the reluctance to give accurate information in this case is understandable, if it introduces a systematic bias into the data it could significantly affect the results We believe this potential problem was reduced to some extent by bringing along a respected member of the pastoral association to introduce the survey to members and solicit their cooperation
We will continue to continue to search for additional ways of dealing with this problem including more literature reviews and further discussions with stakeholders on how to improve data quality

Plans for next Reporting Period

Data are being entered into the computer and preliminary descriptive analysis will be conducted after the data cleaning process is completed SAM modeling will begin shortly thereafter

Regional Workshop on Agro-Pastoral Systems in Conflict

Virginia Tech, INSAH

Introduction

Horizontal scaling of project results is fundamental to the SANREM strategy to achieve impact at the regional and global scales From its inception, Phase II of SANREM WA has sought to facilitate horizontal scaling at the regional level by directly involving our regional partners in the design and technical oversight of project strategies and activities By leveraging our (OIRD/Virginia Tech) leadership in other projects, most notably the West Africa NRM InterCRSP, we have taken advantage of the close working relationships we have established with the Institut du Sahel (INSAH), and through INSAH, the NRM Research Pole, to further the regional objectives of the project

INSAH is the policy and research coordination arm of the nine-country CILSS (Comité Permanent Interetats de Lutte contre la Secheresse Dans le Sahel) organization in arid and semi-arid West Africa Among other functions, INSAH is charged with coordinating the regional implementation of the UN Desertification Convention and fostering regional research coordination in NRM Support for the NRM Research Pole is the primary INSAH (and NRM InterCRSP) strategy to fulfill this latter responsibility The NRM Research Pole is a research center of emerging NRM excellence in Sahelian regional space around which related research in the nine CILSS countries is being organized and coordinated in an effort to stretch limited resources, capitalize on comparative advantage of partner countries, and share research results The Pole Coordination unit is located within INERA of Burkina Faso INSAH and the NRM InterCRSP support regular Pole Coordinating Committee (PCC - composed of national representatives of the nine countries) meetings and the activities of four regional projects In addition, the NRM InterCRSP will provide seed money to launch Pole-coordinated research programs in the four Pole vanguard countries (Senegal, Mali, Burkina Faso, and Niger) The PCC serves as the West African component of the NRM InterCRSP Technical Committee Representatives of the CRSP Council serve as the US component of this committee

INSAH and the PCC were directly involved in the first SANREM WA Implementation Planning Workshop held in Bamako, Mali in March 1998 This workshop was chaired by INSAH and provided the general implementation strategy that has since been followed by the project Among the implementation activities planned during this workshop were regular consultation meetings to be held with the PCC

To leverage very limited resources and take advantage of the presence of the members of the NRM Research Pole and INSAH at a regularly scheduled and InterCRSP-supported PCC meeting in Cape Verde in March of this year, a two-day workshop on the SANREM CRSP was held at the end of the regular Pole meeting This report documents the activities and results of this meeting

Objectives
The objectives of the workshop were

- To inform Pole members and INSAH on the development and progress of the SANREM Project in West Africa
- To solicit the advice of the Pole on technical and strategic aspects of the project Foremost among these aspects was the future relationship of the SANREM CRSP and the NRM Research Pole

Methods
To assist in the presentation of SANREM WA to the Pole PCC members, Mme Sissoko Haoua Traoré (IER specialist in participatory methods) and Daniel Kaboré (INERA – current graduate student at Virginia Tech) were brought by SANREM to Cape Verde from Mali to explain different aspects of the program

Outputs
The workshop began with a discussion of the results of the previous 1998 SANREM workshop in Bamako Mike Bertelsen (SANREM West Africa Coordinator) then presented the objectives of the workshop and made a presentation on the regional background literature and experience survey of conflict and NRM in agricultural and pastoral systems in West Africa that occurred during the previous summer Mme Sissoko then presented the methodology and results of the PLLA in Madiama Commune, Mali that occurred in February of this year This was followed by another presentation by Bertelsen on the resulting call for proposals and the SANREM research program that resulted from the PLLA Daniel Kaboré then presented overviews of the socioeconomic (Social Analysis Matrix – SAM) and biophysical modeling efforts led by Washington State University that form an integral part of the SANREM Program's mandate to inform decision makers at different scales on related conflict and NRM issues Finally, Gaoussou Traoré of INSAH presented an overview of the interface between the SANREM program and INSAH's regional strategy, emphasizing the role of the different SANREM global initiatives (decision-maker assessment needs, regional/global database development) including an overview of the regional/global decision support modeling efforts of Texas A&M

