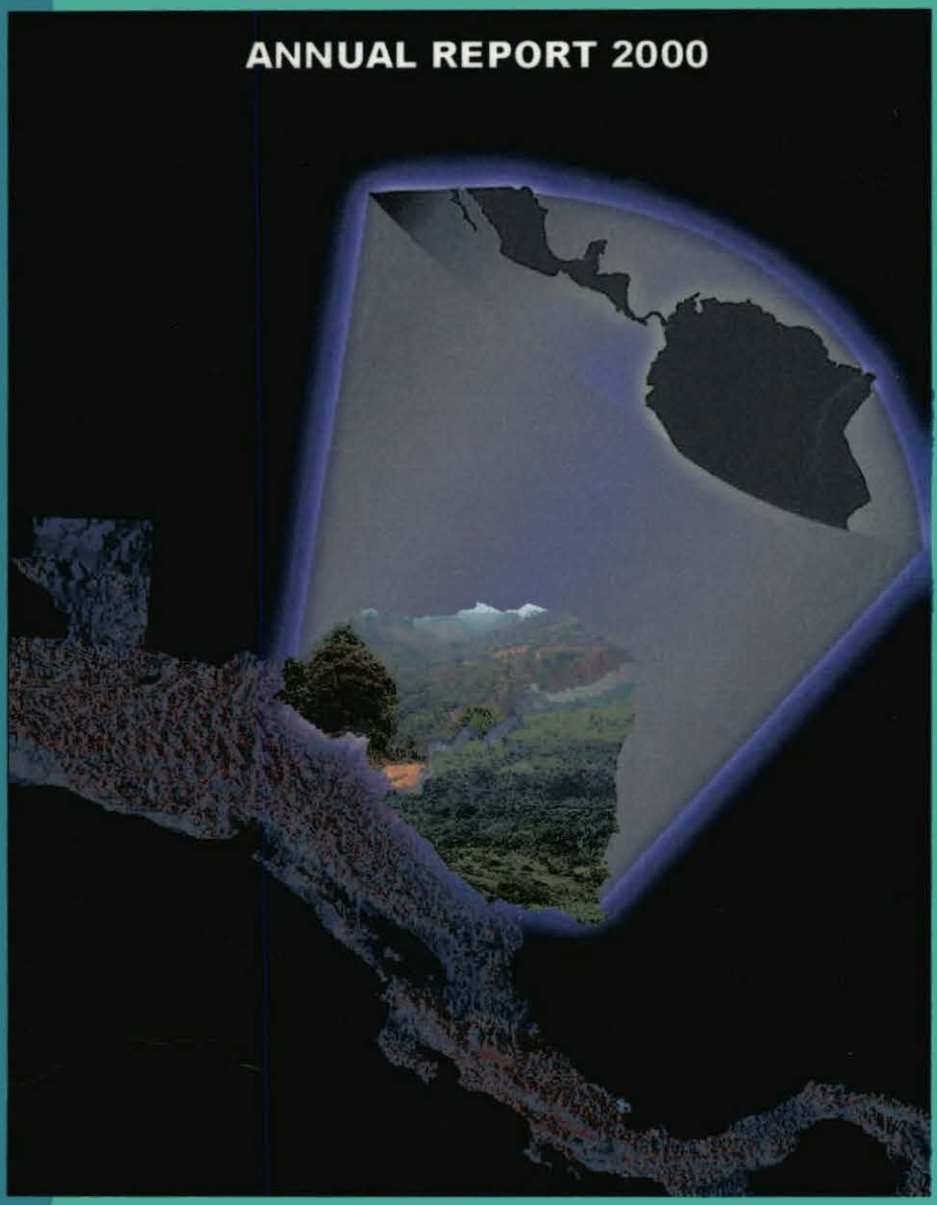
PROJECT PE-3

COMMUNITY MANAGEMENT OF NATURAL RESOURCES IN HILLSIDE AGROECOSYSTEMS OF LATIN AMERICA



OCTOBER 2000

CIAT
Centro Internacional de Agricultura Tropical
International Center for Tropical Agriculture

Cover design:
We are following a two-entry-point strategy. We begin at the reference sites with strategic and participatory action research approaches, and scale up through training, the formation of national training teams, and implementation of numerous and diverse local action plans. These lead to development impact outside our reference sites on a larger scale. The second entry point is the regional view. Here we use DSS and GIS as important parts in the multi-disciplinary approach to larger areas like Central America linking to form a kind of continuum, which will help avoid repetition and fragmentation.

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COMMUNITY MANAGEMENT OF NATURAL RESOURCES IN HILLSIDE AGROECOSYSTEMS OF LATIN AMERICA

ANNUAL REPORT 2000

October 2000

Project PE-3: Community Management of Natural Resources in Hillside Agroecosystems of Latin America

CONTENTS

Executive Summary

Feeding into the natural resource management (NRM) logframe, the PE-3 logframe has five main outputs, which make up what we see as the three main pillars of our strategy. They are innovative technologies (Outputs 1 and 2), strengthening organizations (Outputs 3 and 4), and decision support tools (used in Outputs 1 to 4). These three pillars are intercommunicated and link to the other expertise areas of agroenterprises, soils, participatory research, various crop commodities, and geographical information systems (GIS). We foster collaboration internally with other CIAT projects and externally with other partners (Output 5) in order to achieve these three pillars of impact mentioned in the Central American report. We aim to achieve this through intercommunication, using the Supermarket of Technologies for Hillsides (SOL, its Spanish acronym) and the reference sites as laboratories, and outside the reference sites with training, consultancies, and partly with decision support systems (DSS) and other tools.

Innovative technologies

We start at the reference site and landscape levels where our work is maturing into an integrated watershed management approach (CIAT-Hillsides 2000[1]), into which the SOL system is being worked. This very new development has just begun in Central America and is slower to establish itself because this participatory work deals with plants and the biological systems. Thus the SOL system needs time to grow and establish itself. Evaluations are under way on new genetic materials of annual crops (rice, beans, maize, sorghum, cassava, soybean, and sweet potato) in Honduras and Nicaragua. Participative evaluations of grain and legume crops at farm level have also begun. Other investigations include quantifying the performance of animals in traditional and improved pastures, and evaluating the efficiency of the combination of organic and inorganic sources in annual crop production. Work with fallows includes evaluating the potential of various tree/bush species for improved fallow and fallow management for soil fertility recovery. We are upscaling from this work through training.

Strengthening organizations

The strengthening of organizations is dealt with at the reference site level. This output is the historical strength of the project and is now being reemphasized and moving outwards to other countries. The training of trainers is the hotbed of this upscaling. The eight Guides being used in training are soon to be published in an updated second edition, which will also be available in CD-ROM. Guide no. 1 on local indicators of soil quality now has an adapted African edition (in English). New Guides are being developed on demand and include establishing small seed enterprises, the use of *maquetas*, and the management of soil organic matter, among others. All the Guides are being translated into English and edited for publication as new editions. Training has been given in managerial administration and postharvest management of seed as well as on the Guides. Fifteen action plans were made and follow-up is in process. In February and March some of the Guides were presented in Asia, East Africa, and Peru. Support continues in Honduras, Nicaragua, and Colombia. To date, 18 training courses have been given since August

[1] CIAT-Hillsides. 2000. Land discovery: Training and tools for decision support to stakeholder watershed resource management. Working document no. 181, CIAT, Cali, Colombia. 57 p.

of last year (Table 19). Support continues to local committees and organizations in many different ways on demand.

Decision support systems and tools

In the past, the project was strongly biased in the direction of developing DSS and DS tools and more progress in this field is shown in this report because of it. Historically this part of our work has been self-standing, but it needs more socialization that unfortunately was not done from the start. We see that we have some valuable tools that should be used at regional level, but this must be done with ground truthing and in a participatory manner. We look at GIS as an important part of the multi-disciplinary approach needed to move into the larger, regional view to find the main concentrations of the problems of interest. The use of models in ex-ante analysis is helpful to decision makers (e.g., Decision Support System for Agrotechnology Transfer [DSSAT] modeling, spatial water budget model, and linear programming and optimization models). Other tools were developed to solve differing needs. The spatial data exploration toolbox contains some of these, and the Accessibility Wizard is an example of their success (used after Hurricane Mitch). The Intelligent Team Decision Assistant (ITDEA) builds on years of experience following the methodology of participatory planning by objectives to help build partnerships and expedite the planning process.

Our strategy

We are following a two-entry-point strategy. We begin at the reference sites with the SOL approach, upscaling through training, which in turn upscales through the training of trainers and the local work on action plans that translate into development impact, moving outwards to other sites. The second entry point is the regional view. Here we use DSS and GIS as important parts in the multi-disciplinary approach to this larger area, linking to form a kind of continuum, which will help avoid repetition and fragmentation. We believe that this linking approach will begin to glue the process together. We may be able to concentrate a lot of opportunities instead of spreading out, and we will be able to do so without ignoring our past. The reference sites are useful laboratories and are growing and have an input to give to the approach.

The project management is also following the participatory pattern. Empowerment is the mainstay of our system, building a "self-directed" work team where constant monitoring and evaluation helps strengthen the process.

We strongly believe in the importance of empowerment of the local people. We cannot continue to develop tools and the technology transfer approach without involving the local communities. The opportunities are clear. People are not empowered because of inadequate education, lack of farmer organizations, research development and extension organizations that focus on one-time technology transfer, and the formal agendas of research and development are out of touch with long-term processes.

We see that CIAT is strong in separate disciplines, but that the new research frontier where CIAT has a great strength is in the multi-disciplinary approach.

Project PE-3: Community Management of Natural Resources in Hillside Agroecosystems of Latin America

Objectives: To develop generic biophysical and socioeconomic databases, decision-support tools, and social organizational models that interest groups can improve, institutionalize, and adapt for planning research and development activities for specific locations.

Outputs: Procedures for databases to target problems, priorities, and beneficiaries in watershed resource use management. Techniques for location-specific diagnosis, monitoring, and impact assessment of environmental problems and interventions. Interactive (computer-assisted) decision-support tools established for community-managed development of watershed resources.

Gains: Systemization of organizing, goal-setting, planning, gaining representation, and conflict resolution among communities seeking economic and social growth while protecting their environmental resource base. Technological and methodological advances in information technology for use by members of agricultural communities.

Milestones:

1998: Instructional materials for community-based resource planning organizations and use of environmental databases. Methods to incorporate indigenous biophysical and socioeconomic indicators in decision-support tools.

1999: Planning and policy workshops with stakeholders, incorporating simulation analysis for negotiating collective community action.

2000: Case studies of improved watershed resource planning and management by communities in Colombia, Honduras, and Nicaragua.

Users: Farming families and rural communities of the Andean and Central American hillsides. Project sites profit from increased community action aimed at sustaining the productivity of the resource base. As a result, off-site stakeholders benefit. National and international development organizations involved in priority setting and investments in development.

CGIAR system linkages: Protecting the Environment (60%); Crop Production Systems (25%); Strengthening NARS: Networks (10%); Livestock Production Systems (5%). Participate in the Tropical America Ecoregional Program. Linked to the Systemwide Water Management and Mountain Initiatives.

CIAT project linkages: Inputs from soils (PE-2), Land Use (PE-4), and participatory methods (SN-3) projects. Collaboration with smallholder systems (PE-5) and agroindustries (SN-1) projects.

Project PE-3: Community Management of Natural Resources in Hillside Agroecosystems of Latin America 1999

Project Objective
To improve the standard of living and food security of hillside farmers in Tropical America and make their interaction with the environment more sustainable

Output 1
Production systems improved

- **1.1** Ex-ante evaluate improved system alternatives (identify markets, perform simulation modeling)
- **1.2** Participatively identify, investigate, and validate new alternatives to improve production systems
- **1.3** Validate new alternatives and improved practices
- **1.4** Promote and support multiplication of successful alternatives validated at farm level
- **1.5** Monitor and evaluate the adoption of validated improvements

Output 2
More sustainable landscapes

- **2.1** Benchmark status report at the landscape level (study land use, analyze sustainability)
- **2.2** Ex-ante evaluate alternative scenarios of landscape management
- **2.3** Develop and apply the methodological tools for natural resource management at landscape level
- **2.4** Promote and implement consortia for landscape management
- **2.5** Strengthen participation of grass-roots organizations in consortia for landscape management
- **2.6** Monitor and evaluate landscape changes

Output 3
Organizations strengthened

- **3.1** Develop and/or validate methods and tools for developing and strengthening key organizations
- **3.2** Train local, regional, and national organizations in the use of methodologies and/or tools developed by CIAT and its partners, using methods developed
- **3.3** Strengthen small-scale producers, managers, and local, regional, and national organizations in aspects related to rural development using participatory investigative methods
- **3.4** Support, through incorporating processes of participative investigation, local organizations oriented to agricultural investigation
- **3.5** Promote and support interinstitutional plans for sustainable rural development

Output 4
Decision makers supported

- **4.1** Identify, at different levels, decision-makers related with Project tasks and diagnose their needs in terms of support for their work
- **4.2** Support decision taking at different levels using the information, tools, and methods generated by the project
- **4.3** Strengthen capacity for management and use of information, tools, and methods (train, diffuse, and follow up the process)
- **4.4** Provide technical support for decision taking

Output 5
Efficient, participatory project management

- **5.1** Foster the active participation of partners in the planning of project activities in the region
- **5.2** Actively and permanently coordinate the reference sites, projects, and individuals working in the region
- **5.3** Maintain an efficient information system within the Project and with its partners
- **5.4** Strengthen joint work with other projects and organizations
- **5.5** Establish a participative system of monitoring and evaluation of the Project to monitor its performance and feed back to planning
- **5.6** Initiate on-site activities of impact evaluation
- **5.7** Establish an efficient and participatory administrative system within the Project

Narrative summary	Verifiable indicators	Means of verification	Risks/assumptions
Long-term objective/ GOAL To improve the standard of living and food security of hillside farmers in Tropical America and make their interaction with the environment more sustainable.	• Reduced soil erosion • Improved water quality in rivers and streams • Increased income (monetary and/or in kind)	• National and local statistics • Local research	
Short-term objective/ PURPOSE To strengthen local processes of sustainable rural development in the hillsides of Topical America, based on the experiences of natural resource management at benchmark sites.	• Groups residing at five work sites in Honduras and Nicaragua are successfully implementing land management initiatives consistent with those validated by the Project and its partners • At least 15 key entities of the region have access to at least three tools and methods developed by the Project	• Field verification • Institutional reports	• That the environmental, social, economic, and political conditions, on a macro level, are maintained
OUTPUT 1 **Production systems improved** Farmers use technologies developed by CIAT and its partners to establish sustainable and profitable production systems.	• Screening alternatives in demonstration plots in San Dionisio, Yorito, and Cabuyal (Supermarket of options for hillsides [SOL]) • Validating alternatives in at least 25 Committees for Local Agricultural Research (CIALs, the Spanish acronym) in San Dionisio and Yorito • Alternatives adopted by at least 100 farmers at Project work sites • Successful alternatives being transferred to at least 12 sites other than the initial work sites	• Field verification • Project reports • CIAL reports	• Local collaborators maintain activities related with the project • Donor interest and support maintained for proposed objectives
OUTPUT 2 **More sustainable landscapes** Land use has improved across the landscape because locally organized farmers are using the tools and methods developed by the Project and its partners.	• Three local consortia of NRM operating at work sites in Honduras, Nicaragua, and Colombia • Three local consortia of NRM in formation at other sites of Central and South America • Stable water quality (sediments and contaminants) as integrating indicator of the status of natural resources in at least three watersheds at the work sites • Environmental monitoring initiated in at least two work sites in Honduras and Nicaragua	• Consortia reports • Monitoring reports	• Local collaborators maintain activities associated with the project • Donor interest and support maintained for proposed objectives

Continued.

[a] For acronyms and abbreviations, see page 138.

PE-3 Project logframe for 1999-2001[a] (Continued).

Narrative summary	Verifiable indicators	Means of verification	Risks/assumptions
OUTPUT 3 **Organizations strengthened** Local and national organizations involved in sustainable rural development at various levels (local, regional, national) use the technical and methodological resources developed by the Project in their decision making and other activities. Interinstitutional coordination is enhanced.	• At least 25 CIALs operating at Project work sites • At least 30 CIALs in formation at other work sites in the region • At least 20 national technicians trained and promoting CIALs	• CIAL reports • Training reports • Institutional reports	• Local collaborators maintain activities associated with the project • Donor interest and support maintained for proposed objectives
OUTPUT 4 **Decision makers supported** Decision makers at various levels use and have access to more information, tools, and methods to use in decision making, planning, and monitoring.	• At least two technicians of each collaborating institution trained and using tools developed by the Project and its partners • Digital information (CD-ROM and Web site) available and accessible in Honduras and Nicaragua, and in process in other countries • Local decision makers at the level of three municipalities with access to site-specific information on natural resources and trained to use this information	• Training reports • Institutional reports	• Local collaborators maintain activities associated with the Project • Donor interest and support maintained for proposed objectives
OUTPUT 5 **Efficient, participatory project management** Different internal and external partners directly participate in project management to ensure adequate and efficient use of the Project's resources.	• Plans and reports opportunely prepared and approved by previously established authorities • Partners are well informed and actively participate in fieldwork at the Project sites (local consortia) or elsewhere • Support existing or create new national hillside consortia in Honduras and Nicaragua • Experiences and lessons learned by the Project and its partners disseminated in Latin America through different channels (networks, publications, meetings, etc) • New projects adopt methods, techniques, and experiences generated by the Project and its partners	• Planning documents and reports • Proceedings of Consultative Group and Executive Committee meetings • Collaborators and consortia reports • Dissemination materials and Project reports • Direct verification in networks and consortia	• Local collaborators maintain activities associated with the Project • Donor interest and support maintained for proposed objectives

[a] For acronyms and abbreviations, see page 138.

Major Highlights

Output 1: Production systems improved

- Farm-level models are being developed to help simulate new technology options and the likely effect of new policies at local and national level and will help decision makers choose the best options.
- New genetic materials of annual crops (rice, beans, maize, sorghum, cassava, soybean, and sweet potato) are being evaluated in the Supermarket of technology options for hillsides (SOL, the Spanish acronym) sites in Colombia, Honduras, and Nicaragua.
- Multipurpose forages for crop/livestock systems are being evaluated and selected with farmer participation.
- Continuous support to Committees for Local Agricultural Research (CIALs, the Spanish acronym) has made them a key component in the process of identification and evaluation of technological innovations. They also form an important linkage between formal research carried out in the SOL and farmer perspective for a given technology.

Output 2: More sustainable landscapes

- Information was generated relevant to developing scenarios of use and extrapolation of SOL technologies and is expected to contribute to the diagnostics of sustainability of current land use systems and as an entry point to extrapolate improved land use systems generated at the SOL sites.
- The spatial water budget model (SWBM) was developed and is available for download at the International Consortium for Agricultural Systems Application (ICASA) Web site. It is intended to support local decision making and for teaching local stakeholders about basic functions of multiple-community watershed components such as relationships between land and water resources, effects of land use, demographic changes on future water accessibility, and upstream-downstream relationships.
- Hydrological maps of Honduras were produced to help decision makers in locating the best areas for location of small seed enterprises (PES, the Spanish acronym) and what irrigation is needed in less optimal areas.
- Consortia activities supported include initiation with the Manejo Integrado de Suelos (MIS) and consolidation of annual operative plan with the Local Committee for Sustainable Development of the Tascalapa River watershed (CLODEST, the Spanish acronym). Work with Campos Verdes in San Dionisio and the Network of Local Organizations in Yorito and Sulaco (REDOLYS, the Spanish acronym) better identified demands at local level and their effective linkage with institutional work at different levels.

Output 3: Organizations strengthened

- A Guide was developed and elaborated for the establishment of PES with aspects of marketing, feasibility, and revised managerial administration. It includes basic and essential concepts of orientation to the market, profitability, and sustainability.
- A CD-ROM of the Guides in use will be available soon. New Guides on local indicators of soil quality and management of soil organic matter are being developed.
- During the year, 15 action plans were elaborated and national teams of trainers trained in their evaluation.
- Workshops on the Guides were held in Africa, Asia, the Andean zone, Central America, and Colombia.

- Two local committees for the development of rural agroenterprises were established. The committees are strengthened by attending to support demands. They should be able to mount a support system that is sustainable in the future thanks to an offer of services adapted to the area's demand and with the establishment of a payment mechanism for services.
- Lessons learned, hypotheses, principles, and spaces to be filled by future research activities were identified for CLODEST and REDOLYS in Honduras and the Asociación Campos Verdes in Nicaragua.

Output 4: Decision makers supported

- Following visits to collaborating organizations, an inventory of needs was made from which agreements of collaboration were drawn up and signed with seven organizations of national importance in Honduras.
- Linear programming models were developed and used in various scenarios to help decision makers with questions of land use practices and soil conservation.
- An agreement of collaboration was established between CIAT, the National Institute of Statistics and Census (INEC, the Spanish acronym), and the Ministry of Agriculture and Forestry (MAGFOR) to complete the rural National Atlas of Nicaragua. Sixty thematic maps were elaborated describing and analyzing the most important environmental, social, economic, and cultural aspects in the rural environment of Nicaragua.
- The project "Methodologies for integrating data across geographic scales in a data rich environment: Examples from Honduras" was completed. It has made a substantial and innovative contribution to the development of methodologies that will allow researchers and policy makers to conduct user-controlled and purpose-specific cross-scale analysis using large and complex sets of georeferenced data. It has also produced a valuable extensive database for Honduras.
- Over 39 workshops, meetings, and training and other collaborative events were held to help train decision makers at different levels and establish and maintain links with partners.
- The Intelligent Team Decision Assistant (ITDEA) version 1 is available. The ITDEA helps build partnerships and expedites the planning process. It advantageously replaces participatory planning by objectives, and can be used for strategic planning.
- We are providing decision support to top level decision makers to try and influence policy and approaches of those providing funds.

Output 5: Efficient, participatory project management

- An operational structure was designed and is being implemented to ensure effective coordination of activities among SOL sites in Honduras. The main activities were defined for SOL sites in Nicaragua. The SOL initiative is beginning to play an important role in fostering collaboration among research and development institutions.
- Project plans and research results were diffused through the project Web page, the quarterly bulletin, and publications. The project's Center of Documentation stores all documents, slides, and photos relevant to the project and makes them easily available to interested users.
- Collaborations were strengthened through the many meetings and workshops held throughout the year (Table 19).
- The Hillsides Strategic Planning Workshop was held at Montelimar, Nicaragua for a participative evaluation of project performance, readjustment of its vision and purpose, and strategy planning.

96206

Output 1: Production systems improved

Activity 1.1. Ex-ante evaluate improved system alternatives (identify markets, perform simulation modeling)

Validate farm-level models in Honduras

Highlight

✓ Models on market options developed in 1999 were validated and results diffused to a sample of producers from different communities

Objectives

The aims were to:
1. Evaluate how profitable and sustainable are the production systems that include the market options that were the most preferred in the participatory evaluation with small-scale farmers, and
2. Develop and apply a method for improving farm-level planning by using mathematical simulation to determine crop combinations that will maximize income while protecting the natural resource base.

Methods

In 1999, eight base models representing eight producer categories were designed to support the participatory method for instant farm modeling with small-scale farmers using linear programming. Based on these models, scenarios were developed to aid in decision making relative to which options were the most profitable, taking into account the resources available for each farm type and making different hypotheses. An example of a hypothesis is changing the available capital to simulate a credit system and evaluate its impact on the optimum production system and the resulting income. Full details on methods are given in García (1999), Escolan (2000), and Totobesola et al (2000)[2].

In 2000, the use of the models is being validated and improved in order to consider the influence of risk factors on the results. Nine more farms were analyzed to improve the significance of the

[2] García R. 1999. Evaluación de productos con potencial de mercado con pequeños productores de Yorito y Sulaco: Uso de la Programación Lineal. Thesis for ingeniero agrónomo, Escuela Agronómo Panamericana (EAP) El Zamorano, Honduras.

Escolan J. 2000. Asesoría de fincas para pequeños productores de laderas en Yorito y Sulaco: Uso de modelo de programación lineal. Thesis (Ingeniero) in process. Escuela Nacional de Agricultura (ENA), Olancho, Honduras.

Totobesola M, Barbier B, García R. 2000. Evaluación económica de productos con potencial de mercado para pequeños productores: Uso de la Programación Lineal con fincas de los municipios de Yorito y Sulaco. CIAT, Honduras.

results. The database was completed with data on the new sample and risk parameters needed to run the models. The models are designed and run properly. Further results will be available and analyzed by the end of November 2000.

Results

Table 1 shows results. The overall conclusion is that diversification with short-cycle crops may result in increased erosion, but the difference would be relatively small because new crops cause less soil erosion than do the traditional crops. Further, perennial options such as avocado, coffee, and pastures contribute directly to soil conservation.

Table 1. Most profitable market options for each category of farmer and farm as per models designed in 1999:

Farm access	Economic level		
	Low	Intermediate	High[a]
Permanent			
With current financial resources:	Tomatoes	None of the market options will result in higher income than the traditional production system	Tomatoes, avocado
With more capital:	Semi-technified beans, tomatoes, dairy products	Sweet chili, tomatoes, dairy products	Cassava, tomatoes, avocado, dairy products
Temporary			n.a.
With current financial resources:	Avocado, tomatoes	Semi-technified beans, avocado	
With more capital:	Dairy products	Semi-technified beans, red onions, plantains, avocado	
None (only trails)			n.a.
With current financial resources:	Semi-technified beans, cassava, avocado, cabbage	Avocado, tomatoes	
With more capital:	Semi-technified beans, dairy products	Semi-technified beans, tomatoes	

a. n.a. Farmers of high economic level usually live in accessible areas.

Output

The results from these models were given to a sample of producers from different communities to diffuse them among other producers and use them to make better decisions as to which market options (for each category of producers) suit them best.

Contributors: B Barbier, M Totobesola, R García (Escuela Agrícola Panamerican [EAP]-Zamorano), J Escolán (Escuela Nacional Agricola de Olancho [ENA])

Collaborators: ENA, SN-1, (EAP)-Zamorano

Analysis of maize yields determinants in Yorito, Honduras

Highlight

✓ Limits of maize yield determined for the Tascalapa watershed

Objective

In the region of Yorito, developers and researchers who are members of the SOL questioned whether rainfall, soil nutrients, or germplasm-limited maize and bean yields. The aim was to discover the limitants first of the maize yields.

Methods and Results

The DSSAT model was applied with a soil organic matter (SOM) module from the CENTURY model. Because little weather data are available for the watershed (only 2 years of rainfall data) the new MarkSim weather generator program was used (Jones and Thornton 2000)[3]. Soil analyses were available from sites near the three weather stations. Missing parameters were estimated with a non-DSSAT soil utility. The maize cultivar PB-8 was selected because of its similarity to those used in the watershed whose genetic coefficients are not known.

Figure 1 shows results of maize yields from optimum planting conditions. The limitations of water and N stress were assessed. Irrigation is likely to be a yield-increasing operation and eliminating both water and N stress further increases yield (Figure 2).

Output

Irrigation is not an unrealistic situation for farmers in the hillsides. These simulations give a good reference production level and may help in determining where to put the emphasis. If farmers are able to just irrigate once or twice during the season, a set of model runs can determine at which date or crop growth stage irrigation would give its maximum impact.

Contributors: A Gijsman (PE-5), MT Trejo, O Mejía, P Jones (consultant), B Barbier

[3] Jones PG, Thornton PK. 2000. MarkSim: Software to generate daily weather data for Latin America and Africa. Agron J 93:445-453.

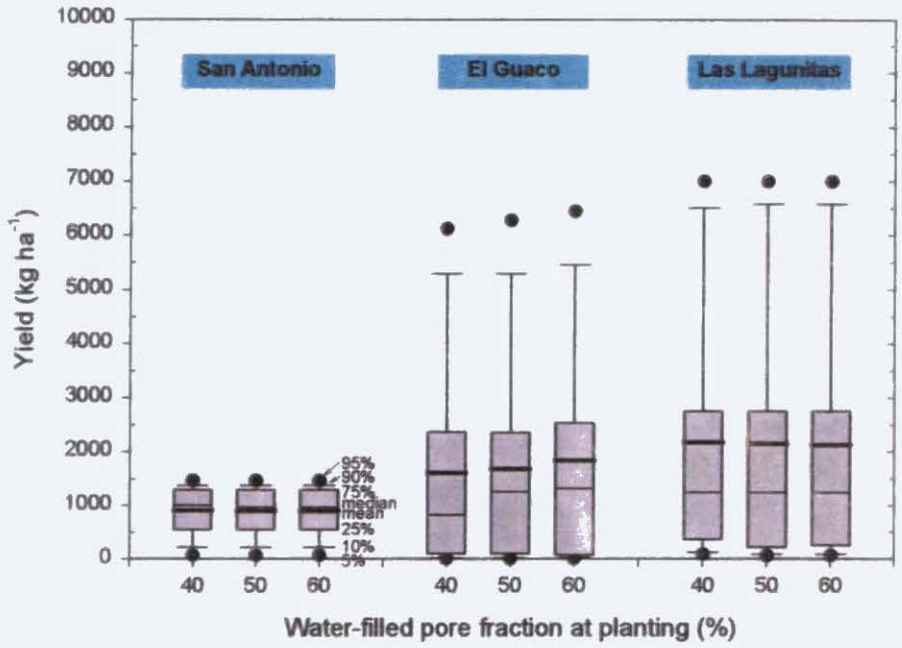


Figure 1. Modeled maize yields resulting from optimum planting conditions, Yorito, Honduras.

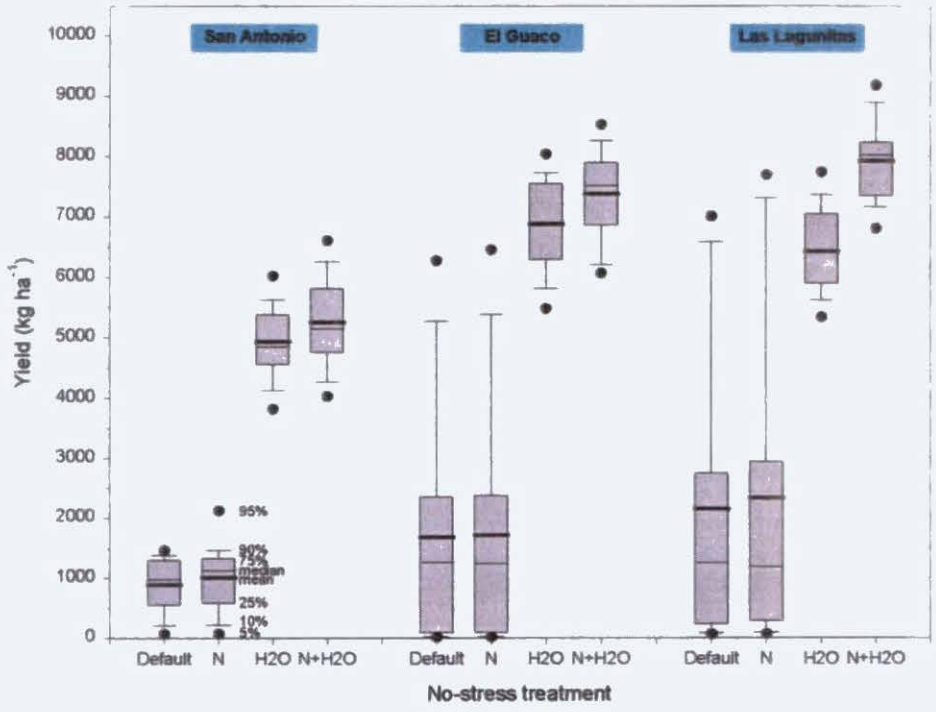


Figure 2. Modeled potential maize yield under conditions of no N stress (N), no water stress (H2O), and neither N nor water stress (N+H2O) as results from optimum planting conditions of 50% water-filled porosity. The yields under unfertilized and non-irrigated conditions are indicated as reference points (Default).

Identify improved bean cropping pattern with DSSAT in the Tascalapa watershed

Highlight

✓ Optimal planting date for bean determined for Tascalapa watershed, Honduras

Objective

The aim was to discover limitants of bean yield in the Tascalapa watershed, Honduras.

Method and Results

The same method was used as for the analysis of maize yield determinants. The bean cultivar Rabia de Gato was used to simulate the native varieties whose genetic coefficients were not known. Different planting dates and maturity times were plotted. Growth limiting factors were also examined.

For San Antonio (low altitude) the planting date is crucial, with the first 2 weeks of October clearly the optimum planting dates. The peak yields of El Guaco (mid altitude) are not strongly affected by planting dates between early September and late October. In Las Lagunas (high altitude) planting date has no major impact on yields. Overall time to maturity ranged from 55 to 75 days. Besides the yield in terms of total bean weight, the size and weight of individual bean grains is also an important factor for farmers. Figure 3 shows that for San Antonio and El Guaco the grain weight can vary considerably. The decision concerning the optimum planting date may not only depend on the expected yield, but also on the size of the individual grains.

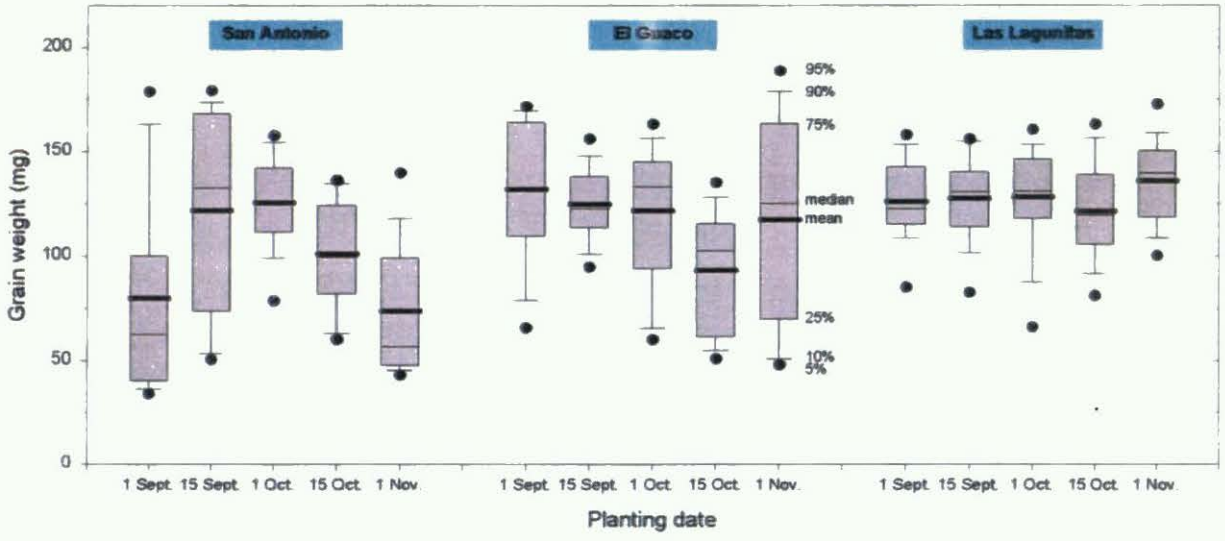


Figure 3. Modeled weight of individual bean seeds from various planting dates at three sites in the Tascalapa watershed, Honduras.

The high SOM content of the soils makes N_2 fixation by the bean crop of limited importance and N hardly a growth-limiting factor. Figure 4 shows clearly that in San Antonio and El Guaco water was the main growth-limiting factor, but of limited importance in Las Lagunitas. The application of N only had an impact if the water limitation was also eliminated. Thus fertilization alone seems a blast of resources, while fertilization combined with irrigation can give an enormous yield increase.

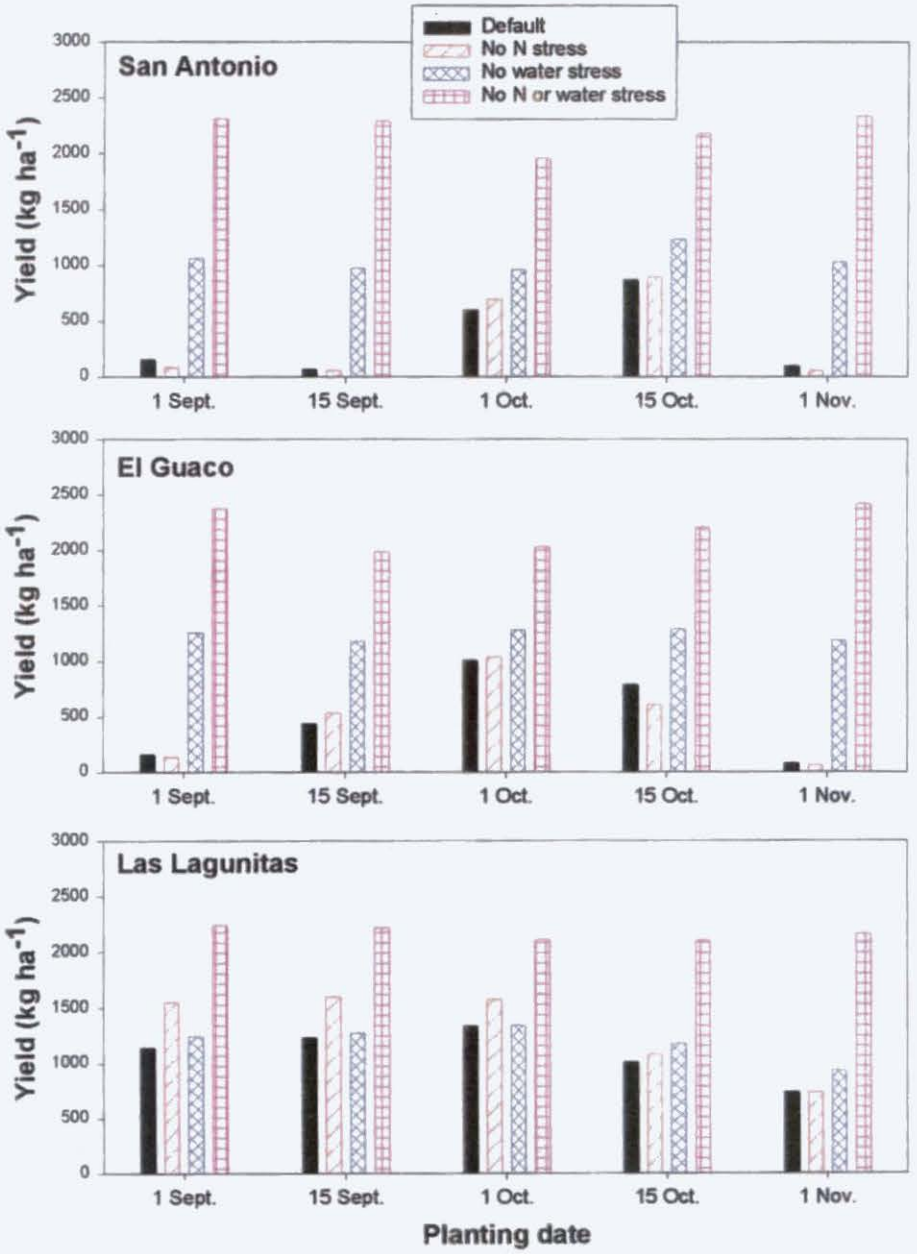


Figure 4. Modeled median bean yield of 20 years' runs [i] under normal conditions, [ii] without N stress, [iii] without water stress and [iv] without N or water stress at three sites in the Tascalapa watershed, Honduras.

Output

The simulations give a good reference production level and may help in determining which growth limiting factors need attention. The information from the simulations can help farmers increase their bean yields.

Contributors: A Gijsman (PE-5), MT Trejo, O Mejía, P Jones (consultant), B Barbier

Production system analysis in San Dionisio, Nicaragua

Highlight

✓ Farm-level models being developed to help simulate new technology options and the likely effect of new policies at local and national level

Objective

The communities of the Calico River watershed in central Nicaragua have a serious problem of degradation of their natural resources. Population density is high and extensive use of technology leads to deforestation, erosion, and contamination. Several new technologies have been promoted over the years by local organization and some are currently tested in the (SOL). The adaptability of these technologies needs to be tested among the different types of farmers. Simulation tools can help technicians and farmers envision the likely outcomes of different decisions.

Method

In collaboration with professors and students from the Universidad Nacional Agraria (UNA), Nicaragua, CIAT developed several models of representative farms. A typology was drawn from 70 farm interviews. The analysis is complete, but the students are still developing the models for each type of farm. Results will be reported when the models are completed and tested.

Contributors: R Richardo (UNA student), P Zuniga (UNA student), L Balmeceda (UNA professor), ME Baltodano, B Barbier

Analysis of agroforestal production systems, Nicaragua

Highlight

✓ Six farm-level models developed that help assess profitability of several agroforestal techniques such as organic coffee

Objective

The aim is to investigate the impact of agroforestry on production systems. Although agroforestry techniques have been promoted for some time in the Calico River watershed, little is known as to how widely techniques have been adopted and even less is known about their impact.

Method and Results

Two students from the UNA supported by CIAT developed six farm-level models to help assess the profitability of several agroforestry techniques such as organic coffee (Moreno and Calderon 2000[4]). Results are encouraging and should be ready in December.

Activity 1.2. Participatively identify, investigate, and validate alternatives to improve production systems

Evaluate new genetic materials of annual crops (rice, beans, maize, sorghum, cassava, and sweet potato) in SOL sites

HONDURAS

Highlights

- ✓ Several improved bean lines have shown good adaptation and yield potential under the conditions of the SOL – Luquigue
- ✓ Farmer preferences are an important aspect within the selection process of improved crop cultivars

Objectives

A main objectives of the SOL initiative is to develop technologies aimed at establishing profitable, sustainable production systems through multi-institutional alliances, using a participatory approach in the design, planning, and evaluation of different options. The introduction of improved crop and pasture germplasm is a key component of this strategy. During the participatory planning exercise held last year with farmers in the watershed they emphasized the need to improve productivity of grain crops (beans and maize) and diversify production systems introducing other crops or developing innovative production systems. Cassava and sweet potato can improve food security and do not require extensive use of inputs.

The specific aims were to:

1. Determine the yield potential and adaptation of local and improved bean, cassava, and sweet potato materials to the soil and climate conditions of the SOL-Luquigue, and

[4] Moreno N, Calderon G. 2000. Modelo de simulacion agroforestal para el manejo de la subcuenca del río Calico, San Dionisio, Matagalapa. Draft Thesis, Universidad National Agraria, Managua. Nicaragua.

2. Evaluate potential acceptance of improved materials by farmers incorporating participatory evaluation methods.

Bean adaptation trial

Methods

An Ensayo Centroamericano de Apaptacion y Rendimiento (ECAR) trial was established at the SOL in Luquigue including 14 bean lines in a randomized complete block design (RCBD) with three reps. Seed was provided by the EAP-Zamorano. The objective was to further test most promising red bean lines within the network supported by the Proyecto Regional de Frijol para Centro América, México y el Caribe (PROFRIJOL).

Parameters evaluated were grain yields, physiological maturity, and disease pressure. Seventy-two farmers conducted a participatory evaluation of the materials at three stages of the crop: before planting, at physiological maturity, and at harvest. Evaluation criteria used by farmers focused on grain characteristics and plant growth habit.

Results

EAP 9508-93 was the best line in terms of yields followed by PM 94223 (Figure 5). Other EAP lines yielded more than 1.4 tons per ha, which is considered good for the region. Behavior of the EAP lines in this trial was similar to those obtained in the other 16 locations where the same trial was established (EAP-Zamorano 2000)[5]. Grain yields and number of pods per plant showed a clear correlation. Physiological maturity was similar among most lines and varied between 84 and 88 days. The local control, Catrachita, was the earliest maturing. Disease tolerance to rust and angular leaf spot was higher for EAP 9509-93 and lower for EAP 9510-77. Most lines were moderately affected by diseases (12%-14% in terms of incidence). Farmers preferred the EAP lines among the materials tested (Table 2).