Summary of Results
Each presentation provoked many questions from the participants and a great deal of lively debate At the conclusion of the workshop, the PCC offered their commentaries and recommendations[9] Among their recommendations was that SANREM (and partner institutions in West Africa) make a greater effort in communicating with partners (particularly with IER), especially in programming future interventions They underlined the important leadership role that IER must take in the program Finally, they discussed at some length the future relationship between the Pole and SANREM They considered three possibilities a) continue with separate meetings associated with the regular PCC meetings, b) incorporate a regular SANREM meeting agenda into the regular PCC

[9] A synthesis of discussion and recommendations is available in French

meeting agendas, and, c) fully integrate SANREM into the Pole program as another thematic area (like the four currently InterCRSP-supported regional activities) A fourth possible option, discontinuing the SANREM/Pole relationship was not mentioned and clearly was not seen as desirable The consensus of the PCC was that the third option (full integration) was premature and that more reflection was necessary in order to decide between the first two options Meanwhile, the present option (separate but connected meetings) should continue

Impacts Discussion
The SANREM CRSP presents an interesting and early challenge for the Pole, both in concept and in implementation All members recognize that SANREM is clearly a regional NRM program dealing with important issues Nevertheless, some elements of SANREM fall outside of the thematic areas identified for the Pole The question naturally arises, 'if the Pole is to assume its coordinating and leadership role in NRM research in the Sahel, how should it react in the future to SANREM and similar projects that overlap with some aspects of the Pole thematic areas?' The Pole was initially conceived as a more limited effort to take advantage of the comparative advantage of the NARS in different thematic areas by concentrating leadership of these areas within individual NARS This would permit a degree of specialization, a reduction in the duplication of effort, the use of internal resources for regional purposes, and the preparation of regionally coherent program that may attract greater donor support However, the Pole is finding that spillover effects are as common in programming NRM activities as in NRM itself As a result, it appears that the concept of the Pole is already beginning to evolve toward accepting a greater responsibility for interacting with and coordinating regional NRM activities SANREM may be the first (after the InterCRSP project) of perhaps many future initiatives where the Pole may assume a coordinating role Perhaps in the future the PCC meetings will be combined with a series of workshops sponsored by different regional NRM projects that report on their progress and seek the technical and coordination advice of the CRC Although problems remain for the Pole and the PCC has a ways to go before it becomes an effective coordinating body, this may be a very positive development for future NRM research in the Sahel

Partners and Collaborators
The principal partners in this activity are the regional entities INSAH and the NRM Research Pole Through coordination

Problems encountered and steps taken to resolve them
In order to leverage very limited funds to support this activity, this workshop was combined with the regular meeting of the Pole PCC and INSAH This had the desired effect of greatly reducing project cost

Plans for Subsequent Reporting Period
The related workshop scheduled for this coming year is being planned to overlap with a regular meeting of the Pole PCC and the NRM InterCRSP

VII. Appendix

Appendix to Global Project Report: Global Information Exchange and Global Knowledge Base Development

Capacity Building

Proposal on Dissemination of Value-Added Information to Natural Resource Decision-Makers for Easing Conflicts in West Africa

Dissemination of Value-Added Information to Natural Resource Decision-Makers for Easing Conflicts in West Africa

Objective

The objective of this proposed project is to reduce the potential for conflict over natural resources through an appropriate, timely and easily accessible information system By adding value to radio broadcasts and making this information easily accessible to all segments of Malian society, this proposed project is intended to address USAID's special strategic objective to facilitate political stability, encourage democratization and alleviate poverty in northern Mali

Background

With limited human and natural resources and little investment in infrastructure, the political balance in northern Mali is fragile Uneven distribution of Mali's scarce resources resulted in the Tuareg rebellion of 1990-95 Though the warring factions reached an agreement, 150,000 refugees returning during 1996 and 1997 are straining northern Mali's tenuous peace

Natural resource management (NRM) is often the crux of conflicts among diverse peoples and cultures in the Sahel, all of which depend on natural resources for their livelihood Conflicts are particularly acute in areas where competition is highest for natural resources, especially water, and for rights to cultivate and graze Ethnic differences broaden and aggravate conflicts, sometimes resulting in widespread and long-term chaos in already difficult circumstances

The development community has tried to address the importance of natural resource management as a component of conflict resolution, but the issues are complex In Mali, the delta region attracts herders, farmers and fisherfolk who compete for crop residues, water use and grazing areas Clashes often arise between sedentary farmers and nomadic herders who use natural resources in different, often opposing, ways

Nomadic herders are viewed by many as an ecological and economic liability In an effort to limit this liability, development efforts have been aimed historically at encouraging nomadic populations to end their practice of seasonal migration Success of this policy could potentially control disease and provide to these nomads access to democratic governance and taxation, which would then aid infrastructure development In addition, many in the development community believe that livestock policies could be improved, potentially alleviating the current meat supply shortage in the coastal countries of West Africa