Table 2. Ranking of bean lines according to farmer evaluation.

Ranking	Seed	At physiological maturity	Grain at harvest
1	EAP 9510-77	EAP 9510-1	EAP 9510-77
2	Catrachita SRC 1-1-18 SRC 1-12-1	UPR 9609-2-2	SRC 1-12-1
3	SRC 1-18-1 (A) DICTA 117	PM 9422-3	PTC 9558-17 Catrachita SRC 1-18-1 (A)
4	EAP 9508-93 EAP 9510-1	DOR 364 SRC 1-18-1 (A)	EAP 9510-1 EAP 9508-93

[5] EAP-Zamorano (Escuela Agrícola Panamericana). 2000. Informe Tecnico Annual. Presentado por el Programa de Investigaciones en Frijol, EAP-Zamorano al Programa Cooperativo Regional de frijol para Centramerica, Mexico y el caribe (PROFRIJOL), Mayo, 2000. 11 p.

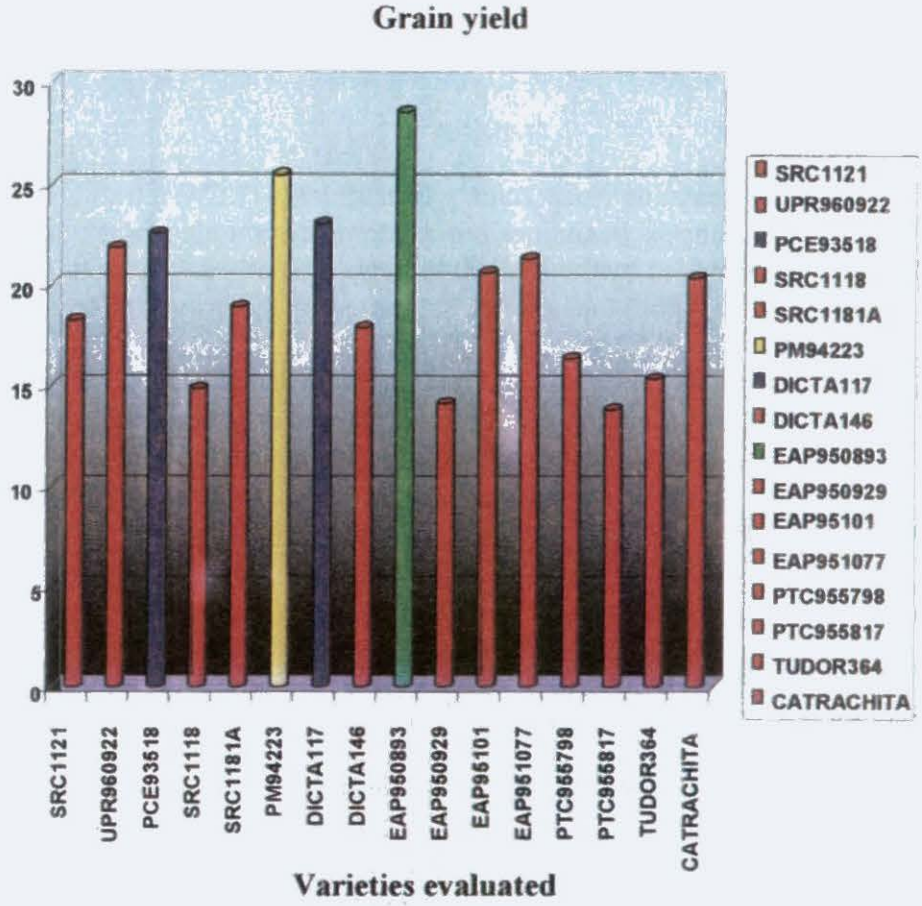


Figure 5. Grain yields (t ha^{-1}) of 14 red bean lines planted in an adaptation trial in the SOL-Luquigue, Honduras.

Main criteria for selection were related to grain characteristics (small size, red color, and rounded shape). Further testing will continue in the SOL during the second season of the year and in farmer's fields. The best eight lines were distributed for this purpose to several CIALs in the region.

Output

Results of the bean trial indicate that EAP lines are well adapted to the conditions of the region and produce higher yields than the local controls (DOR and Catrachita). However, their susceptibility to diseases may be a problem, especially for EAP 9510-77.

Cassava and sweet potato introduction and evaluation
Methods and Results

Thirty-two cassava cultivars and eight sweet potato species were planted in the SOL sites at Luquigue and Mina Honda to evaluate adaptation to the soil and climate conditions of each site. Most cassava cultivars were introduced from the CIAT Core Collection 2 years ago. The rest

were collected in the region. All sweet potato materials were introduced from the Centro Internacional de la Papa (CIP) core collection in August 2000 and planted in small plots for multiplication. Materials were recently planted and are in the establishment phase. Performance will be reported next year.

Contributors: L Brizuela, G Palma, M Ayarza, G Giraldo
Collaborators: JC Rosas (EAP-Zamorano), J Jimenez (Investigacion Participativa en Centro America [IPCA]), CIP

NICARAGUA

Highlights

- ✓ Improved upland rice has potential to become a feasible option for small-scale farmers in hillsides
- ✓ Producers visiting the SOL trial perceived the high genetic diversity and potential adaptation of promising bean materials
- ✓ Seven red bean lines selected for further evaluation in farmers' fields
- ✓ Preliminary evidence suggests soybean is a promising option for diversifying agricultural activities in the San Dionisio region

Objectives

Results of the participatory workshop conducted with farmers at the Calico watershed showed that upland rice could be an important option to diversify crop options in the region. Materials developed by CIAT and the centre de coopération internationale en recherche agronomique pour le développement (CIRAD) in the region show promise. The present objectives were to:

- Evaluate the adaptation of 11 rice cultivars to the soil and climate of San Dionisio, Nicaragua,
- Expose 92 advanced bean lines to the conditions of San Dionisio,
- Evaluate the yield and adaptation of 16 advanced red bean lines,
- Evaluate grain yields and adaptation of three soybean varieties, and
- Evaluate the grain and characteristics of 10 improved varieties of maize in San Dionisio, Nicaragua.

Testing of adaptation of upland rice varieties to the hillsides of San Dionisio
Methods and Results

Eleven rice lines were planted in small plots in June 1999 in the SOL site at San Dionisio, Nicaragua. The Instituto Nacional de Tecnología Agropecuaria (INTA) and CIRAD provided seed. Seed was planted in the field in rows 40 cm apart using a seed rate equivalent to 60 kg per ha, the research norm for rice varieties 1999.

Rice yields can be grouped into three categories (Figure 6). The most responsive variety was CT-8553, followed by a group of seven varieties that produced between 4 and 5 tons per ha. The

lowest yielding varies were INTA Dorado, IRAT-301, and IRAT-90 with less than 2 tons per ha. These results contrast with those from the farmer-made evaluation. Best variety according to farmer perception was IRAT 376. Selection criteria were based on size of the panicle, grain size, and market acceptability. CT-8553 was rejected because of its short size and slow growth.

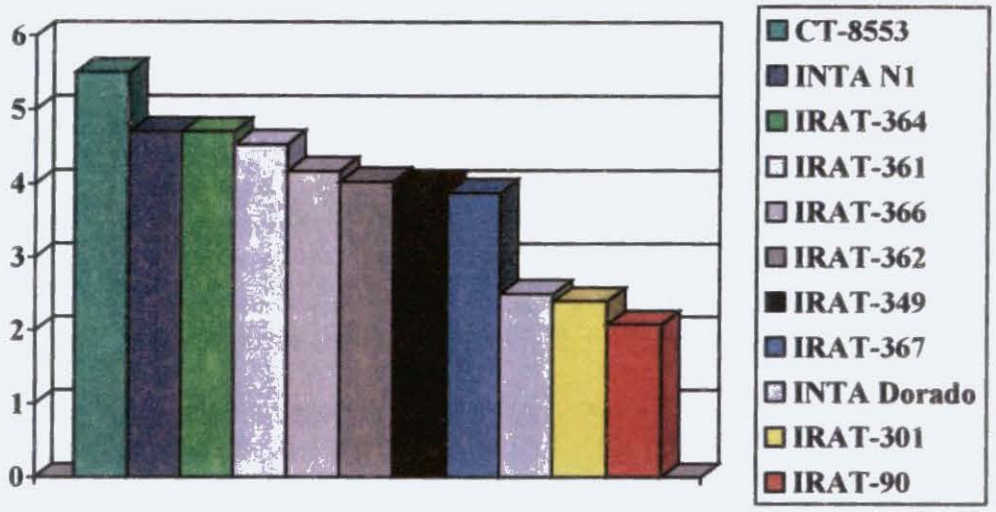


Figure 6 Rice yields (t ha^{-1}) from adaptation testing of upland rice varieties, San Dionisio, Nicaragua.

To continue the process, IRAT-367 variety is being multiplied and given to eight CIAL committees for further testing under farm conditions. Results reported here are preliminary. They constitute one step of the process that will lead to the adoption of high yielding, pest-resistant, and farmer-accepted rice varieties for the upland conditions of hillsides.

Contributors: T Reyes, N Espinoza, P Orozco (Proyecto de Desarrollo de San Dionisio [PRODESSA])
Collaborator: J Obando (INTA)

Bean evaluation trials – Vivero de Adaptación Centroamericano de grano rojo (VIDAC) 1999-2000

Methods and Results

A VIDAC was planted at the SOL site in San Dionisio. This trial is part of the evaluation network supported by the PROFRIJOL network.

Sixteen lines were selected as the most promising in the San Dionisio conditions according to grain yields and farmer preferences. They are PRF 9657 – 57 – 14 (3.1 t ha^{-1}); EAP 9504-30B (2.8 t ha^{-1}); ICTA JU 95-16 (2.6 t ha^{-1}); EAP 9508-43, EAP 9508-48, EAP 9508-54, and PTC 9557-10 (2.5 t ha^{-1}); PTC 9558-4 and PRF 9657 – 53 – 13 (2.4 t ha^{-1}); DICTA 143, PTC 9559-100, EAP 9506-28, PRF 9653 – 16B-1, and PTC 9607-29 (2.3 t ha^{-1}); EAP 9508-13 and EAP 9508-28 (2.2 t ha^{-1}); and DOR Criollo (1.9 t ha^{-1}). Selected lines will be tested again.

Output

A large supply of improved bean materials is available with potential to increase yields and meet farmer preferences.

Contributors: T Reyes, N Ramos
Collaborator: J Obando (INTA)

Ensayo Centroamericano de adaptacion y rendimiento de frijol rojo (ECAR)
Methods and Results

The ECAR trials were designed by the PROFRIJOL network to evaluate the genotype X environment interaction of advanced red bean lines before they are released as varieties. The SOL sites in Yorito-Honduras, and in Nicaragua were selected as testing sites. The trial was planted and managed according to the standard protocol provided by PROFRIJOL.

Table 3 shows the ranking of materials according to yields and farmers' preferences. Materials from EAP-Zamorano were the materials that farmers most preferred. These results are similar to those observed at other testing sites in Central America including the SOL of Yorito, Honduras. However, these materials must be further tested. Seed of EAP-9508-93, EAP-9510-1, DICTA-117, PTC-9558-17, UPR-9609-2-2, PM-9422-3, and EAP-9510-77 was delivered to CIAL committees for planting during the second season of 2000.

Table 3. Grain yield and farmer's preference of sixteen bean materials planted in the Supermercado de Opciones para Ladera (SOL) site in San Dionisio, Nicaragua.

Material	Grain yields (kg ha^{-1})	Farmer's preference	Positive attributes	Negative attributes
EAP – 9508-93	1.99	1	Good grain fill and color	-
EAP-9510-1	1.79	2	Good weight, color, and market	-
DICTA 117	1.59	3	Good weight, color, and market	-
PTC-9558-17	1.57	4	-	Poor weight, many empty grains
UPR-9609-2-2	1.50	5	Good solid color	-
PM-9422-3	1.34	6	Big, well-filled grains, good color	-
EAP-9551077	1.23	7	Light red	In rainy season can lose color
SRC- 1-12-1	1.63	8	Well-filled grains, good weight	-
SRC-1-18-1(A)	1.14	9	Well-filled grains, good weight	-
EAP-9509-29	1.14	10	Good color and grain form	Very dark
PTC-9557-98	1.14	11	Good weight	Medium grain, pale red
DOR-364	1.51	12	Good color, well-filled grain	-
Local check	1.05	13	Good weight, grain, and yield	-
PCE 9351-8	1.04	14	-	Many empty grains
SRC-1-1-18	1.02	15	Good weight	Many pale grains
DICTA 146	1.67	16	-	Many pale grains

Contributors: T Reyes, N Espinoza
Collaborator: J Obando (INTA)

Soybean adaptation trials
Methods and Results

Soybean is a crop with high nutritional value and high added value. Small-scale farmers in other parts of the world have successfully exploited its potential. However, little has been done to bring this crop into the hillsides region to improve food security. The PE-3 Project this year introduced some soybean varieties to initiate the process of selecting the most adapted and most accepted soybean materials by farmers, especially women. Three soybean varieties were planted in the SOL-San Dionisio. The varieties planted (CEA-CH-86, CH-P-96, and Cristalina) are commercially available in Nicaragua, but have not been tested in the region before.

The variety CEA-CH-86 was the best in terms of grain yields and Cristalina was the worst. Farmers prioritized varieties in terms of grain size, type of stand, and number of pods per plant. The varieties CEA-CH-86 and CH-P-96 are currently under testing in four CIALs in San Dionisio.

Output

The introduction of adapted crop and pasture germplasm can potentially diversify agricultural activities in the region. Preliminary evidence indicates that soybean is a promising option. However, further testing and evaluation is needed before farmers can widely adopt it.

Contributors: T Reyes, N Espinoza
Collaborators: Centro Experimental del Algodón (CEA)

Evaluation of improved maize varieties in different environments
Methods and Results

The 10 varieties of maize were established in San Dionisio using an RCBD with three repetitions. The distance between furrows was 80 cm, with four furrows per plot, 5 m long, and 25 cm between plants. This trial is established in the field and has not finished. The plants are in grain-filling stage (R4 phenological stage). Results and output will be reported next year.

Contributors: T Reyes, N Espinoza
Collaborator: J Obando (INTA)

Establish rotation systems of annual and perennial crops in SOL sites

Objectives

The general objective is to reduce dependence on annual crops and to increase the proportion of semi-perennial and perennial components that favor greater stability and resilience in agrosilvopastoral systems.

Methods

Because of the high natural variability of the hillside soils, and as observed in the SOL-Wibuse, this year we began a phase of reducing soil variability through the sowing of maize as a covering without fertilizer before beginning the production systems experiments. This practice allows us to carry out a better experiment block when using the crop as a bioindicator (i.e., height) that integrates the soil chemical, physical, and biological characteristics. Sowing maize without fertilizer also allows the levels of nutritional variability from the effect of previous use to diminish, and the effect of the used treatments will be clearer for the later experiments.

Contributors: M Ayarza, E Barrios (PE-2), RJ Thomas (PE-2), JA Beltrán, M Peters (IP-5), JI Sanz, JG Cobo, N Asakawa

Evaluate and select multipurpose forages for crop/livestock systems with farmer participation

Highlights

- ✓ Nongovernmental organization (NGO) and national agricultural research systems (NARS) partners trained to contribute to participatory selection of forages
- ✓ Innovative farmers in Honduras test selected grasses on their farms
- ✓ A farmer in Honduras has started to produce and market seed of one grass accession (Toledo, CIAT 26110)
- ✓ Major problems in respect to forage production identified by farmers in Honduras, Nicaragua, and Costa Rica
- ✓ More than 200 farmers start participatory selection of improved forage options
- ✓ Research collaboration with NARS, NGO, and development project partners established and a Technical Committee formed

Objective

Forage germplasm in its multiple uses could play an important role in improving the well-being of the small- and medium- scale farmers in Central American hillsides. However, adoption (particularly of forage legumes) has been limited, possibly because of lack of direct interaction with farmers. Therefore we need to develop forage germplasm technologies with farmers, using participatory approaches. We anticipate that the work will also contribute to developing an overall strategy to guide future research and to aid in the diffusion and final adoption of forage-based technology by small-scale farmers.

Methods

In collaboration with NARS, NGOs, and farmer groups CIAT identifies germplasm preferred by farmers. Some GIS tools are being developed for strategic targeting of forage germplasm first to environmental and later to socioeconomic niches in the hillsides of Central America. The interaction with strong national partners – alongside the farmers – will be of paramount importance to the success of the approach.

As a spin-off, an on-farm experiment to test the ability of improved forages to reclaim land in valley areas affected by Mitch is underway. We anticipate that appropriate forages can revegetalize land without incurring the high costs of other land reclamation practices. A combination of agronomic evaluation techniques, participatory technologies, soil indicators, socioeconomic studies, and GIS tools is employed. The work links closely with the TROPILECHE Project, using some of the same germplasm. On the other hand, forage germplasm selected from this work will be useful to TROPILECHE and to other projects working in developing new forage alternatives for crop-livestock systems in hillsides.
To initiate the process of participatory selection of improved forage options several training and planning activities with involved partners were executed:

- A course on Methods and Techniques of Participatory Research was given in collaboration with CIATs Participatory Research Group (SN-3) in Feb/Mar 2000. Twelve participants from several institutions in Honduras, Nicaragua, Costa Rica, and Colombia were trained and are now using participatory methods in collaborative activities with CIAT.
- In May 2000, again with SN-3 collaboration, research and development personnel from various national and international research institutions and NGOs were trained in methods for stakeholder analysis. Participants were from CIAT, the Dirección de Investigación de Ciencias y Tecnología Agrícola (DICTA) and the Servicios Técnicos para el Desarrollo Sostenido (SERTEDESO) in Honduras; CIAT, INTA, and PRODESSA in Nicaragua; and the Ministerio de Agricultura (MAG) and Fundación Ecotropica in Costa Rica. The methods are now applied as part of the diagnosis in the study sites.
- A major activity in 2000 was a planning workshop for the project held in Comayagua, Honduras. Fifteen officials from institutions involved in the project participated: from Honduras (DICTA, SERTEDESO, CIAT), Nicaragua (INTA, PRODESSA, CIAT), Costa Rica (MAG, Instituto Interamericano de Cooperación para la Agricultura (IICA)- German Agency for Technical Cooperation (GTZ), CIAT, Fundación Ecotropica), Colombia (CIAT), and Germany (University of Hohenheim). Staff from IICA-GTZ, Costa Rica, facilitated the course.

Letters of Agreement with the institutions involved in the project were prepared and are in process of ratification. Several types of trials for the agronomic evaluation and simultaneous participatory selection of improved forages as agreed in the planning workshop were established in Honduras, Nicaragua, and Costa Rica. Multipurpose germplasm including grasses, herbaceous legumes, shrub legumes, and cover and green manure legumes are offered to farmers. Table 4 shows the trials established in Central America. The sites were selected based on the diagnosis and in some cases complimented by approaches from interested farmers.

Table 4. Trials for the participatory selection of forages established in 2000 in Central America.

Country	Locality	Grasses	Legumes		
			Herbaceous	Cover	Shrub
Honduras	Las Cañas	1	1	1	1
	Sol Luquigue	1	1	1	1
	Jícaro	1	1	1	1
	Ayapa	-	-	1	-
	La Playa	-	-	1	-
Nicaragua	SOL San Dionisio	1	1	1	1
	Piedra Larga	1	1	1	1
	El Corozo	1	1	1	1
Costa Rica	Santa Marta	1	1	1	1
	Mastastal	2	2	2	2
	La Gloria	1	1	1	1
	Acosta	1	1	1	1
	Turubares	1	1	1	1
	Canales	1	1	1	1
Total	14	13	13	15	13

The initial plant material selected is as follows (in future years this list could be altered according to perceptions and demand by farmers as well as performance).

Grasses: *Andropogon gayanus* CIAT 621; *Brachiaria brizantha* CIAT 6780, 26110, 26646, 16322, 36061; *Brachiaria dictyoneura* CIAT 6133; *Panicum maximum* CIAT 16031; 'King grass' (*Pennisetum purpureum* X *P. typhoides*)

Herbaceous legumes: *Arachis pintoi* CIAT 18744, 22160; *Centrosema pubescens* CIAT 15160; *C. plumieri* DICTA; *Desmodium ovalifolium* 33058; *Stylosanthes guianensis* CIAT 11844; *Clitoria ternatea* cv. Tejuana

Green manure and cover legumes: *Pueraria phaseoloides* CIAT 7182; *Mucuna pruriens* IITA-BENIN; *M. pruriens* DICTA; *M. deerengianum* DICTA; *Canavalia brasiliensis* CIAT 17009; *Lablab purpureus* DICTA

Shrub legumes: *Calliandra calothyrsus* CIAT 22310, 22316; *Cratylia argentea* CIAT 18516/18668; *Leucaena leucocephala* CIAT 17263; *L. macrophylla* OFI47/85; *Gliricidia sepium; Erythrina verteruana; E. poepigiana*

Each of the trial sites except for Ayapa, La Playa and one site in Mastastal (where we work with fewer farmers because of the specificity of the demand) corresponds to a group of 10-15 farmers. More than 200 farmers are so far directly involved in the project.

The trials are in the establishment phase, hampered in some sites by dry conditions and in others by extremely wet conditions. Most sites, in some cases after reseeding, have now acceptable populations for a good establishment. All plantings were done together with groups of small- to medium-scale farmers, including mixed crop-livestock farmers and farmers focusing on crop or livestock production. The farmers were identified in previous diagnosis studies, in some cases complemented with stakeholder analyses. These farmers are expected to continue in the process of participatory selection of forage options. We are beginning to see a potential that

communication lines between small-/medium- and larger-scale farmers are reversed. Although normally smaller scale farmers were seeking information from bigger scale farmers (often with better access to information), in our study the bigger scale farmers address the small-/medium-scale farmers to obtain information on scale-neutral pasture grasses. This indicates that the project may facilitate more interactions between different groups of farmers.

As an example, Table 5 shows results from preliminary work in Honduras on the agronomic performance of some shrub legumes.

Table 5. Agronomic performance of a range of shrub legumes in San Jerónimo, Yorito, Honduras.

Evaluation	Accession[a]	Dry matter leaf material (g per plant)	Dry matter stem material (g per plant)	Height (cm)	No. regrowing points/plant
1	Ca 18516	8	0	28	2
	Ca 18668	6	0	28	2
	L1 17263	102	30	53	5
2	Ca 18516	27	1	41	2
	Ca 18668	20	0	45	2
	L1 17263	47	8	35	4
3	Ca 18516	59	1	62	6
	Ca 18668	63	1	62	7
	L1 17263	165	33	89	12

a. Ca = *Cratylia argentea*; Ll = *Leucaena leucocephala*.

Based on earlier work with a group of about 15 farmers, after about 18 months of collaboration eight farmers have established improved grass pastures on their farmers, based on *Brachiaria brizantha* La Libertad on their farms. One farmer has established *Stylosanthes guianensis* on his farm as feed for rabbits. As expected, farmers have started with the uptake of grasses, but we anticipate this could be an entry point for legumes.

Outputs

The institutional framework and partnership with farmers for the success of the project has been established. Forage options are in the field and participatory selection by farmers should start by the end of 2000/early 2001. The value of grasses as an entry point for forages has been confirmed.

Contributors: M Peters (IP-5) P Argel, H Cruz, T Reyes, SN-3, PE-5
Collaborators: DICTA, TROPILECHE, INTA, PRODESSA, SERTEDESO, MAG Costa Rica, Fundacion Ecotropica, IICA-GTZ

Quantify the performance of animals in traditional and improved pastures in SOL

Participatory diagnosis in three communities in the Department of Yoro, Honduras

Objective

The objective of farmers participating in the project is to address the problems mentioned below and thus to improve family income, and family and community nutrition. The diagnosis was not only for pastures and livestock owners but also for soil fertility and other NRM.

Methods

Fifty-nine people, of whom 45% were women, took part in the participatory diagnosis. The age composition was diverse, participants ranging from 18 to about 75 years of age. Livestock farmers as well as crop farmers and mixed farmers responsible for various activities in the field and at the homestead were involved. The diagnosis included plenum and small-group activities, leading to the identification and prioritization of problems as related to agriculture and NRM with emphasis on forages. The diagnoses were done at three sites in and around CIAT's reference site of Yorito (i.e., El Jícaro in Victoria, Las Cañas in Sulaco, and Luquigue in Yorito).

Results

In all diagnosis, the participation of women was significant except for Luquique where only 18% of the participants were women. Common problems identified across the three communities include:

- Erosion, lack of water, burning, deforestation, low productivity of the resource base, and low fertility.
- Free roaming of animals in the dry season, lack of wood (poles and firewood), lack of land, and lack of green material in the dry season for conservation and as feed.
- Lack of technology options, technical support, and seed and planting material.
- Interestingly, one group mentioned their own lack of interest in improving their situation as being a problem.

Most problems were closely related with the lack of feed for animals, soil degradation, and lack of firewood. Results of the prioritization of these problems were heterogeneous, but tended to emphasize the problem of lack of suitable planting material and lack of livestock feed particularly during the dry season.

Output

The communities clearly perceived the degradation of soils and deforestation and the inherent negative effects of these on themselves.

Quantification of animal performance in traditional pastures and improved pastures in SOL

This work is just initiating, the pastures being in the process of establishment. Grazing trials will be carried out in both SOL sites in Honduras and Nicaragua, in collaboration with TROPILECHE.

Contributors: M Peters, P Argel (IP-5), H Cruz, T Reyes
Collaborators: TROPILECHE, DICTA

Evaluate potential of various tree/bush species for improved fallow in SOL

Objective

The aim is to evaluate various tree and bush species for their potential for improved fallows in the SOL.

Methods

Two trials of improved fallows were established in the SOL–Nicaragua with five species in each. Each trial is an RCBD with three repetitions, but with different sized plots. The established species are *Flemingia macrophyla*, *Crotolaria* sp., *Sesbania sesban*, *Theprosia candidans*, and *T. voguelii*. One trial, Barbechos mejorados Nicaragua zona uno (BMA-1N-1Z), has 27 m² plots, and a total area of 405 m² with 11 plants per plot. In the other trial, Barbechos mejorados Nicaragua zona dos (BMA-1N-2Z), plots are of 33.75 m² with 14 plants sown in each. The total trial area is 506.25 m². So far stem height and diameter at 1 month of establishment has been measured.

Contributors: E Barrios (PE-2), G Palma, PP Orozco

Evaluate the efficiency of combination of organic and inorganic sources in annual crop production in SOL

Objective

The aim is to determine if N, P, or K is restrictive for normal crop development.

Methods

The establishment of this trial was carried out according to the protocol of activities carried out in the SOLs of Honduras and Nicaragua and the Tropical Soils Biology and Fertility (TSBF) Program protocol. The sowing date was 27.06.00. The trial is established and results are pending. The plants are in the R1 stage.

Contributors: L Brizuela, M Ayarza, E Barrios (PE-2), RJ Thomas (PE-2), JI Sanz

Fallow management for soil fertility recovery in tropical Andean agroecosystems in Colombia

Highlights

- ✓ Results from field studies suggest that the *Tithonia diversifolia* slash/mulch fallow system could be the best option to regenerate soil fertility of degraded volcanic-ash soils of the Andean hillsides where rainfall is not limiting

Objective

The aim was to identify strategies for the soil fertility recovery of volcanic-ash soils degraded following continuous cassava cultivation.

Methods

Previous studies on land use in the Cabuyal River watershed (6500 ha) show that a considerable proportion of land (about 25%-30%) remains under natural fallow every year. The focus of our studies is on systems of accelerated regeneration of soil fertility, or improved fallow systems, as an alternative to the natural regeneration by the native flora. The typical cropping cycle in the region includes monocrops or intercrops of maize, beans, and/or cassava. Cassava is usually the last crop before local farmers leave plots to natural fallow. Fallow improvement studies were conducted on plots following cassava cultivation. The potential for soil fertility recovery after 12 and 28 months was evaluated with two fast growing trees *Calliandra calothyrsus* (CAL) and *Indigofera constricta* (IND), and one shrub, *Tithonia diversifolia* (TTH) as slash/mulch fallow systems compared to the natural fallow (NAT). This study attempted to integrate the impacts of slash/mulch planted fallow systems on soil quality by simultaneously evaluating the biological, chemical, and physical dimensions of the soil. For greater detail on the methods see the PE-2 Annual Report.

Results

The slash/mulch planted fallows systems evaluated in this study were more productive in terms of greater biomass production and nutrient recycling than the traditional practice of natural regeneration by native flora, suggesting that the objective of increased nutrient recycling was achieved. The TTH slash/mulch fallow system proved to be the best option to recover the overall soil fertility of degraded soils following cassava monocropping. Nevertheless, its use may be restricted to areas with seasonal drought because it is not very tolerant to extended dry periods. The CAL slash/mulch fallow system proved to be the most resilient because it produced similar amounts of biomass independently of initial soil quality and thus has the potential for wider testing as a possible source of nutrient additions to the soil and fuelwood for rural communities. The slower rates of decomposition in CAL, compared to IND and TTH, suggests that benefits provided would be longer lasting and potential losses would be reduced through a greater synchronization between nutrient availability and crop demand. The IND slash/mulch fallow, on the other hand, showed more susceptibility to initial soil quality and this may limit its potential for extended use. Increased soil bulk density as a result of decrease in SOM was possibly

mediated by the presence of large populations of endogeic earthworms. Additionally, the decrease in total soil N and increased N availability by slash/mulch planted fallows using this species suggests that the process of mineralization is greatly accelerated. This is consistent with the observation of increased soil bulk density values in this treatment containing large density of earthworm species, *Pontoscolex corethrurus,* known to stimulate N mineralization and responsible for soil compaction when a diverse earthworm community capable of ameliorating soil physical structure is absent. Although increased available N may be apparently a good short-term impact, the significant decrease in total soil N suggests that considerable N losses may be occurring during the fallow phase and benefits to subsequent crops could be limited. Further multilocation testing is needed to confirm these observations.

Output

The use of *Tithonia diversifolia* slash/mulch fallow systems has the potential to regenerate volcanic-ash soils that are degraded as a result of continuous cassava cultivation in Andean hillsides.

Contributors: E Barrios (PE-2), IM Rao (PE-2), R Thomas (PE-2), E Amézquita (PE-2), JJ Jiménez, JG Cobo, J Ricaurte, N Asakawa

Activity 1.3. Validate new alternatives and improved practices

Highlight

- ✓ Continuous support to CIALs has made them a key component in the process of identifying and evaluating technological innovations

Objective

Participatory research is a farmer-oriented process by which farmers identify a problem and find solutions by themselves (Braun and Hocdé 2000[6]). The CIALs are local research systems that belong to the community and are managed by them. They also form an important linkage between formal research carried out in the SOL and farmer perspective for a given technology. The aim is to strengthen the capacity of rural communities to take sound decisions to improve their production systems incorporating formal research principles. The main objective of the analysis was to evaluate their dynamics over time in terms of number of CIALs and materials tested.

[6] Braun A, Hocdé H. 2000. Investigación participativa con el agricultor en América Latina: Cuatro casos. In: Memorias trabajo con los agricultores: La clave para la adopción de tecnologías forrajeras. Cagayan de oro, Filipinas. Australian Center for International Agricultural Research (ACIAR), forthcoming.

Methods

A qualitative analysis was made on the information collected from the CIALs in the Calico River watershed in San Dionisio. These committees were created in 1997. Details about methodological approach were given in the 1999 Annual Report and in Braun and Hocdé (2000) and Tijerino et al (1997)[7]. Quantitative assessment will be available soon through the Participatory Research Project (SN-3).

Results

There are 12 CIALs at present in the region. Four were formed in each of 1997, 1998, and 1999. Most work in CIALs has concentrated on germplasm evaluation (bean and maize). Recently, soybean has been incorporated. This year CIALs have evaluated eight maize varieties, 10 bean lines, and three soybean varieties. Maize has been evaluated in five CIALs. The result of this process is the successful spreading of the Catacama maize variety (NB 90-43) within the range between 380 and 750 m. Other maize varieties have higher yields, but are taller and suffer from wind flattening.

Farmers have evaluated 10 bean materials in 33 plots. The materials most frequently tested were Estelí 150, Compania 93, and DOR 364. Of these, farmers selected the bean Compañía 93 and distributed it to Wibuse, Zapote, and Quebrachal. The reasons for its preference are associated to its wide adaptation to soil and climate conditions. Other materials such as Tío Canela and Estelí 150 have shown good adaptation to other sites in the watershed. We expect that testing and exchange of new materials will intensify with the SOL presence in San Dionisio.

Figure 7 shows the results of the analysis of CIALs' performance in the region based on a Strengths, Options, Deficiencies, Actions (FODA, the Spanish acronym) approach. Interest in this methodology of farmer experimentation is growing, but some weaknesses exist that should be considered in any sustainability analysis.

Contributors: J Jimenez, B Jarquin, S Hernandez
Collaborators: G Palma, T Reyes, IPCA, CIALs

Palman Trinidad Germán

[7] Tijerino D, Baltodano ME, Vernooy R. 1997. La formación de los comités de investigación agrícola local en la subcuenca del río Calico, municipio de San Dionisio, Departamento de Matagalpa. In: Reportes de progreso 1997. Proyecto CIAT-Laderas, América Central.

Strengths

- Percieved interest of farmers on experimentation
- Demand to create new CIALs
- The only local organization with formal research
- High participation of women on the committees
- Support by the community of the different groups
- Allows rural communities to make decisions and to outline agricultural solutions
- Allows access to information and research products
- The research products are community property
- Allows the community to organize around a common good

Weaknesses

- Lack of evaluation mechanisms and follow-up
- Lack of training in the methodology for the technical team and committees to make the research more formal
- Little coverage in disclosure of results
- Little availability of funds for the CIALs
- Little exchange among the different committees
- Mechanisms not established for maintaining the link between CIAL members and the community
- Clarity lacking on each member's functions
- Little relationship between the research and the management of natural resources.

Opportunities

- Presence of institutions that contribute with germplasm: INTA, PRODESSA, EAP-Zamorano, PROFRIJOL, CIAT, CIMMYT
- Presence of other producer research groups in Nicaragua: UNICAM, INPHRU
- Interest in the participative focus of institutions such as INTA, PRODESSA, and ADDAC
- Presence of the Campos Verdes Association that offers credit for production plots
- Obtain greater credibility with government services and other formal services
- Permanency of local institutions that support the Research Committees in technology to achieve their sustainability

Threats

- *Competition of* other institutions that use similar methodologies
- The community does not support the research committees
- Lack of validation and synthesis of results can cause lack of credibility
- Disposition of funds

Figure 7. Results of the analysis of Comité de Investigación Agrícola (CIAL) performance in the Calico River watershed, Nicaragua. (For acronyms see page 138).

Activity 1.4 Promote and support multiplication of successful alternatives validated at farm level

Highlights

✓ Six large plots of multi-purpose forages established

Objective

The objective is to evaluate the adaptability and yield of four *Brachiaria* species and two cultivars of peanut forage.

Methods

In 1999, plots of *Brachiaria dictyoneura*, *B. decumbens*, and *B. brizanta* 6780 (marandú), were 75% established. These plots were given two pastures in December 1999 and July 2000 to standardize the plots established in the 1999 peanut forage of the cultivars 22160 and 18774 and

the sowing of the fourth plot with *B. brizantha* 26110. The greatest difficulties in the establishment are seed quality and rain problems.

In 1999, the establishment of six parcels of multi-purpose forages was begun in order to have germplasm required by the cattle farmers of the reference site. Each seed production plot is of 1000 square meters. In 2000, seed of *B. dictyoneura*, *B. brizantha* 7680 (marandú), *B. brizantha* 26110 (Toledo and *Arachis pintoi* 22160 and 18744) will be harvested. The two plots of *Cratilia argentea* are being established.

Contributors: M Peter (IP-5), H Cruz, T Reyes, G Giraldo
Collaborators: C Burgos (DICTA), INTA

Activity 1.5 Monitor and evaluate the adoption of validated improvements

Develop and implement a monitoring system of the adoption of technologies developed in SOL

Highlight

✓ A monitoring and evaluation system (M&E) developed and put into practice in the SOL of Yorito, Yoro, Honduras

Objectives

The principal purposes of the SOL's M&E system are to:

- Regularly provide and document information on the activities and processes in each site,
- Identify problems and obstacles in order to support decisions for corrective action and to allow for adjusting project strategies in a timely way,
- Systematize the most relevant experiences with the SOL project,
- Improve feedback and communication between farmers and scientists and between collaborators within the network, and
- Provide a basis for measuring the impact of the SOL project.

Methods

The M&E system was developed in iterative cycles of action and reflection, jointly with field staff of the collaborating institutions (CIAT, SERTEDESO, EAP Zamorano, and IPCA) and with some representatives of local groups involved in the SOL Project. The actual M&E system is the outcome of a process of consultation with stakeholders and analysis of collected information. The system is not static, but will gradually evolve and improve with the experience of the actors involved.

This 'pilot experience' forms part of an action research project implemented by the University of Hohenheim in collaboration with the Participatory Research on Gender Analysis (PRGA) Program. It involves three different case study projects with the aim of yielding knowledge on participatory monitoring and evaluation (PM&E) as an instrument to support collective learning in participatory research processes.

The actors involved selected some aspects that need to be monitored for successfully managing the SOL Project towards achieving an impact at local level (success factors). Each of these topics was further specified in form of more precise 'indicators'. Quantitative and qualitative limits or envisaged 'milestones' have not yet been defined. Forms were developed to document the required information (Table 6). A set of corresponding questions is supposed to facilitate the analysis and evaluation of the information obtained. Most of the information is documented by agronomists and local groups working in the three SOL sites using simple formats. The fact that the three sites use the same M&E procedure will facilitate an exchange and the comparability of results between the institutions and groups involved.

Table 6. Form for documenting required information in monitoring and evaluation.

Area of observation	Indicator (form #)	Questions for analysis and reflection
Improved interinstitutional cooperation	– Accomplishment of the annual workplan. – Number of workshops and field days that have been organized together. – Collaboration and responsibilities in other SOL sites. – Number of institutions and groups collaborating in the network. – Satisfaction of collaborators in the joint project.	How do we perceive the cooperation in the SOL network? Does it lead to collaborative advantage? How can we strengthen and improve the interinstitutional coordination and cooperation?
Client participation in the SOL	– Register of people (clients) who visit the SOL sites and purpose of their visit. – Participation of men and women (form #2).	Who are our clients? Do women and marginalized groups participate in or make use of the SOL? (poverty-orientation, equity)
Activities and events developed in a practical, attractive, and user-friendly manner	– Number of workshops and field days that have been organized together. – Evaluation of each event from farmers' point of view.	Is there a regular and functioning communication/dialog between farmers and scientists/institutions? How can we improve the communication? How can we increase farmers' interest in new technological options and stimulate local experimentation?
Demand-orientation	– Comments and feedback from clients made during site visits and events. – (Specific surveys / interviews in order to capture farmers demands and perception).	Does the SOL correspond to farmers' needs? How can we increase demand-orientation of research?
Cost efficiency of the SOL approach	– Costs of experimentation and events.	Is the SOL approach cost efficient? How can we reduce the costs of investigating, validating, and transferring technologies?

Results

The M&E forms have only recently been put into practice, and it needs some time, practice, and joint learning until monitoring and documenting becomes a routine (instead of being perceived as a burden). The same applies for analyzing and reflecting on M&E results, as a prerequisite for decision making and corrective action.

Outputs

The M&E system lays the foundation for measuring the SOL's impact. Because of the documentation of activities, events and clients' comments, the formulation of impact hypotheses and the design of a more in-depth impact assessment study will be facilitated. The continuous registration of all people coming to the SOL sites (clients) will also allow for a more precise impact assessment and adoption study. The registration includes baseline data on their actual farming practices and socioeconomic conditions, the purpose of their visit, and the things they take home from the SOL (knowledge, seeds etc.).

Contributors: K Probst (University of Hohenheim), L Brizuela, G Palma, H Cruz, O Gallardo (EAP-Zamorano), Producer Groups of 3 de Marzo, Santa Cruz, Yorito, M Gonzalez (SERTEDESO)
Collaborators: Technical Committees of SOL sites

Follow-up of socioeconomic impact in level of well-being of beneficiaries (Plan Tierra)

Highlights

✓ Land ownership has, in the short term, a positive impact on the decrease of rent costs

Objective

The aim was to analyze the impact of land ownership as an economic alternative for improving the quality of life of the poor rural family.

Methods

Lack of land is a big obstacle to improving the quality of life of the small-scale hillside producers according to the results of an ex-ante study developed by the project in 1997. To check this hypothesis, we designed a pilot action for facilitating land purchase to nine producers, two of them women. The project provided them with the capital to purchase a unit of 0.7 ha in 1997.

Selected producers had the following characteristics:

- Main income was obtained from salaried employment. Only two of the producers did not have employment.

- The average family size was six people. This figure is similar to the average of the whole watershed.
- Most of the producers only sow maize and bean, the main crops, and only have small animals and/or a horse.
- Half of the producers consume 50% of what they produce and the remainder is sold. Of the rest of the producers, three consume all they produce.

The description of the current state of the plots acquired by the producers is:
Plot 1: Wibuse, one part coffee and the rest in fallow.
Plot 2: Piedra Larga, maize.
Plot 3: Ocote Abajo, sown with beans only.
Plot 4: Ocote Abajo, maize and bean. Soil conservation with live and dead barriers, dams, irrigation canals. Diversified with fruit-bearing trees and some vegetables.
Plot 5: Wibuse, nursery of 4500 plants of coffee, orange trees.
Plot 6: El Carrizal, beans.
Plot 7: El Quebrachal, beans; diversified with banana, fruit-bearing trees, tomato.
Plot 8: Wibuse, maize.
Plot 9: Wibuse, maize, beans, and some reforestation.

Results

To date the integration of family manpower to the production of their own plot is not yet a decisive element in the observed changes. In the cases where it occurs, it is circumstantial, that is, it is not a product of the change in land ownership. However, the fact of being owners of the land that they work presents a significant saving when not having to pay rent for the land (US$30.00). The crop revenues remain at the same level as those obtained on rented lands because they are subject to the same technological and climatic problems.

In terms of adoption of conservation practices, the introduction of live and dead barriers, irrigation canals, dams, and even trees for shade and to reforest sources of water can already be observed on some plots. It is worthwhile mentioning that other factors can be observed that are inherent to the project and that are interesting for follow-up, such as the exchange of experiences among the farmers of the group to find methods of payment, and the resolution of their problems.

Land ownership has, in the short term, a positive impact on the decrease of rent costs. However, the producer needs to accumulate enough capital to adopt more efficient systems of management that allow long-term improvement in well-being.

Output

The management problems of the plots are the same as those of all farmers of the watershed—low fertility, little diversification, few market options, and little investment capital. This causes the impact of land ownership to be slow.

Contributor: ME Baltodano
Collaborators: Asociación Campos Verdes (ACV)

96207

Output 2: More sustainable landscapes

Activity 2.1. Benchmark status report at the landscape level (study land use, analyze sustainability)

Research on collective natural resource management in Colombia

Highlight

✓ Presentations of a paper on stakeholder analysis methodology

Objectives

The research objectives were twofold:
1. Continue and publish investigation on collective NRM initiated in Colombia, and
2. Strengthen a project proposal for a collaborative research program called "Landscape management: Between consensus and conflict" (between CIAT, Center for Development Research (CDR), and various universities in Denmark and Tanzania) submitted to the Danish International Development Agency (DANIDA) October 1, 1999

Methods

Fieldwork was conducted in collaboration with Helle Munk Ravnborg (CDR) in Nicaragua between November 1 and December 4, 1999. Two sites were selected; the community of Puertas Azules in the Natural Reserve called Miraflore in the district of Estelí and the community of El Zapote in the municipality of San Dionisio. The research sites were dominated by small-scale farmers and selected according to their importance as reference sites for DANIDA, Estelí, and CIAT-Nicaragua. The basic methodologies used were parts of a stakeholder analysis methodology (Ravnborg et al 1999[8]) and method for defining local indicators for development both previously developed at CIAT-Laderas (Ravnborg 1999[9]).