However, the local population has not traditionally been involved in design and implementation of these interventions Such efforts have resulted not in a decrease in herder migration, but in many cases have heightened the conflict between herders and farmers We believe that more community-based approaches are needed, and that the nomadic populations should be included in the process

SANREM CRSP in Mali

The Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program (SANREM CRSP), funded by USAID, is committed to developing strategies for natural resource management as a means of conflict resolution Early in 1999, SANREM CRSP's West African Regional Program held a Participatory Landscape/Lifescape Appraisal (PLLA) in Mali The Executive Summary of this PLLA is attached

A main objective of the PLLA was to determine how natural resource management could be used to ease food insecurity and poverty as well as conflicts in agricultural and pastoral systems in the arid and semi-arid regions of West Africa The PLLA included a three-day workshop held in Bamako Workshop participants included SANREM CRSP representatives, local partners including the Rural Economic Institute and the Institute of the Sahel, CARE-Mali, and the Project for Natural Resource Management Intensive participatory appraisals were conducted at three villages Each village appraisal resulted in a set of themes on which SANREM CRSP researchers would concentrate While each village is different, all face similar circumstances For example, the key themes that emerged from the village of Madiama are

1 Seek to understand the Landscape/Lifescape interactions in natural resource use, access and control, food security, and poverty
2 Assess natural resource management practices and the factors influencing those practices
3 Identify natural resource conflicts Conflicts between farmers and herders are the most frequent and contentious, as both groups rely on natural resources for their way of life
4 Identify conflict management strategies It will be necessary to provide village leaders with information on mediation strategies
5 Identify decisions made by village-level authorities

Pilot Project

We propose a partnership among organizations such as SANREM CRSP/West Africa, ACMAD, AGRHYMET, WMO, and the Mali Meteorological Service, with the assistance of USAID/Mali, NARS, NGOs and local communities, to develop and implement an information dissemination system for natural resource managers and users in Mali Battery-less radios will be used to bring to Mali's most volatile areas critical, timely information in the local dialect The project will also develop strategies for mediation between conflicting parties Specific communities have not been identified for the pilot project we envision

We propose that ACMAD, SANREM/Global Program and AGRHYMET use remote sensing, meteorological data and forecasts to develop an information stream specific to the needs of Mali's populace, to be distributed by the Mali Meteorological Service, Extension Service and NGO community This process would add value to the information stream by incorporating crop and forage model data that would predict crop maturity dates, grassland productivity and animal carrying capacity, and the length of

time grasslands could support grazing Combining these data would enable predictions of areas where the timing and extent of herd animal movement may overlap with crop maturity dates, indicating the potential for conflict

We believe that distributing such information to local people, especially women, could provide a means to avert conflict through alternative solutions

Objectives

1 To avoid degradation of the fragile Sahelian environment through a better correlation of livestock grazing with vegetative production
2 To promote sustainable use of Mali's scarce natural resources between nomadic herders and sedentary farmers
3 To provide timely information to local people and communities, enabling them to manage their resources while avoiding conflict
4 To encourage community dialogue and democratization, and ultimately to alleviate poverty and environmental degradation through more effective use of natural resources

Outputs

1 Models of the relationships between climate and climate variability and the availability and productivity of renewable natural resources and agricultural systems shared by farmers and nomads
2 Systems recommending responses to model predictions of food and fodder resources over time and space Interpretations of those predictions in terms of potential impact, e g (a) to identify zones where natural pastures are not used effectively, (b) to recommend beneficial grazing patterns for nomadic herders that will not antagonize sedentary farmers, (c) to monitor impacts on the natural resources of pastoral systems
3 A clear, concise and timely information dissemination system
4 A study of the potential for expanding the scope of information to address other concerns such as desert locusts and disease outbreaks

Conclusion

Natural resource management in Mali encompasses several complex issues By providing information specifically tailored to the needs of the local populace, we believe that this proposed project would enable Mali's citizens to address cultural, political and environmental issues in a peaceful and effective manner Likewise, we would develop information dissemination methods that could be used to address similar problems throughout West Africa