Results

Intensified cultivation of river banks and valley bottoms cause problems of erosion and of water depletion and pollution further downstream; crop damage caused by crop pests and diseases suddenly escalates either because of the occurrence of new pests and diseases or because of the sudden escalation of those already known. These are just some examples of the spatial and temporal interdependency that characterizes NRM and that is accentuated especially as land use intensifies. What happens at one point in time or in one part of the landscape affects and is affected by what happens at other times or parts of the landscape. Some of these temporal and spatial interdependencies are immediately visible while others, such as the relationship between

[8] Ravnborg HM, Guerrero M, Westermann O. 1999. Accion colectiva para el manejo de los recursos naturales: Manual para identificar grupos de interes. CIAT, Cali, Colombia.

[9] Ravnborg HM. 1999. Developing regional poverty profiles based on local perceptions. CIAT, Cali, Colombia.

landscape diversity and structure and the occurrence of specific crop pests and diseases, are more complex and subtle.

The complex and subtle nature of the biophysical interdependencies at play in determining many NRM problems is, however, not the only factor complicating improved NRM. Particularly in hillside regions, agricultural landscapes are fragmented among numerous users, that is numerous individual decision makers. Thus, even if recognizing the biophysical interdependencies related to a specific NRM problem, effectively managing these requires the individual farmer to coordinate his or her resource management with that of neighboring farmers.

This brings a second set of interdependencies into play, namely the social and economic interdependencies that exist between individual landscape users. Some farmers depend fully or partly on others for their livelihood. Examples are through their provision of employment as day laborers or of informal loans, or farmers may belong to different ethnic or religious groups that may complicate communication and thus coordination between them, or previous experiences of cooperation among farmers may have failed. These and other factors shape the individual farmer's willingness to engage in coordinated or collective NRM and thus the ability to manage the biophysical interdependencies involved in many NRM problems.

Outputs

The paper (Ravnborg 2000) was presented at a workshop in the Netherlands and at a conference in the US. An article was submitted for publication in the journal Agricultural Systems.

The collaborative project proposal and the primary results of the fieldwork were presented at the local DANIDA office in Estelí at the beginning of December. Although the proposal raised much local interest for further collaboration, DANIDA in Denmark did not approve it. However, based on the experiences obtained we felt that these research issues were very pertinent and worthwhile pursuing. This has resulted in a Post Doctorate program for Helle Munk Ravnborg on organizing practices, and a PhD proposal for Olaf Westermann on the importance of social capital in collective water management, which was submitted to DANIDA for approval in October.

Contributor: O Westermann
Collaborator: HM Ravnborg (CDR)

Elaborate a watershed management approach

Highlight

✓ Poster presented at technical workshop

Objective

The aim was to present CIAT's approach to watershed management as a contribution to the first objective of the workshop; (1) to review experience of the Consultative Group on International

Agricultural Research (CGIAR) and other key institutions on watershed management research, particularly research on the institutions that affect watershed management.

Methods

The poster was based on a recently published booklet (CIAT-Hillsides 2000[10]). The stakeholder watershed management approach was presented at the reference sites in San Dionisio to a group of watershed management researchers from different CGIAR organizations and universities from all over the world. They included:

- Systemwide Program for Collective Action and Property Rights of the CGIAR (CAPRI),
- Maizeell University, USA
- Institute for Social Research, Uganda
- International Board of Soil Resources and Management (IBSRAM), Thailand
- International Center for Agricultural Research in the Dry Areas (ICARDA), Syria
- International Center for Living Aquatic Research Management (ICLARM), Philippines
- International Center for Research in Agroforestry (ICRAF), Kenya
- International Food Policy Research Institute (IFPRI), USA
- Michigan State University, USA
- University of British Colombia, Canada

The elaboration of a watershed management approach is a continued effort guiding our research and at the same time benefiting from its outputs. At the workshop we also made a presentation for discussion about participatory watershed management and research. Based on this presentation a paper is being written in collaboration with Nancy Johnson (BP-1), Helle Munk Ravnborg (CDR) and Kirsten Probst (PRGA) that will be submitted to the international journal, Water Policy. This paper will include an analysis of CIAT's stakeholder watershed management approach in relation to participation and research.

Output

These publications help diffuse CIAT's watershed management approach and help guide our research.

Contributor: O Westermann
Collaborators: N Johnson, AL Jones, JI Sanz

Diagnostic of support systems for development of market options

Highlight

✓ Database of supply and demand of support services established, diffused, and used in Yorito and Sulaco

[10] CIAT-Hillsides. 2000. Land discovery: Training and tools for decision support to stakeholder watershed resource management. Working document no. 181, CIAT, Cali, Colombia. 57 p.

Objective

The aim is to provide good knowledge in the local support system for rural agroenterprises to improve the database's efficiency and augment its use by those involved in local development (producers, small-scale managers, those who lend services, and institutions).

Methods

Support systems for rural entrepreneurial development is defined as:

> "The willingness of all the different local actors that are involved in and/or influence the rural development process (state, special interest groups, universities, research institutions, NGOs, civil society, private entrepreneurs, etc.) to develop a common vision and mission to support rural development, with an entrepreneurial approach and an efficient use of human, technical, and financial resources."

This implies that support systems should emanate from a broader process in which, if possible, all existing social actors in a (micro) region should participate. This process requires going beyond specific products and committed actors at the personal and institutional level.

The guiding principle in the whole process is that all the methodological steps are especially designed to motivate an active participation of all the actors, users, and clients. This achieves a high level of commitment among actors and fosters the growth of social capital in the region.

The following methodological steps were proposed:

- Search of a consensus among all the local actors and institutions,
- Participatory and integrated institutional diagnosis,
- Inventory, characterization, and segmentation of economic activities in the (micro) region,
- Inventory and characterization of existing support services for rural entrepreneurial development (formal and informal),
- Identification of support services needed with users and/or clients by productive subsectors,
- Feedback of the process to all the local actors and institutions,
- Prioritization, consensus, and definition of areas where support is to be provided, and
- Participatory design of a dynamic, entrepreneurial local support system for rural development.

The members of the local committees of development of rural agroenterprises in Yorito already participate. They are:

1. CLODEST, Honduras Commission of Credit, Microenterprises, and Commercialization (CMC), and
2. The Comité Interinstitucional para el Desarrollo de Sulaco, Honduras (CIDES) Commission of Production, Credit, Commercialization, and Microenterprises (CPCCM).

A database is being established on the support system to the agroenterprises to evaluate the supply and demand of support services in Yorito and Sulaco and to be able to design actions for improving this system's efficiency. Data were collected on 24 formal support institutions, organized producers, and independent suppliers. Nineteen institutions and producers of support services for rural agroenterprises were identified and their services evaluated through rapid

diagnostics in several local workshops and revision of the available literature on the topic in the area. The database needs completing with:

- Data on informal suppliers (middlemen, service suppliers such as transport or manpower, family companies) and a higher number of users, and
- A more complete and detailed characterization of the services that are offered or demanded (e.g., in costs/prices of the services and products, quality/quantity, and terms of loans and credits).

Results

Of the 24 offerers of support services, 14 (58%) offer diverse financial services (lines of credit for production, irrigation projects, buying and selling of inputs and equipment, etc.). However, the existing financial support although high does not seem very efficient and needs improvement because, of the 19 demanding services surveyed, 75% still need financial support for several uses (e.g., production capital, work capital for the support institutions, capital to enlarge credits). At the same time, adaptive initiatives of the financial services offered are observed to answer better to the demand requirements and more feasible payment capacity for small-scale producers. In this way the rural banks and funds for small productive projects co-negotiated by development institutions or of producer investigations and associations emerged in the zone, for example:

Rural or communal banks:
IPCA- Asociación de CIALs (ASOCIALs) and producers who are members of CIALs
SERTEDESO-producers who are members of Asociaciónes de Enlaces de Ladera (ACELYs)
Swiss Development Cooperation (SDC), Secretaria de Agricultura y Ganadería (SAG)-women members of Asociación de Mujeres Campesinas de Yoro (AMCY)
Credit funds for small productive projects:
IICA and CIAT, CLODEST and CIDES, and producers of Yorito and Sulaco

A high offer of non-financial services is observed in technical assistance for production and postharvest management in basic grains and cattle farming. A few organizations offer technical assistance that promotes crop diversification (e.g., evaluating and installing systems of micro irrigation, support for horticulture, etc.) apart from the organizations that support family kitchen gardens for food security, dietary improvement, and supply of homemade medicine in the area.

Even scarcer is the offer of service related to management of small agroenterprises, transformation, marketing strategy, and commercialization channels and the little on offer is inefficient or does not serve all the demand. Indeed almost all demands are for training in forming and administrating microenterprises (accounting and managerial organization included), transformation of products, search for commercialization channels, and market information (prices, linkage to buyers), etc.

A supply of training is observed on topics of sustainable agriculture and soil conservation. The training of local actors in diagnostic processes, systematization and diffusion of information for the development and strengthening of a local system of support to the rural agroenterprises, and their strengthening in answering this process according to needs is being achieved during the whole process.

Impact

A system of M&E of the impact will be needed at all levels. It is hoped that productivity, profitability, and incomes will be increased.

Contributors: M Lundy (SN-1), M Totobesola, V Gottret (SN-1), the CMC of CLODEST and the CPCCM of CIDES
Collaborators: CLODEST and CIDES

Biophysical characterization of Luquigue and Jalapa watersheds

Highlights

- ✓ Predominant soil types were identified in the watersheds where the Luquique and Mina Honda SOL sites are located
- ✓ Information was generated relevant to the development of scenarios of use and extrapolation of SOL technologies

Objectives

The three main aims were to:
1. Define the reference situation of soils in the watersheds where SOL sites are situated.
2. Make a diagnostic of the potential, conflicts of use, and vulnerability of the systems of soil use in the watersheds based on edaphic parameters (geology, soil type, current and potential use).
3. Guide the extrapolation of SOL technologies at watershed level within biophysical parameters.

Methods

Agronomic commodity-constraints research has focused on improving cropping productivity. This approach is an undeniably important element in predicting the acceptance and rejection of new technologies by individual decision makers. However, an arguably more relevant task for assessing the impact of soil degradation within a watershed context is the identification of land management practices and inherent soil characteristics that put the soil resource at risk of exceeding a threshold of irreversible loss of soil productivity.

The work consisted of a preliminary phase in which the different landscape units were defined. During the field phase the actual use of the units and soil conditions were verified. A map of current and recommended use was later elaborated based on the soil characteristics.

Results

The studied watersheds are composed of highly defined morphological units. Mountains predominate (60%), then ridges (23%), and terraces (17%). Acidic sedimentary materials prevail

in the Luquigue basin and calcareous materials in upper Jalapa. The lower parts of the Luquigue watershed have rainfall sediments. Laboratory analyses are pending.

Big differences exist between the two watersheds in terms of soils and land use. Upper Mina Honda has moderately good fertility for crops, but is highly susceptible to erosion. Upper Luquigue is suitable for agroforestry systems, but has low fertility. The lower part is suitable for agricultural activities. The presence of SOL sites in each watershed is justified because of the edaphic, climatic, and risk differences found in each.

Output

The information generated in this work is expected to contribute to the diagnostics of sustainability of current land use systems and as an entry point to extrapolate improved land use systems generated at the SOL sites.

Contributors: M Ayarza, M Trejo
Collaborators: J Martinez (consultant)

Analysis and mapping of Luquigue watershed vegetation

Highlight

- ✓ Analysis showed that most of the watershed is covered with forests of pine and broad-leaved species already intervened by production of wood and coffee and that the diversity of forest species and bushes of the watershed is relatively low

Objectives

The aims were to describe the floristic and structural composition of the watershed's tree and bush vegetation and elaborate a map of its distribution.

Methods

The Luquigue watershed is located in the central-northern region of the Yorito municipality, Yoro Department. The work included field and laboratory phases.

The field information began with an identification of the watershed through participative mapping together with 21 producers of the watershed. The information gained was coordinated with air photos of 1:10,000 scale. Later, 14 transects of 100 m length and 4 m width were defined in some points of the watershed to identify the predominant vegetation. The detailed characterization of the vegetation was made in four plots of 10 x 10 m selected in some points of the watershed. In these plots the type of vegetation and its age and composition were identified.

The laboratory information consisted of identifying the predominant species in the watershed. The collected field samples were identified in the herbarium of EAP-Zamorano. The land use maps and vegetation maps were elaborated at the GIS laboratory of EAP-Zamorano.

Results

Most of the vegetation is young pine (<15 years, about 39%) and broad-leaved forest (about 27%) that is mostly (90%) mixed with coffee. The area in pasture is about 18% and gallery forest is about 3%.

Results indicate that most of the watershed area has been intervened. The predominance of young pine confirms that the original pine forest was deforested about 15 years ago. On the other hand, most of the broad-leaved forest is sown with coffee. In these high areas serious erosion problems are observed. In the low parts of the watershed only some small gallery forests remain. The rest has been incorporated in agricultural production. Overall the vegetation is not very diverse.

Output

The diagnostic of vegetation coverage gives information that can be used to propose strategies for recovery of degraded lands and the sustainable management of areas with agroforestal potential.

Contributors: A Sierra, J Pilz (EAP-Zamorano)

Ethnobotanic study of forest species in the Calico River watershed

Objective

The purpose of the study was to generate and improve knowledge on the ethnobotanic and productive uses of the forest species of the watershed.

Methods

The work was divided into three stages, fieldwork, laboratory work, and analysis of the information. Dendrological, ecological, and usage records were completed for 31 farms distributed in the upper, middle, and lower parts of the watershed.

Results

Seventy-one different forest species were encountered, corresponding to 32 botanical families. The most representative were Fabaceae, Mimosaceae, and Caesalpiniaceae. The greatest representativeness is in the lower part of the watershed, diminishing as one moves upwards. This is because of the edaphoclimatic changes of the site. Consequently, the flora appears in the form of bushy patches in the highest parts, altered by the extensive pasturing and agricultural crops.

Also, 15 different uses were found, the most frequent being firewood, posts, rural construction, beams, and shade for coffee. Table 7 shows the type of results obtained in this investigation.

Table 7. Number of species present by type of use in areas of the Calico River watershed, San Dionisio, Matagalpa, Nicaragua, 1998.

No.	Uses	Number of species in areas[a]			
		Upper	Middle	Lower	Total
1	Firewood	22	40	44	63
2	Posts	22	22	16	37
3	Construction	14	20	14	31
4	Beams	7	12	8	22
5	Shade for coffee	15	-	13	20
6	Roadside stalls	4	5	7	14
7	M.A.C	9	5	3	12
8	M.A.N.C	7	7	1	11
9	Forage	9	6	5	10
10	Foodstuff	3	4	6	10
11	Livestock feed	-	3	5	7
12	Tools	1	2	1	4
13	Medicine	1	-	2	3
14	C.V	-	-	1	1
15	Bird feed	-	1	-	1

a. Total number of different species: 33 in upper area, 43 in middle area, 50 in lower area, 71 in whole watershed.

No forest tradition exists in the watershed; thus knowledge regarding the best use, management, and conservation of forest resources is lacking.

Output

A better knowledge of the ethnobotanic and productive use of forest species in the Calico River watershed was obtained. This will be helpful to decision makers regarding land use and sustainability.

Contributors: RA Martinez, UNA/ Facultad de Recursos Naturales (FARENA)
Collaborators: B Barbier, ME Baltodano

Fitness of the Cabuyal River watershed as an "environmental filter" for water-borne chemicals as affected by alternative land use scenarios

Highlight

✓ Laboratory and fieldwork completed and thesis drafts will be completed by year-end

Objectives

Intellectual tradition assumes intensive, detailed measurements of fine-scale processes are necessary to predict consequences of broad-scale patterns such as changing land cover/use in complex tropical hillside agroecosystems. The strategic goal of this activity is to infer effects of trends of ecological processes at the landscape scale for tropical hillside agroecosystems using observations and procedures appropriate for local-level, community stakeholders. The research activity reported here focuses on "soil and water" - valued ecosystem resources. Our intent is to explicitly address responses of soil functions in scenario analysis. We are interested in characterizing the responses of the critical functions of environmental filtering and water retention as well as productivity for different scenarios.

Methods

Figure 8 shows a hierarchical framework for soil quality assessment proposed by The Canadian Center for Land and Biological Resources Research (CLBRR). The figure illustrates relationships for in situ measurements associated with nutrient retention and ultimately productivity. The work on determining spatial and temporal variability of selected soil chemical properties, with emphasis on organic carbon, total exchangeable bases and exchangeable acidity, for selected land-uses has been ongoing since 1993 (see PE-3 Annual Reports from 1994 to date for methods). Results then showed that clear differences in organic-C, total exchangeable bases (TEB) and exchangeable acidity (ExAc) existed between the five sites and their land-use types (LUTs).

The original sites were resampled in 1998 to assess whether significant changes and trends in the soil properties could be identified. Data analyses were made in 1999.

Results

The trends the data show reinforce the earlier findings that intensive cultivation in the Cabuyal River watershed is actually improving important soil chemical properties, most significantly, TEB presumably as a result of increasing applications of organic fertilizer. The "bad news" is the increased potential for leaching of ions and concomitant nutrient loading of the Cabuyal River.

Output

These soil chemical properties will be evaluated as proxies of landscape risk and fitness during scenario analysis.

Contributor: CM Buitrago
Collaborators: T Oberthur, PE-4, EB Knapp (Oregon University), Universidad Nacional de Colombia

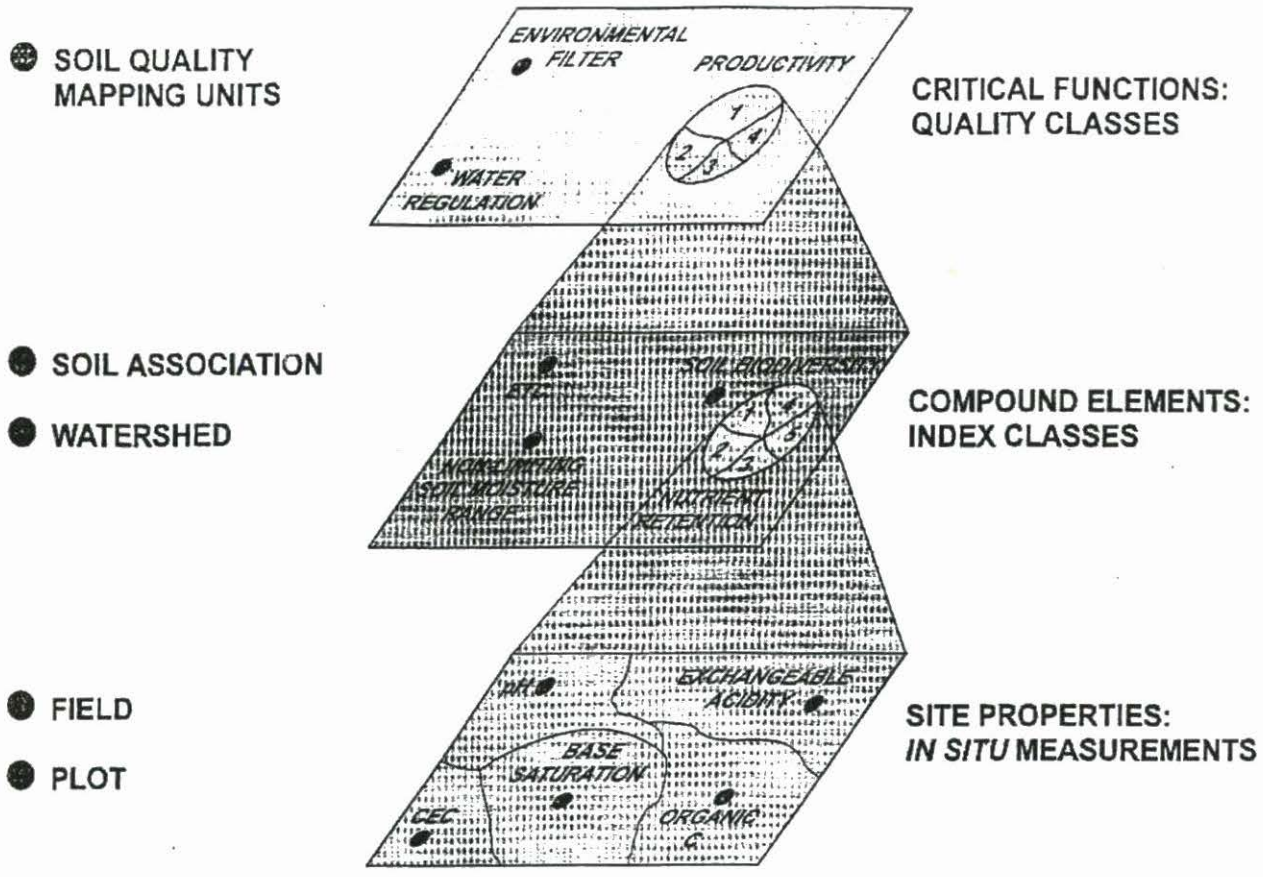


Figure 8. Hierarchical classification framework illustrating mapping concepts of scale, choice of soil quality criteria, and resolution of extrapolation (after a soil quality assessment framework proposed by the Canadian Center for Land and Biological Resources Research).

Analysis of production systems in the Calico River watershed

Highlight

✓ Survey of 130 families completed

Objective

The aim is to model productive and technological options of producers in the watershed, analyzing mainly the types of existent producers, based on their resources and their economic and social situation.

Methods

A survey of 103 families was completed to obtain a first global description of the agrarian reality of the area. At the same time it served as a diagnostic to establish agroecological, geographical, economic, social, cultural, and infrastructural conditions of the area and to describe its main crop systems. This information was obtained by interviewing producers and key informants. The work includes a prediagnostic, the definition of the typology of producers, and finally a simulation model of production systems. Financial, social, and productive indicators were also calculated to characterize the production systems. The financial indicators used were gross margin, net flow, family benefit, net income, and profitability of capital. The selected social indicators were: manpower by production unit, opportunity cost of women's work, family composition, farm nutritional balance, production unit expenses, and groups by age. The productive indicators were: total vs. cultivated area, item type, technical-economic criteria by farm, and indicators of the cattle system by farm. The collected information is being analyzed and will be reported on next year.

Output

The analysis of this information will allow the definition of the typology of producers and then the simulation of a production systems model.

Contributors: Universidad Agraria/ FARENA
Collaborators: B Barbier, ME Baltodano

Macroinvertebrates and other indicators as an "early warning" of ecosystem change in hillside areas

Highlight

✓ Use of integrated parameters to assess and monitor soil quality in hillside agroecosystems

Objective

The aim was to analyze and compare soil parameters in hillside areas as an early warning of soil quality.

Methods

Data collected during the PE-3 project " Impact of land use in hillside areas on the communities of macrofauna of the department of Cauca, Colombia " were analyzed and reviewed to develop land quality indicators under diverse land uses types in the Cabuyal River watershed of Cauca. Feijoo et al (2000)[11] give the sampling protocol.

[11] Feijoo MA, Knapp EB, Quintero H. 2000. Los macroinvertebrados del suelo como indicadores de calidad y salud agrosistémica. In: Silva F, Castro H, eds. Memorias IX Congreso Colombiano de la Ciencia del Suelo: Manejo de Suelos e Impacto Ambiental.

Results

A cluster analysis performed on the chemical characteristics of 10 land use types differentiated them into three clusters grouped by carbon content. The first group had an average C content of 12.7% (± 2), the second 4.4% (± 1), and the third 7.9% (± 1.5). The lowest levels corresponded with land uses that are susceptible to erosion, such as *Melinis minutiflora* and *Brachiaria humidicola* pastures or cassava crops. Highest levels corresponded with sites with good vegetative cover, e.g., forests or *Pennisetum clandestinum* pasture (Feijoo et al, unpublished data). Few studies have been made on the changes in SOM with the conversion of forest (mainly C3 plants) to pasture (C4 plants) so this could be an important contribution to the literature. Our results agree with the literature in the case of *P. clandestinum* pasture, but disagree with it in the case of *B. humidicola* and *M. minutiflora* pasture.

In Cauca Department, Feijoo et al (unpublished data) found that the structure and composition of the communities changed with land use. Under secondary forest, the biodiversity was higher (98 taxonomic units [t.u.]) than when the land was used to raise cattle (13 – 20 t.u.). Cultivation (18 - 31 t.u.) drastically reduced the diversity of the macrofauna. *B. humidicola*, bean/maize/cassava cultivation, and pine plantations had fewer species than other agricultural systems (Figure 9). At biological level, these results are promising, because they made it possible to use the future in a tool with prediction facility to monitoring the changes of the land use at landscape level.

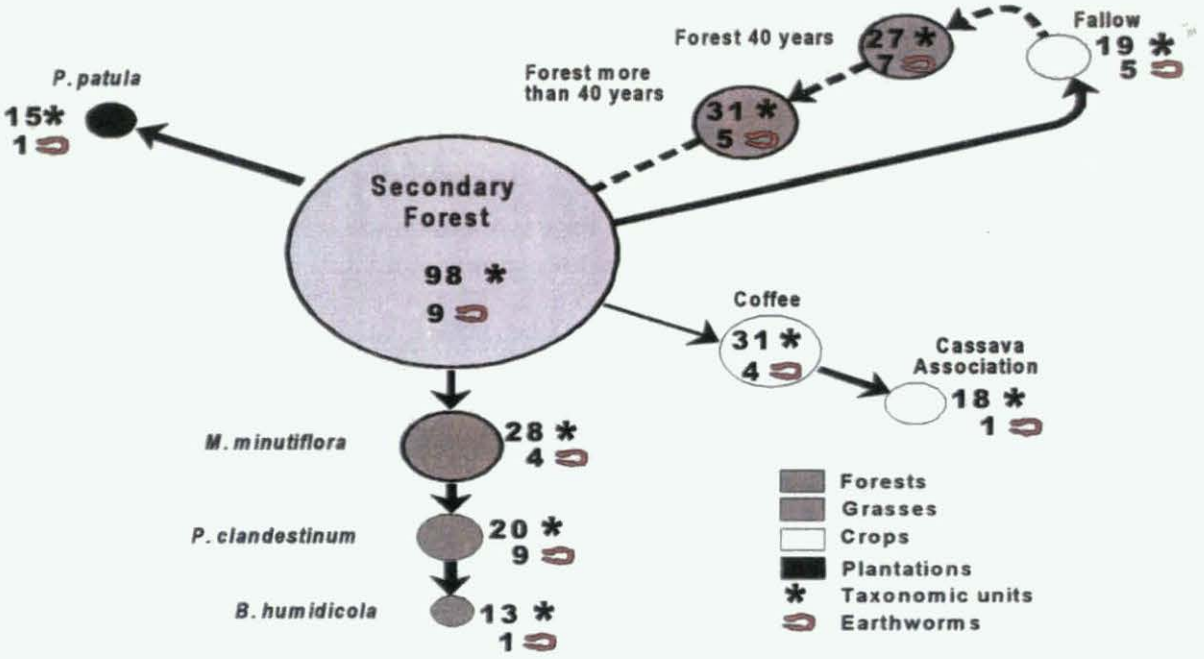


Figure 9. Species richness of earthworms and taxonomic units of macrofauna in the study sites, Cauca, Colombia.

Feijoo (unpublished data) in an attempt to explain the interaction of variables of the soil as possible tool predicting of its quality carried out a regression analysis between leaf and trunks

biomass and earthworm biomass in a forest of >40 years and pasture of *P. clandestinum*. Linear regression explained a low percentage of the total variation (r = 0,359 and 0,34 respectively). This was also the case when a multiple regression analysis was made of earthworm biomass against precipitation, soil humidity, organic matter content, total nitrogen, Ca, Mg and Al. In another attempt to explain the distribution of earthworm biomass an analysis was made for soil properties against two land uses. The results do not show a clear tendency in the distribution pattern of earthworm biomass.

Output

Earthworm population distribution may be a complex system that requires more sophisticated tools for data analysis and modeling. These results open several ways for future research.

Contributors: A Feijoo, EB Knapp, E. Amézquita (PE-2)
Collaborators: JI Sanz, P Hill (PE-4), CE Fragoso (Instituto de Ecología, AC), AG Moreno (Universidad Complutense de Madrid), P Lavelle (París University).

Activity 2.2. Ex-ante evaluate alternative scenarios of landscape management

The Spatial Water Budget Model (SWBM) developed and applied to the Tascalapa watershed, Honduras

Highlights

- ✓ Hydrological model developed and available for download at the ICASA Web site
- ✓ Publication in ArcUser has resulted in strong international demand

Objective

The SWBM is intended to support local decision making and for teaching local stakeholders about basic functions of multiple-community watershed components such as relationships between land and water resources, effects of land use, and demographic changes on future water accessibility, and upstream-downstream relationships.

Methods

The SWBM was developed using hillside watersheds in Latin America and the Caribbean of up to about 50,000 ha and for which limited biophysical data are available. Before the SWBM was developed, a thorough evaluation of many available water-based simulation models were evaluated including AGNPS, ANSWERS93, SWRRB, SWAT, PRMS, ARC/INFO GRID and ArcView Spatial Analyst, BASINS, and OWLS. None met all our criteria. In general they are too complex, too data demanding, or incapable of simulating and manipulating stream flows or simulating flow control structures, e.g., dams. The SWBM fills the gap between current needs and resources of rural communities throughout developing countries and data demands of

established, more complex multi-faceted models designed for resources and applications in developing countries. The model is not designed for engineering specific hydrological projects or for describing the movement of water and soil based on detailed physical processes. This simulation model was developed around the belief that an approximate answer to the right question is worth a great deal more than a precise answer to the wrong question.

A case study demonstrating the value of the SWBM was carried out for a benchmark watershed, Tascalapa, in Central Honduras. Using the SWBM, scenario analyses were carried out describing effects of plausible development paths on future water yields and patterns. Another analysis looked at equity issues, i.e., which zones in the watershed were net suppliers or net consumers of accessible water. Results are being made available on the Web as part of the Project's tutorial.

Results

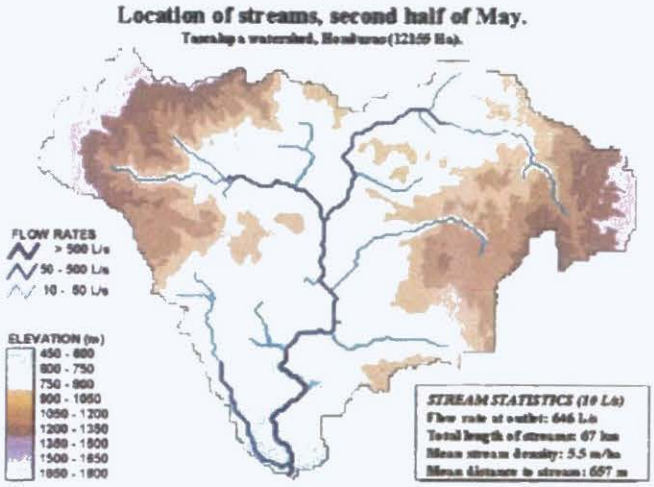
Based on the results, statements can be made such as, "In the second half of April, about 20% of the residents in the watershed have to walk more than 1 km to get to any stream, and 30% have to walk over 5 km before they reach a point where stream flow is greater than 50l/s". Not surprisingly, the poorest families and those settling the "frontier" of the watershed are often those without piped water and therefore may rely on stream water for domestic needs. The analysis also has implications for gender studies.

Based on the above analysis, decision makers could, for example, set goals for minimum flows at the watershed outlet during the driest seasons so that all farm families have access to water within a set distance from their homes (Figure 10). A second type of analysis carried out with the SWBM demonstrates the effects of different land use patterns on water yields. Current land use varies significantly between zones within the watershed that in turn affects relative water yields and temporal variability.

Output

The model is an official ICASA tool and is available for download at the ICASA Web site. Its publication in ArcUser has already resulted in a strong demand internationally. The fact that it is easy to use and requires few data makes it attractive to application in data-poor environments typical of most developing countries.

Contributors: C. J. Luyten (University of Florida), EB Tonson Knapp, J Jones (University of Florida), G Gregoire Leclerc (PE-4)



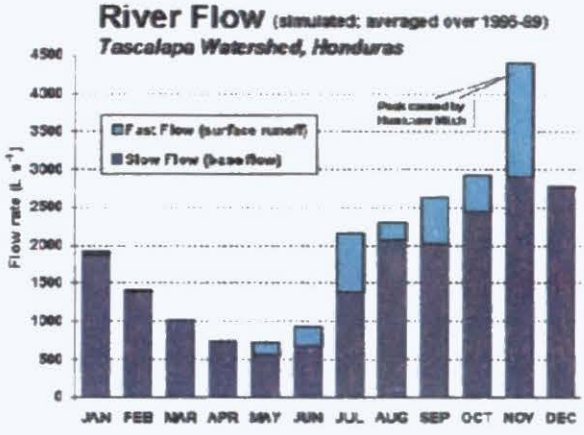


Figure 10. Results of analyses of flow rates for the Tascalapa Watershed, Honduras from analyses using the Spatial Water Budget Model (SWBM)

Application of the Soil and Water Assessment Tool (SWAT) to evaluate three scenarios of land use in the Jalapa River watershed

Highlight

✓ Simulations modeled for three scenarios in the Jalapa River watershed

Objective

The aim was to compare different scenarios of land use in the Jalapa River watershed and make projections for future years.

Methods

The SWAT is a scale model developed by the Blackgrass Experimental Station of Texas A&M University. It is a tool useful for evaluating water use and to quantify the impact of practices of land use in large watersheds. It is a model of continuous time that operates in daily periods.

The SWAT was used interfaced with ArcView to estimate the monthly water flow and siltage in the Jalapa watershed. Information (maps and databases) was prepared to feed into the model. The defined projection system for all the entrance maps was the Universal Traverse Mercator 1927. A digital elevation model (DEM) was prepared to delineate the watershed starting from a 20-m contour map. The DEM combined with river pattern was used to calculate the direction and accumulation of water flow. The two resulting maps were overlaid with a mask defining the minimum layer of available information. A map of the watershed was obtained showing relief and river system.

Three different land uses were modeled. The three scenarios that were tried in the model were current use, potential sustainable forest, and potential environmental payoffs. Each land-use map was converted to grid format for later feeding to the model. The current use was generated from air photos and verification in the field. For the scenario of sustainable forest management, the optimization made by the model obeys current market conditions: prices, costs, yields, manpower availability and requirements, capital, and soil for crop type. These were obtained by analyzing survey data. The watershed's recognized potential land uses were analyzed by comparing revenues that the pine forest could generate (selling to an industry that would pay Lps.120.00 for each standing cubic meter) versus the revenues perceived as coming from traditional agricultural crops such as maize, bean, pastures, and coffee.

To define soil polygons we used the maps of Simmons and Castellanos (1968)[12] and the soils database of the Dirección Ejecutiva de Catastro (DEC). For the configuration of the climate generator we used daily rainfall data for Yorito 1996.

[12] Simmons C, Castellanos V. 1968. Dirección de catalogación y deslindes, 1973. Clasificación de los suelos según la organización de las Naciones Unidas para la agricultura y alimentación. Tegucigalpa, Honduras.

Results

The simulated average rainfall was about 1814 mm and was used for the three simulated scenarios. The annual production of silt in the scenarios of sustainable forest and environmental payoffs did not differ significantly in quantities of silt, the sustainable forest scenario having the smaller quantity. On the other hand, current land use produces twice the siltage than the optimal land use scenarios. The differences of water production between optimal and current use are small (about 2%). Figure 11 shows the simulated quantities of silt and water production.

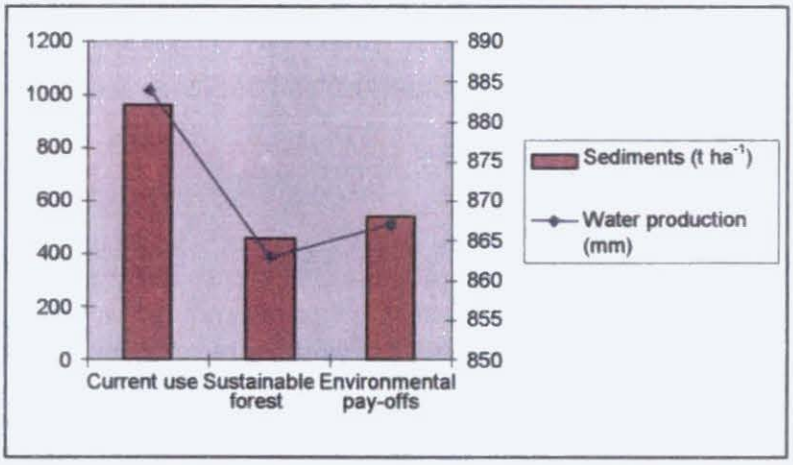


Figure 11. Simulated annual averages of sediment and water production in three scenarios, Jalapa watershed, Honduras.

The monthly average of siltage for the three scenarios shows a tendency towards smaller quantities at the beginning of the year (dry months) and a maximum between the months of September and November (months with higher incidence of phenomena such as tropical storms or hurricanes). We must mention that the series of available rain data for the simulations is from the last 4 years, during which (in 1998) Hurricane Mitch struck, which may be affecting the calculation of monthly averages of siltage.

The scenarios of optimal use generate similar quantities of silt. This may be because both scenarios have considerable forest coverage and the more sloping areas are protected from erosion. Agricultural activities in the upper part of the watershed with bigger slopes contribute 50% more silt compared to siltage in the optimal use model. Water production is not significantly affected among the different scenarios, because the scenario of current use possesses considerable vegetative coverage.

Output

The simulations will help decision makers in choices of land use and soil conservation for the Jalapa watershed.

Contributors: O Mejía, A Hernandez (Corporación Hondureña de Desarrollo Forestal [COHDEFOR]), B Barbier

Design and validate models of linear programming at watershed level

Choluteca watershed modeling

Highlight

- ✓ Support given to the Office of Land Use Planning of the Natural Resources Ministry in adopting linear programming and hydrological models as tools to simulate future scenarios of land use within watersheds

Objectives

The Secretaria de Recursos Naturales y Ambiente (SERNA) is in charge of improving land use in Honduras. Their Office of Land Use Planning (OLUP) has been storing a large amount of biophysical and socioeconomic data about agroclimatic potential and infrastructure for Honduras at different scales. However, their team has had some difficulties in developing a coherent picture of watershed problems and in identifying useful strategies. Our aim was to give support to their efforts by bringing in our expertise in analyzing watersheds and proposing concrete solutions.

Methods and Results

The CIAT DS tools allow determining how to reduce the conflicts between optimal and current land uses by comparing different scenarios. The Choluteca watershed was selected, being the most affected by Hurricane Mitch in 1998, for the application of such tools. The OLUP contracted two students to apply two models with CIAT help. The optimization model is maximizing the income of the whole watershed based on homogenous land units (Figure 12).

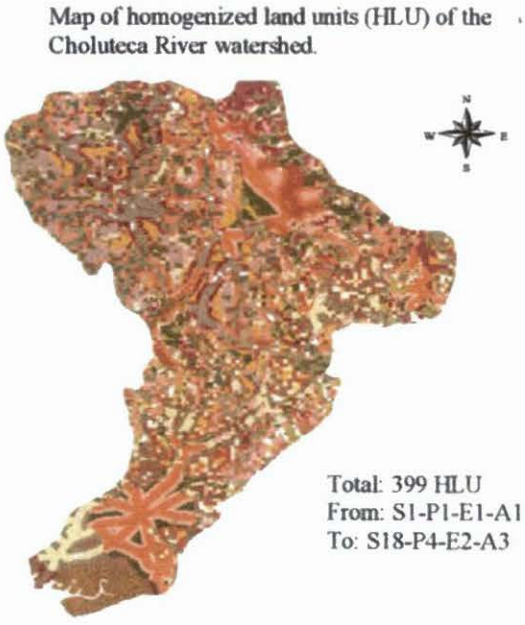


Figure 12. Homogenous land units of the Choluteca watershed, Honduras.

The homogenous land units are the results of the superposition of three maps: distance to market, slope, and altitude and soil characteristics. The optimization spatial model is based on a spatial analysis of the watershed. The analysis consisted in determining homogenous land categories. These were determined using altitude, slope, and distance to road. The map is drawn. The student is still collecting data about local farming systems.

Output

We expect that the OLUP will go beyond map making and analyze the watershed in an integrated way. They are likely to apply the technique for other watersheds and present relevant scenarios to policy makers.

Contributors: R Hernandez (Escuela Nacional de Ciencias Forestales [ESNACIFOR] student), F Lopez (ESNACIFOR), A Cortes (OLUP), O Mejía, B Barbier

Communicating a vision of the future with optimization models and virtual landscapes: An application to the Jalapa watershed in Honduras

Highlights

- ✓ Optimization model linked to a virtual reality rendering software
- ✓ The tool improves communication of possible futures for land uses, and replaces the use of *maquetas* and flat maps

Objective

The aim was to help communities more clearly visualize possible futures for land use.

Methods

Exploratory work on the communication of possible scenario outcomes to the population of a small watershed was done by combining optimization models with computer-generated images of future landscapes. Five scenarios (a rapid population increase, a sustainable forest management, an increase in agricultural productivity, a new credit program, and a payment for environmental services) were introduced in a linear programming (LP) model that maximizes the total income of the watershed while finding the most profitable land use condition.

The results of the model were fed into a virtual-reality (VR) landscape rendering software that allows us to simulate the aspect of the watershed under given scenarios. We presented to the population the realistic "pictures" of the watershed they are living in, according to possible futures. This included present and future roads, buildings, land use patterns, and eroded hillsides. We also generated animations that correspond to what an observer travelling through or flying over the landscape will have in his field of view.

Results

Figure 13 shows the resulting actual land use and environment payments scenario. Surprisingly, farmers have no problem in grasping the profit maximization principle, and understand perfectly what would be the impact on the landscape. In fact, we found that VR helps to lower the level of abstraction typically associated with LP and GIS. The VR animations reinforced the perceived realism of the simulated landscapes.

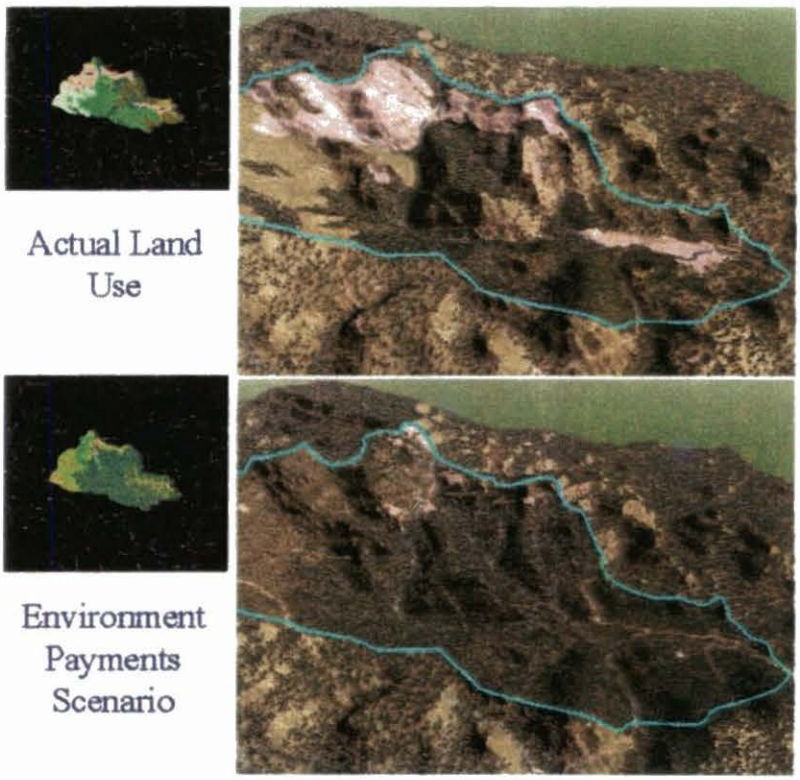


Figure 13. Results of using the model to show actual land use and environment payments scenario.