VIII. Acronyms

ACRONYM LIST

ACMAD	African Center for Meteorological Applications and Development
ACT	Almanac Characterization Tool
ARTEMIS	Africa Real-Time Environmental Monitoring Information System
ASB	Alternatives to Slash-and -Burn
ASM	Agricultural Sector Model
ATSAL	Agroforestry Tree Seed Association of Lantapan, Philippines
AU	Auburn University
AWS	Automatic Weather Stations
CARE	Cooperative for American Relief Everywhere
CBNRM	Community Based Natural Resource Management
CCD	United Nations Interdepartmental Committee on Convention on Combating Desertificaiton
CGE	Computable General Equilibrium
CGIAR	Consulative Group on International Agriculture Research
CIAT	Centro Internacional de Agricultura Tropical
CILSS	Comite Permanent Interetats de Lutte contre la Secheresse Dans le Sahel
CME	Common Modeling Environment
CMU	Central Mindanao University
CODELSPA	Defending San Pablo Lake Committee
CONDESAN	Consortium for the Sustainable Development of the Andean Ecoregion
CENRO	Community Environment and Natural Resource Office
CIMMYT	International Maize and Wheat Improvement Center
CQ	Central Queensland University
CRRA	Regional Agriculture Research Center, Mali
CSD	United Nations Commission for Sustainable Development
DA	Department of Agriculture, The Philippines
DENR	Department of Environment and Natural Resources, The Philippines
DILG	Department of the Interior and Local Government
DMNA	Decision-Maker Needs Assessment
DRAER	Regional Ministry for Management and Provision of Farming Tools to Rural People
DRAMR	Regional Ministry for Support to the Rural World
DRRC	Regional Office of Regulations and Enforcement
DURW	Durum Wheat
ENRO	Environmental and Natural Resource Officer
ENSO	El Niño/Southern Oscillation
ESRI	Environmental System Research Institute
FAA	Department of Fisheries and Allied Aquacultures, Auburn University
FAO	United Nations Food and Agriculture Organization
FEWS	Famine Early Warning System, USAID

FIVIMS	Food Insecurity and Vulnerability Information Mapping System
FLIPSIM	Farm Level Income and Policy Simulation Model
FVI	Forage Value Index
GASM	Global Agricultural Sector Model
GDRN5	Natural Resource Management and Decentralization NGO Network, Mopti Region, Mali
GDSS	Global Decision Support System
GEM	Growth with Equity in Mindanao
GIEWS	Global Information and Early Warning Information System, FAO
GIS	Geographic Information Systems
GO	Governmental Organization
GOLD	Governance and Local Democracy
GOM	Government of Mali
GTOS	Global Terrestrial Observing System
HES	Human and Ecology Security
HPI	Heifer Project International
HRS	Hard Red Spring Wheat
HRWW	Hard Red Winter Wheat
ICAAE	International Center for Aquaculture and Aquatic Environments, Auburn University
ICIMOD	International Center for Integrated Mountain Development
ICRAF	International Center for Research in Agroforestry
IER	Institut d'Economie Rurale, Mali
ILRI	International Livestock Research Institute
INSAH	Institut du Sahel
IPAS	Integrated Protected Area System
IRRI	International Rice Research Institute
ISU	Iowa State University
KARI	Kenya Agricultural Research Institute
KIN	Kitanglad Integrated Non-Governmental Organizations
KNP	Kitanglad Natural Park
LEWS	Livestock Early Warning System
LGU	Local Government Unit
MFCAL	Multifunctional Character of Agriculture and Land
MULP	Municipal Land Use Plan
MW	Manupali Watershed
NAPACOR	National Power Company
NARS	National Agriculture Research System
NASA	United States National Aeronautics and Space Administration
NDVI	Normalized Difference Vegetation Index
NGAs	National Government Agencies
NGOs	Non-Governmental Organizations
NIA	National Irrigation Administration
NOAA	National Oceanographic and Atmospheric Administration
NPC	National Power Company
NRM	Natural Resource Management

NRMAC	Natural Resource Management Advisory Committee
NRMC	Natural Resource Management Council
NRMDP	Natural Resource Management Development Plan
NUTBAL	Nutritional Balance Analyzer Program
NVS	Natural Vegetative Strips
OIRD	Office of International Research and Development, Virginia Tech
PAMB	Protected Area Management Board
PCARRD	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
PCC	Pole Coordination Committee, CILSS
PGRN	Natural Resources Management Project, Mali
PI	Principle Investigator
PLLA	Participatory Landscape/Lifescape Appraisal
PPDO	Provincial Planning Development Office
P/PE	Precipitation/Potential Evapotranspiration
SAM	Social Analysis Matrix
SANREM-CRSP	Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program
SAP	System Alerte Precose, Mali
SCO	Site Coordination Officer
SCT	Spatial Characterization Tool
SEAMEO	Southeast Asian Ministers of Education Organization
SEARCA	Southeast Asian Center for Graduate Studies
SOFT	Soft Red Winter Wheat
SUBIR	Sustainable Use of Bio-Resources Project
TAMU	Texas A&M University
TNA	Training Needs Analysis
TSS	Total Suspended Solids
TW	Tigbantay Wahig
UGA	University of Georgia
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNORCAC	United Peasant Organization of Cotacachi
UPLB	University of the Philippines at Los Baños
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VT	Virginia Polytechnic and State University
WAICENT	United Nations World Agriculture Information Center
WANRM	West Africa Natural Resource Management
WCM	Western Carolina University
WMO	World Meteorological Organization
WSU	Washington State University