Output

This DS tool will help communities forecast the impact of different collective actions such as new rules, new roads, or adoption of new techniques on both their incomes and their landscapes.

Contributors: G Leclerc (PE-4), B Barbier, A Hernandez (COHDEFOR)

Physico-geographic and socioeconomic characterization to establish small seed enterprises

Highlight

- ✓ Hydrological maps of Honduras produced to help in locating best areas for small seed enterprises

Objectives

The aim was to generate informative maps that allowed the Seeds of Hope Project to make correct decisions in identifying the appropriate areas for establishing small seed enterprises (PES, the Spanish acronym) both in Honduras and Nicaragua.

Methods and Results

A series of maps was produced using rainfall data from the CIAT database.

The maps showing the Honduran hydrological balance show that in the months of January and April the hydrological levels are deficient, between 100 and 200 mm, the lowest in the year. This indicates that to produce seed in these months we need to have irrigation equipment to guarantee success of production. We would be making from the weakness of the system strength for the SSE, because we would be producing seed at a difficult time for the rest of the producers.

Also, we can select the areas with the best hydrological level, 0 – 250 mm and supplement the levels from 0–100 mm with irrigation. We can avoid those areas where precipitation is very high, over 250 mm. This amount would be a problem in field production because of the risk of pests. It would also be a problem because of high relative humidity, which would make it, if not impossible, then highly difficult to reach a humidity content in the seed of 11%-12%, which is safe for their storage.

Output

The maps produced are of help to decision makers in working out the best areas to locate the PES and what irrigation is required in less optimal areas.

Contributors: G Giraldo, M Méndez

Compile and analyze base line on crop/ soil use systems of Wibuse/Jicaro watershed

Biophysical characterization of the Calico River – soil profiles, scale 1:50,000

Highlight

✓ Biophysical characterization of Calico River watershed carried out

Objective

The aim was to generate basic information on edaphic resources through a soil characterization.

Methods and Results

A biophysical characterization was carried out using 21 aerial photos at a scale of 1:25,000. Using GIS, seven maps were defined collating data of the physiography, slope, soils, capacity for land use, and proposed land use. Nine land systems or landscapes were determined in the watershed and their individual areas were estimated using polar planimetry. The area percentages were checked using GIS.

The hillsides system proved to be predominant in the area (Table 8).

Table 8. Estimated areas of nine landscapes in the Calico River watershed, Honduras.

Type of landscape (land system)	Area (km^2)	Area (%)
Steeply sloping hillside	62.79	36.57
Moderately steeply sloping hillside	21.76	12.67
Semi-inclined hillside	21.57	12.56
Hilly	36.42	21.21
Dissected plateaus	11.23	6.54
Fluvial terrace	6.59	3.84
Mountainous	6.39	3.72
Non-dissected plateaus	4.19	2.44
Colluvio-alluvial terraces	0.78	0.45
Total	171.72	100.00

The topography of the area is characterized by an irregular relief with slopes that vary from 2% to >75%. The simplified soil classification of the watershed (Table 9) was made using the categories order, suborder, great group and subgroup, according to the soil classification system of the United Sates Department of Agriculture (USDA), 1995 version.

Table 9. Simplified soil classification of Calico River watershed[a].

Order	Name	Area (km^2)	Area (%)
ENTISOLS	Lithic Ustorthents	148.13	86.26
	Vertic Ustorthents	0.41	0.24
INCEPTISOLS	Fluventic Eutrochepts	5.07	2.95
	Typic Eutrochepts	1.55	0.90
ALFISOLS	Mollic Hapludalfs	7.30	4.25
VERTISOLS	Entic Haplusterts	2.69	1.57
	Typic Haplusterts	6.57	3.83
	Total	171.72	100.00

a. According to the soil classification system of the United States Department of Agriculture (USDA), 1995 version.

With current land use (Table 10), most of the watershed is not well used and is covered by natural grass associated with annual crops, resulting in low agricultural potential. The steep slopes and inadequate soil use worsen the situation.

Table 10. Current land use in the Calico River watershed.

Type of Use	Area	
	km^2	%
Natural pasture + crop	75.25	43.82
Natural pasture	46.86	27.28
Tacotal + natural pasture	6.49	3.78
Coffee with shade	24.00	13.98
Crop	0.52	0.30
Open woodland	0.17	0.10
Gallery forest	13.89	8.09
Inhabited	0.33	0.19
Crop + natural pasture	1.83	1.07
Natural pasture + *Tacotal*	1.18	0.69
Tacotal	1.20	0.70
Total	171.72	100.00

According to the characterization of the edaphic resources carried out in the watershed, more than 80% of the area is of forest type, according to the capacity of land use. However, these resources were determined as being used in about 88.4% of the watershed's total area.

Output

Decision makers on topics of land use, soil conservation, and cropping systems can use the information generated.

Contributors: UNA/FARENA
Collaborators: B Barbier, ME Baltodano

Identifying local determinants in landscape management

Highlight

- ✓ Local determinants in landscape management determined for the community of Ocote Abajo, San Dionisio, Nicaragua

Objective

The purpose was to analyze the present dynamics of the CIAT research site in San Dionisio, exemplifying the relationships among the different levels of decision within the municipality.

Methods

The management of natural resources and agriculture is approached considering biophysical and socioeconomic aspects because the optimization of these resources also depends on the decisions taken by those who can take advantage of them. The investigation is developed from an anthropocentric perspective and focused on decision taking at different levels of collective organization. Emphasis was laid on the definition of the level immediately above farm level corresponding to groups of the community carrying out collective action. Second, the hierarchical relationship between social and biophysical systems was analyzed; evaluating in what measure the domains of the determinants coincided with biophysical units of the landscape, like for example, watersheds. One might expect that each level of decision taking would correspond with a landscape and characteristic domain.

The study area was the community of Ocote Abajo in San Dionisio, Matagalpa, Nicaragua. The analysis was to identify an intermediate level between farm and community, that is, a level above Productive Unit. We used the Stakeholder Analysis methodology. To identify the relationship between collective action and landscape, projects were spatially represented, considering the influence area of each of the participant families, looking for a grouping pattern.

Results

At least 99 families have dominion over about 678 ha. About half (53%) of this dominion is dedicated to pasture and fallow, about one third (29%) is occupied by agricultural crops, about one fifth (17%) by forests, and the remaining area by buildings and public places. About 86% of the area is managed by landowners. In the remaining 14%, multiple work agreements were observed to take advantage of the lands.

The family domain at productive unit level extends over an average area of 6.6 ha. Ten types of area were observed—shifting agriculture, permanent crops, subsistence farming, forests, pastures in use and others, fallow, agricultural use of low fertility, buildings, and public places. Men, with or without a family to support, dominate the areas of shifting agriculture, pastures, and permanent crops as landowners, sharecroppers, lessees, or journeymen. Women with a family to support take care of water supply and the smaller animals. Their radius of action is bounded to the house, the lots where hens are raised, and the patches of forests where the sources of water are. The women also participate in collecting firewood and cultural labor of agriculture.

In the level above productive unit were 25 groupings congregating in turn around initiatives led by NGOs of development, religious, and political tendencies. Groups of families work in collective form in some of these initiatives, mainly in those in which NGOs participate, related with the management of water, reforestation, soil conservation, and sowing of basic grains.

The community is divided into three sectors, but they are not an administrative division nor are they recognized by the municipality, therefore they are not a decision space. They respond more to historical reasons, territorial extension. Some relationship was found between divisions of watersheds bigger than 10 ha and the sectors.

Four levels of landscapes were determined, their characteristics, the resources that the community demands at each level, and who decides upon them (Table 11).

Table 11. Levels of landscape, their characteristics, resources required by community at each level, and decision makers determined for Ocote Abajo, San Dionisio, Nicaragua.

Domain	Territory (landscape level)	Landscape types (patterns)	Primary interested parties	Decision makers
Agricultural products Firewood and wood Water Housing, constructions	Plot	10	Members of the family (7 types)	
Main family income: Agricultural products, cattle, or mixed, or activities different to agricultural production	Productive unit	4	Family (6 types)	Men with and without family to support Women with family to support
Well water that protects food and credit	Sector	3	Work groups	Land owner of water site Support institutions and/or Leaders by sector
Roads School	District	1	Community	Mayor, *alcaldito* Leaders sector 2

The family has direct influence on the productive unit. Families take advantage of the resources of the productive unit and take the decisions, being mainly the men and the women with families to support. The level below the productive unit is the plot or territory associated with the subdominions of the family. The level above productive unit is the "sector", which exhibits characteristic historical and social specifics. When analyzing the projects in NRM and

agriculture that are developed in combined form, it is deduced that the sector domain is related with the water of collective springs and the forests that protect them, food, and credit. With respect to water, the owners of the lands where the source is located decide on this resource and not the group.

The community would correspond to a higher landscape level than the sector and is defined by the limits of the district. Who makes the decisions at this level is not clear, despite having an "*alcaldito*". However, such a functionary does not have autonomy for the position. The absence of recognized petitions that represent the interests of the whole community is noted.

The main elements that call the community together are the necessities of water and credit. The problems with water supply gave rise to the formation of the Comité de Agua Potable (CAP), which involves 29% of families plus 34% in informal collectives.

Output

The clearer picture that emerges of the levels of decision making within the community helps make support more efficient.

Contributors: L Hurtado (Ecoregional Program), A Imbach (Ecoregional Program), ME Baltodano

Activity 2.3. Develop and apply the methodological tools for natural resource management at landscape level

The methodological Guide for development of a local geographical system has been the object of various planning meetings and a basic idea for its construction has been agreed. The CIAT-CATIE proposal to the Inter-American Development Bank (IDB), in which it is included as a tool for intermediate production, has been approved. Work has begun.

The Guide for constructing scenarios of land use based on bioeconomic models is pending the finalization of respective research. Meanwhile components have been validated to generate the methodological tool, validate it, and produce the Guide.

The initial proposal of a single Guide on the use of mapping and phototopographic analysis in evaluating natural resources at watershed level integrating mapping and phototopographic analysis was discarded following the analysis made this year. We are presently working on the reconstruction of the form for the Guide to include in the second edition of Guides being prepared from January 2001.

Contributor: V Zapata

Activity 2.4. Promote and implement consortia for landscape management

Support initiation of activities with consortium of Manejo Integrado de Suelos (MIS)

Highlights

- ✓ Operational Plan for 2000-2001 defined and approved by stakeholders
- ✓ Exchange of information and systematization of experiences initiated
- ✓ Collaborative activities with other Soil Water and Nutrient Management (SWNM) consortiums identified

Objective

The aim is to develop, adapt, and disseminate improved options for the sustainable management of fragile soils in the Central American region.

Methods

Following a series of meetings with stakeholders including farmers, farmers' organizations, NGOs, Ministries of Agriculture, and local universities, it was decided to develop an interdisciplinary and multi-institutional consortium to develop alternative management systems that contribute to improving the quality of life of small-scale producers. The MIS Consortium is a member of the SWNM Program, a CGIAR's systemwide program.

A second workshop was convened during Jan 31-Feb 2, 2000 to define the outputs and modus operandi of the consortium. Stakeholders identified common problems including:

- Soil and SOM losses,
- Water quality and availability constraints,
- Burning,
- Lack of knowledge of the role of biological processes and nutrient cycling,
- Inadequate use of fertilizers and lack of alternative sources,
- Limited use of alternative production systems/components,
- Lack of quantification of the biophysical and socioeconomic impact of traditional and improved land use practices, and
- Inadequate policies on land use.

Agreed common sites for the consortium activity were the watersheds of the Tascalapa River and Lempira Sur in Honduras and the Calico and La Dalia Rivers in Nicaragua. The group elected a steering committee. It includes representatives from the NGO PRODESSA and the UNA in Nicaragua, the National Program DICTA and the EAP-Zamorano in Honduras, with CIAT as coordinator.

Results

The consortium recognizes that a large amount of information and practices already exist on the integrated management of hillside soils, but it is often not readily available in adequate forms for the end user. Therefore we are collating this information and presenting it in easily understood formats using a variety of media. Better understanding of the driving forces behind land use is also required. For this reason we are characterizing constraints and potential use of fragile soils in the two countries. This work will identify opportunities and sites for technical interventions that are thoroughly grounded in the socioeconomic and environmental context.

Outputs

The expected outputs include:

- Information on SWNM available for multiple stakeholders,
- Production systems efficient in the use of soil, water, and nutrients, and
- Technological innovations developed and disseminated with active participation of farmers.

Contributor: M Ayarza
Collaborators: MIS Executive Committee

Consolidate annual operative plan of CLODEST

Highlight

✓ CLODEST annual operative plan consolidated

Objectives

The aims were to:

1. Improve coordination among the institutions and at the same time between the institutions and the local organizations to be able to reach a sustainable development over time.
2. Develop representative local structures to improve the communication of the necessities requested by local, regional, and national entities.
3. Improve the capacities of each of the partners in the areas of administration, research, and development.

Methods

The establishment of the interinstitutional consortium, CLODEST, has increased social capital considerably within institutions and between institutions and local actors. This has allowed us to develop combined activities. An example of these is the establishment of the SOL network that allows us to put agricultural technologies related with environment conservation and improved production levels at the disposition of the small-scale producers in the hillsides. In this way a rational use of the natural resources is obtained.

Another important example of the benefits of this coordination was the creation of a documentation center in the reference site. This will facilitate in the future the establishment of a local system of support for decision taking, because it will bring together all available information of the municipality, reducing in this way the duplication of effort and maximizing the use of human and economic resources. Having organizational structures in place has facilitated the integration of partners that develop topics of great importance in the region.

The annual operative plan is thus of great importance to the working of the consortium. On the 16th of March, a workshop was held on "Establishing the action plan, vision, and mission of the local committees of development of rural agroenterprises of Yorito and Sulaco". The workshop consolidated the committees involved in CLODEST, clarifying and revising the prioritization of activities for the year 2000 and established work plans and budgets. On the 29th of May the Support Group for CLODEST (CIAT/IICA Holland/IPCA) met to discuss lines of action for strengthening the consortium.

Results

Table 12 shows the activities developed by the commission and support group.

Table 12. Activities developed by the commission and support group for CLODEST.

Agriculture and environment	Production projects	Education and social action	Microenterprises and commercialization
-Communal market gardens project	- Financing, approval, and monitoring of production projects	-Campaign "No burning" -Adult literacy	-Identification of the coffee chain

Board of Directors	Facilitators	Support group
-Dispatch of official statements to support the resolution of conflicts -Programming of workshops and meetings at interinstitutional level -Application of framework of agreement -Collaboration in establishing the documentation center -Interinstitutional meeting for presentation of annual operative plan -Establishment of an office and recruiting of personnel	- Workshops of social motivation - Development of action plans	- Exchange of experiences with similar organizations - Training of facilitators - Structuring of the Network of local organizations of the municipality of Yorito and Sulaco (REDOLYS) - Elaboration of framework of agreement - Proposal to establish the documentation center - Delivery of funds for operative expenses and financing of projects - Workshop for the structuring of the Network of SOL sites - Technical and financial support to the commissio of microenterprises and commercialization level

Table 13 shows the main results of CLODEST grouped by topic, not by activity, because not all have a tangible result or are of short term.

Table 13. Main results of the Comité Local para el Desarrollo Sostenible de la Cuenca del río Tascalapa (CLODEST), Honduras, grouped by topic.

Theme	Results
Agriculture and environment	• 145 market gardens in nine communities (225 direct beneficiaries) • 37 production projects developed benefiting 294 people directly and 2991 indirectly
Education	• Improvement in humane development of organization members • Population's conscience awakened and involvement of children in campaign against burning • 105 students approved at three levels in eight communities • 29 facilitators for development in training process
Commercialization	• Identification of the coffee chain
Organizational	• Incorporation of 27 types of local organizations through the net of local organizations (formation of REDOLYS)[a] • Commercialization commission with funds and work plan defined (incorporation of CIAT-Agroenterprises) • CLODEST Assembly in process of legalization (Application of framework of agreement)
Human resources infrastructure and logistics	• Office stabilizing and conditioning • Recruiting of personnel • Documentation center working

a. Red de Organizaciones Locales de Yorito y Sulaco, Honduras.

Contributors: L Brizuela, JA Beltrán
Collaborators: IPCA, IICA-Holland, CLODEST

Opening of a Documentation Center in Yorito – support to consortia activities at local level

Highlights

- ✓ With funds mainly from local organizations a documentation center was inaugurated in February in Yorito, a poor municipality of central Honduras
- ✓ The documentation center will be a platform for GIS and other DS systems

Objective

The aim was to help local consortia in setting up a documentation center in Yorito so that tools and models that have been developed can be used and maintained.

Methods

By law the municipalities of Honduras are required to build development plans in order to improve infrastructure and production, reduce poverty, and reduce vulnerability. Over the last 6 years, CIAT has worked with the community of Yorito and Sulaco to develop DS tools for municipalities and organizations involved in development. These tools included an interactive municipal Atlas, local database, farm optimization models, and watershed optimization models. However, to date technicians have made a limited use of these tools despite several years of training and an apparent interest. The local organizations pointed out their limited capacity to use or to maintain the tools. Also the organizations could not afford to put enough human resources into these activities.

In 2000, several organizations from Yorito decided to join in an effort to create a common platform where the different stakeholders can share data and information in a way that reduces costs and improves individual analysis capacity. This platform was called the Documentation Center and a technician was hired.

Results

After 6 months of existence the Center seems sustainable and computers are available for the public and the local population. The technician has been giving regular courses to organizations, highschools, and primary schools where participants pay, making the center financially sustainable.

Output

The Center will help local farmers, organizations, and institutions in training with GIS and other tools that help in decision making.

Contributors: B Barbier
Collaborators: CLODEST

Activity 2.5. Strengthen participation of grass-roots organizations in consortia for landscape management

Highlight

✓ Better identification of demands at local level and their effective linkage with institutional offers at different levels

Objectives

The aims were to:

1. Strengthen local networks of community organizations allowing them to develop their abilities and capacities to achieve interaction with external agents and the taking of decisions especially in NRM.
2. Develop local structures that are participative and representative with the power to negotiate and channel local necessities to the agents of external help.

Methods

For the past 3 years we have been offering support to an agricultural association of farmers (Campos Verdes) in San Dionisio, Matagalpa, Nicaragua and for 1 year to the network of local organizations (REDOLYS) in Honduras. This support attempts to invigorate the Association, on one hand through its increasing decision taking that affects its locality, and on the other hand through stimulating and creating spaces so that decision taking is covered at municipal level.

We have supported and documented the organizational experience of the Campos Verdes Association and REDOLYS. The systematizing of this experience has had as a platform the nine methodological steps that hypothetically guarantee a certain level of success in the development of an organizational process at watershed level (Beltrán et al 1999).[13]

Results

The success of CLODEST can be seen under the report "Consolidate annual operative plan of CLODEST", page 65, and in the numerous references to its work that are made in this annual report. The association is becoming ever more independent as it becomes more experienced.

One year after forming the REDOLYS network, it is being well consolidated since the elaboration and approval of its internal regulations. The members, and especially the Board of Directors, have developed a series of activities that allows an evaluation of its level of development (Table 14).

[13] Beltrán JA, Tijerino D, Vernooy R. 1999. Developing processes of organization at local level for collective management of natural resources. Guide no. 9 (in Spanish) of the series "Instrumentos metodológicos para la toma de decisiones en el manejo de los recursos naturales". CIAT, Cali, Colombia. 147 p.

Table 14. Activities of the Red de Organizaciones Locales (REDOLYS) in Honduras, 1999.

Area	Result
Organizational	• Seven board meetings and five assemblies held • Integration of members to the board of directors of CLODEST[a] and the commission of approval of projects • Reforms to the internal regulations
Education and social action	• 30-50 representatives of local organizations qualified in the following topics: social motivation, parliamentary norms, control of expenses, and elaboration of small projects
Operative	• 60% of annual work plan developed • Two organizations interviewed to determine their support needs • Nine production projects elaborated and requested, of which six were approved • Two advance reports produced • A tour carried out to the fruit and vegetables exhibition at La Esperanza, Intibuca

a. CLODEST = Comité Local para el Desarrollo Sostenible de la Cuenca del río Tascalapa, Honduras

Output

The strengthening of local organizations will eventually lead to their independent functioning and an increase in self-autonomy of the region.

Contributors: L Brizuela, D Tijerino, JA Beltrán
Collaborators: Communities of Yorito and Sulaco

Activity 2.6. Monitor and evaluate landscape changes

Monitor water of Tascalapa River and Calico Rivers watersheds

Monitoring water of Tascalapa River watershed

Highlights

✓ Eroded soil at plot level will not affect El Cajon reservoir thus land conservation projects may be less necessary than was thought

Objective

The aim was to measure the amount of eroded soil that reached the El Cajon reservoir in order to help decision making on soil and land conservation.

Methods

We have been applying the SWAT hydrologic model in three watersheds in Honduras. In the Tascalapa watershed, we are measuring sediments as well as stream flow and rainfall. These measurements permit us to verify the accuracy of the model. If the model is able to predict stream flow and rainfall reasonably, then the modeler can run other scenarios with different land uses. Sedimentation is being measured twice weekly during the 2000 rainy season. Results will be published at the end of the rainy season in December.

Stream flows were also ruler measured every day on four spots in the watershed by paid farmers. Rainfall in the watershed was measured over the last 5 years in 15 raingauges.

Outputs

When results are finalized, the information will be of use in deciding on relevant proposed projects of soil and land conservation.

Contributors: S San Martin (SERTEDESO), B Barbier, O Mejía (CIAT)
Collaborators: SERTEDESO

Monitoring water of Calico River watershed

Highlight

✓ Information on soil erosion provided for the Calico River watershed

Objective

The aim was to collect data on soil erosion, which is much needed.

Methods

Erosion is the first expressed concern in discussing sustainable agriculture in developing countries. Most projects claiming to work on NRM first promote soil conservation practices, but little is known about erosion and the real cost of erosion for farmers and for society in general. The Central Bank of Nicaragua is putting in place a green accounting framework to verify if the gross domestic product (GDP) is sustainable. The bank has asked soil scientists to provide information about the real cost of erosion.

The CIAT experiment is located in the Calico River watershed in Nicaragua on a representative antisol. Students from UNA have been monitoring the erosion process and its impact on yield in six different plots for 2 consecutive years. They compared three techniques in a maize-bean rotation, such as traditional techniques, dead barriers, and contour plowing with one replication of each land use. Results are pending.

Output

The data and analysis produced will be of great use to decision makers given that little information is available on soil erosion.

Contributors: J Morales (UNA), B Barbier, ME Baltodano

Monitor rainfall distribution at watershed level

Highlights

- ✓ Measurement of interception from vegetative covers in Tascalapa River watershed confirms that forest cover decreases the production of spring water
- ✓ Precipitation data for San Dionisio analyzed for the years 1987-99

Objective

The aim is to help validate the biophysical and bioeconomic models that we have been developing and to provide information of use to decision makers in the watershed.

Rainfall interception in the Tascalapa watershed, Honduras

Methods

We measured the rainfall interception by different vegetative cover in the Tascalapa watershed. The problem is that interception is a main factor in the water balance. The main hypothesis behind the watershed project is that trees increase water production through more rainfall and through better infiltration and retention. Most hydrology books disagree with this hypothesis. Evidence shows that tree cover reduces water production through higher evaporation (interception by tree crown) and by transpiration caused by deeper roots and larger leaf area. Literature mentions about 30% or 40% interception in tropical forests. There has been no measurement in Honduras to date.

In 1999, ESNACIFOR and CIAT installed 27 linear rain gauges under three vegetative covers and one electronic rain gauge in a pasture to compare the difference of interception between tree cover and no tree cover. The rain gauges were installed in one small area in the Tascalapa River watershed. A farmer measured the rainfall daily during 1999 and 2000.

Results

In 1999, the results suggested interception as high as 60% for both pine trees and broadleaf forest, including coffee. Among the dozens of measurements made in the world this was the highest. Given that the protocol suffered from the failure of the electronic rain gauge, we had to redo the measuring in 2000.

Output

The impact of this study is likely to be important in the Honduran context where most projects are based on a misconception. If it is confirmed that trees intercept most of the water, then it is probable that the watershed strategy should be rethought. The national Electricity Company of Honduras has already tried to discuss the matter at the political level because they suspect that trees reduce the production of electricity. The company even tried to promote improved pasture instead of trees in the El Cajon watershed.

Contributors: A Suazo (ESNACIFOR), A Ulua (ESNACIFOR), B Barbier, S Rivera (ESNACIFOR), O Mejía, W Turcio (Catholic Relief Service [CRS])

Rainfall analysis in San Dionisio, Nicaragua (1987-99)

Methods

The Meteorology Department of the Instituto Nicaraguense de Estudios Territoriales (INETER) provided the data. Figure 14 shows the monthly pattern over the years analyzed.

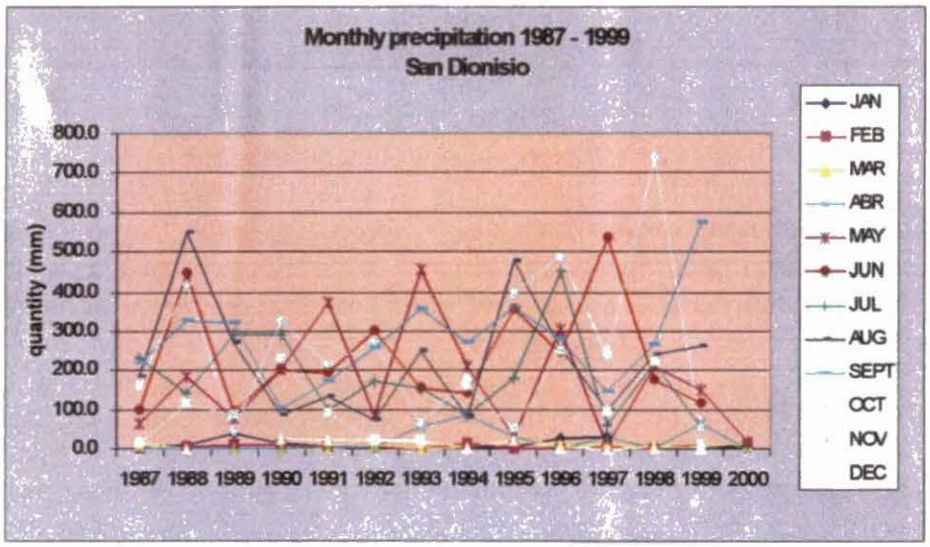


Figure 14. Monthly precipitation pattern 1987-99, San Dionisio, Nicaragua.

Results

The month with most rain in the 13 years was October 1988 because of Hurricane Mitch. However, subtracting that maximum value (741 mm), the maximum precipitation moves to the month of September and the minimum to the month of May. The rain average in the winter months (May-October) oscillated between 100 and 280 mm per month, with September always having the highest and May the lowest average.

Observing annual precipitation, very dry years occurred from 1989 to 1994 and in the remaining years distribution has a highly irregular tendency with very marked highs and lows. The high

points of the years 1988 and 1996 present more reduced rainfall when compared with the year of Hurricane Mitch. However, this is because of its distribution—the 741 mm of the hurricane fell over 15 days, while in the years 1996 and 1988 an accumulation of the whole year is presented.

The tendency in 1999 and so far in the year 2000 is of a reduction in rainfall, which has already been demonstrated with the droughts that farmers have had to face in this period.

Output

We now have a clear diagnostic on the rainfall pattern for San Dionisio for the years 1987 to 1999. This information can be used for planning with regard to land use, crop systems, and irrigation.

Contributor: ME Baltodano
Collaborators: INETER, Nicaragua

Measuring spring water volume quality in different small watersheds within the Tascalapa River watershed

Methods

Although scientists consider that trees are likely to decrease the volume of water produced by springs, development practitioners and farmers consider that deforestation decreases the water volume of springs. This contradiction is important for watershed management. Many projects promote protection of small watersheds, which means aforestation, expecting to increase water volume. This is of particular importance for the national economies because the cost of electricity is partially determined by the volume of water produced by the springs during the dry season.

For the past 4 years, SERTEDESO has been measuring spring volume in the Tascalapa River watershed in collaboration with SDC and CIAT. We have acted as adviser to the student doing the survey in 2000. The results of the study will help CIAT run a study of environmental pay offs.

Output

The information from this project will add to that on rainfall measurement in the watershed to help decision makers on matters of water conservation.

Contributors: S San Martin (SERTEDESO student), M Pineda (ESNACIFOR), S Rivera (ESNACIFOR)
Collaborators: B Barbier, SERTEDESO

Output 3: Organizations strengthened

Activity 3.1. Develop and/or validate methods and tools for developing and strengthening key organizations

Develop a Guide for establishing small seed enterprises

103950

Highlights

- ✓ A Guide developed and elaborated for the establishment of small seed enterprises with aspects of marketing, feasibility, and revised managerial administration
- ✓ The Guide includes basic and essential concepts of orientation to the market, profitability, and sustainability

Objective

The aims were to:

1. Help trainers and trained small-scale managers to take into account market tendencies, profitability, and sustainability involved in setting up a PES.
2. Develop a methodological tool that allows the National Institutions and NGOs to implement, with groups of producers of the hillsides and marginal areas, the PESs
3. Decentralize seed production and allow these producers access to a source of good quality seed and to fair prices and suitable quantities at the required times.

Methods

Using previously collected data and experience, between March and July, four sections were produced as components of the Guide.

Results

Section 1 is entitled "Identifying the appropriate zone and organizing the interest group". This section emphasizes the alternatives that institutions have in identifying the appropriate zone to establish the PES, for example, using GIS, the physical and agroclimatic profile, and the psychometer. Different aspects related with the strategies are analyzed for identifying and organizing within a community the group of producers most appropriate for the PES. This is based on organization, planning, execution, M&E, and on the strengths and weaknesses of being associated to a PES.

Section 2 is entitled "Seed commercialization and managerial administration". This section puts forward some mechanisms for commercializing the seed produced by the PES, based on the socioeconomic profile, the studies and evaluation of markets in the PES's zone of influence, and the distribution channels and publicity. Also relevant aspects related with accounting systems are presented as mechanisms for the economic control of the PES.

Section 3 is entitled "Pre- and postharvest management of the seed". This section presents all aspects related with seed quality, appropriate harvest time, and their influence on seed deterioration. Rules are also established for the seed drying and storage, as well as some tests for evaluating seed quality.

In Section 4, aspects related with the internal quality control in the PES are presented. This is managed through M&E in all production processes: field, cleaning, drying, storage, commercialization, and administration. This internal quality control is also compared with the official control carried out by the institutions of seed certification.

This Guide will also have a set of prototypes of the equipment used for producing better seed, such as: an air ventilator, a chute for manual selection of seed, and a stationary dryer. These prototypes will allow qualified technicians to carry out some exercises related with the postharvest handling of seed.

Output

This Guide will ensure that small seed enterprises are formed, trained, have studied market options, have pre-evaluated profitability and sustainability, and thus have an increased probability of success.

Contributors: G Giraldo, V Zapata, M Meléndez (Seeds of Hope Project [SOH]), M Totobesola
Collaborators: IPCA, CLODEST

Elaborate the second edition of Guides supporting decision taking in NRM and new presentation posters of the Guides

Highlights

- ✓ CD-ROM of Guides in preparation
- ✓ New Guides on local indicators of soil quality and management of soil organic matter are being developed

Objective

The aim is to improve the Guides developed to contribute to the institutional strengthening of projects, programs, and entities working in the management, protection, and negotiation of natural resources with emphasis on the local level (watershed/municipality).

Methods and Results

The second edition of the Guides so far produced is being prepared as a CD-ROM using material from the first edition and introducing editorial changes. The product is ready for copying. A pause is being taken to give authors of the Guides the time to make corrections. This has delayed

production of the CD-ROM because of the multiple commitments of staff. The end of 2000 has been stipulated as a final date for submitting corrections.

The first draft of Guide 1, Local Indicators of Soil Quality, is prepared. Contributions from six specialists in Africa are included with the scientific coordination of Edmundo Barrios (PE-2). This Guide will be validated in Arusha, Tanzania in October in a course for 30 trainers of five East African countries.

At the same time, and following the model developed for the CIAT Guides, Robert Delve (CIAT-Africa) is developing a Guide on the Management of Soil Organic Matter. This will also be used in Africa and later adapted to tropical America. It will be revised by the team of African authors and CIAT staff at the Arusha course in Tanzania.

Output

The Guides provide support and training for decision makers and those working in the field of NRM at local level.

Contributors: V Zapata
Collaborators: PE-4, PE-2, SN-1

Develop a Guide on use of maquetas *with the community*

After various attempts to secure the participation of Jairo Morales (UNA-Nicaragua) to work with a student on the research necessary for this Guide, an agreement has been reached. Work is going ahead with UNA and results will be available by the end of the year. The Guide should be available by April 2001.

Contributors: J Morales, V Zapata
Collaborators: JA Beltrán, Campos Verdes, PE-4, UNA

Activity 3.2. Train local, regional, and national organizations in the use of methodologies and/or tools developed by CIAT and its partners, using methods developed

Training in managerial administration and postharvest management of seed

This activity is part of the Seeds of Hope Project and will be reported in the SOH final report later this year. Some of the training workshops are shown in Table 19 under Activity 5.4.

Action plans: Support their development, hold training workshops for their follow-up and evaluation, and supervise, monitor, and document those elaborated by trainees

Highlights

- ✓ 15 action plans elaborated
- ✓ National teams of trainers trained in evaluation of action plans

Objective

The aim is to support and strengthen local institutions and decision makers involved in NRM at the local level (watershed, municipality).

Methods

Various training events and workshops were carried out during the year with the support of teams of national trainers in Honduras, Nicaragua, and Colombia (see Table 19 under Activity 5.4). As a result, the managements of the respective institutions (seven in Nicaragua, six in Honduras, and two in Colombia) have supported 15 action plans (APs). The 13 APs of Central America have produced evaluation reports in an independent publication, containing text, figures, and photos on the:

- Socioeconomic and physiographic context where the methodological tools are applied,
- Description of the organizations and institutions of the area where the AP is to be applied and their relationships with the AP, and
- State of execution of the AP.

Three participative workshops were carried out as follow-up to the APs in situ in Tegucigalpa (Honduras), Granada (Nicaragua), and Bolivar (Valle-Colombia). In these workshops, the trainers, in their new role as monitors, revised the general theory on follow-up and they designed, with those from CIAT responsible for training, the tools for collecting ex-ante information. They also formed work teams to visit the APs and the timetable for this work.

The supervision, monitoring, and documentation of the follow-up process to the APs was in the charge of the training coordinators in the three countries with the collaboration of the trainers. Table 15 shows the visited institutions and organizations whose APs were reported on in the separate publication.

Outputs

The activities whose tasks were completed have generated:

- National teams of trainers trained to carry out the evaluation of specific cases where APs are carried out.
- A simple methodology for carrying out in situ follow-up of the APs and a set of tools.
- Fifteen institutions in the process of incorporating the Methodological Instruments into their normal development plans and programs.

- Some relationships strengthened with the partner institutions, to such a point that it has been internally suggested that their representatives should be members of the CIAT Consultative Group in each country.

Table 15. Institutions and organizations visited as follow-up process of action plans.

Nicaragua	Honduras	Colombia
1. Universidad Nacional Agraria (UNA)	1. Secretaria de Recursos Naturales y del Ambiente	1. Corporación Socioecológica para el Futura de Bolivar
2. Universidad Centroamericana (UCA)	2. Fomento Evanagélico para el Progreso de Honduras	2. Sociedad de Acueductos y Alcantarillados del Valle del Cauca
3. Centro Intereclesiástico	3. Escuela Nacional de Agricultura	
4. Fundación para la Autonomia de la Costa Atlantica de Nicaragua	4. Comisión de Acción Social Menonita	
5. Centro de Promoción y Desarrollo Rural	5. Cooperative for American Remittances Everywhere (CARE)-Dipac	
6. Escuela de Agricultura y Ganadería de Estelí	6. Proyecto Lempira Sur (PROLESUR)-Food and Agriculture Organization (FAO)	

Contributors: V Zapata, M Trejo, J Cisneros
Collaborators: Government organizations (GOs), NGOs

Incorporate the use of methodological tools to support NRM organizations through workshops with national groups

Highlight

✓ Workshops held in Africa, Asia, the Andean zone, Central America, and Colombia

Objective

The aim is to support and strengthen NRM organizations through workshops on the methodological tools with national groups.

Methods and Results

In February-March 2000 some of the Guides were presented to audiences in Asia (CIP-CIAT Vietnam–Analysis of Groups of Interest and Gender) and to a group of researchers from East Africa (Uganda) with the collaboration of the African Highlands Initiative (AHI) and the SWNM. The African experience allowed the formation of a team of soils experts who have elaborated a Guide of Local Indicators of Soil Quality, which will be validated during the training of 30 trainers from five countries of this region.

In February 2000, four of the Guides were presented to 22 professors of the National University of La Molina in Peru. They elaborated an action plan on their application in classwork and in fieldwork carried out with their students. In October the visit to follow up this plan was made.

A variety of additional support has been given to institutions that requested partial access to information and/or training in the use of the Methodological Tools. Marco Tulio Trejo, together with the Honduran national team of trainers offered support on five opportunities to organizations, partners, and non partners, such as CARE–DIPPAC y Extensa, PROLESUR, SCD, the CALEL and CASFUL Cooperatives, and CONCERN[14], involving almost 250 individuals. In Nicaragua, a variety of support events were carried out, such as María Eugenia Baltodano offered to students of the Universidad Centroamericana in the application of the tool on levels of well-being. The work carried out by Celia Gutierrez stands out in the induction of members of other UCA faculties to the knowledge of the Methodological Tools.

In Colombia, seven support meetings were held on the application of the Guides in which Olaf Westermann and Vicente Zapata participated for the formulation of the APs of Ecofuturo and Acuavalle.

Output

Training in and diffusion of the methodological tools is ensuring better management and decision making in NRM.

Contributor: V Zapata
Collaborators: M Trejo, O Westermann, ME Baltodano, J Cisneros, national groups

Activity 3.3 Strengthen small-scale producers, managers, and local, regional, and national organizations in aspects related to rural development using participatory investigative methods

Training in the elaboration of projects at community level

Events are recorded in Table 19 under Activity 5.4.

Support the consolidation of Committees for Developing Rural Agroenterprises in Yorito and Sulaco

Highlight

✓ Two local committees for development of rural agroenterprises established

[14] For acronyms see page 138.

Objective

The aim is to help and support the consolidation of committees for developing rural agroenterprises in the region, including help with integrated production projects (PPIs, the Spanish acronym) and system of local support (SAL, the Spanish acronym).

Methods

A workshop, "Support to the commercialization and development of agroenterprises in Yorito and Sulaco", held in October 1999 in Yorito consolidated two local committees of development for rural agroenterprises. The two committees were consolidated based on an existent structure within CLODEST and CIDES that are CMCs of CLODEST in Yorito and the CPCCM of CIDES in Sulaco. However, they were not very active because they lacked a vision and clear mission, a well-defined action plan, and starting capital to begin to develop activities.

The committees were formed through local partners interested in taking into their own hands the managerial development in the region. At present the committees have a similar vision and mission guided toward the development of rural agroenterprises and they have established action plans for the year 2000, which are being implementing with SN-1 support. Both the committees benefit from a starting capital of the International Development Research Centre (IDRC) to develop strategies and execute activities whose results are beneficial for the development of activities related to agroenterprises in Yorito and Sulaco.

Results

Action plans have been defined and started upon. The functions of the committees have also been defined and their vision and mission. Monitoring and evaluation remain to be put into operation to define impacts.

Contributors: M Lundy (SN-1), M Totobesola, L Brizuela
Collaborators: Agroenterprise Committees of Yorito and Sulaco

Consolidate Committees for Developing Rural Enterprises in developing a local system of support for small rural agroenterprises

Objective

The aim is that the committees for developing rural enterprises (DER, the Spanish acronym) are strengthened by attending to support demands. They should be able to mount a support system that is sustainable in the future thanks to an offer of services adapted to the area's demand and with the establishment of a payment mechanism for the services.

Method

The method used for Yorito and Sulaco was a similar process to that being developed by the Proyecto de Desarrollo de Agroempresas Rurales (PDAER) elsewhere in Colombia and Peru. The process has two components:

1. Support the formation of a local DER committee in the organization of the interested parties (institutions, individuals, organized groups), definition of a vision, mission, and work concepts held in common that are in harmony with those of the CIAT's SN-1 project.
2. Familiarize and strengthen members of the local committees in the use or adaptation of PDAER-developed methodologies to attend the development needs of rural agroindustry of a given area, such as the following ones in Yorito and Sulaco, that is:
   - Identify market opportunities for small producers (IDOP, the Spanish abbreviation)
   - Develop a system of local support (SAL, the Spanish abbreviation) for the development of rural agroindustries
   - Participative design of integrated productive projects (PPI, the Spanish abbreviation)

The IDOP methodology (see SN-1 Annual Report) identifies and evaluates the different market options that are presented to the producer following a process of different stages:

- Socioeconomic profile of the area of interest,
- Rapid market study to determine demand tendencies in the market of several products that can respond to different marketing strategies,
- Characterization of the products of a "products-with-demand" portfolio from the agronomic, commercial, and economic point of view, and
- Participative evaluation—where the different options are presented to the producer for their choice of preferences.

In the case of Yorito and Sulaco this methodology was carried out in 1999 and the following varied products were chosen: red onion, green chili, tomato, cabbage, avocado, banana, butter and cheese, coffee, maize, and beans. The process of participative evaluation allowed rejection of some products because of such problems as sustainability or access.

As part of their activities for the year 2000 the Yorito DER local committee chose coffee and the Sulaco committee chose maize to test the development methodology of PPIs. They chose these products because they are traditional in the area, they show demand according to the IDOP methodology applied in 1999, and their development problems affect most of the residents of the two places. For the elected options an analysis of the agroindustrial chain was made to identify the processes in the chain—the actors present at each stage and the bottlenecks that exist and need to be overcome. Then the problems that exist were identified and prioritized and finally an analysis of cause and effect to establish the activities that should be determined in the project design. This design can establish research and development actions that can motivate implementation of activities or projects developed in a participative way with the different actors present in the chain.

Results

Table 16 shows results to date for activities in Sulaco and Table 17 shows results for Yorito.

Contributors: B Ferrera (CLODEST), M Flores (CIDES), Members of the CMC-Yorito and the CPCCM-Sulaco, M Lundy (SN-1), M Totobesola

Table 16. Results and advances to August 2000 of the Comisión de Producción, Crédito, Comercialización y Microempresas (CPCCM), Sulaco, Honduras

Activities and subactivities	Results and advances
1. Setting up of a commercial maize company	An informal meeting was held and an informative meeting followed. Other meetings are planned for later this year.
2. Market research	Two maize processing agroindustries were contacted: Alimentos Concentrados (ALCON) and Compañia Avícola de Centro América (CADECA) with verbal agreement on possibilities of purchase and prices.
3. Funds administration	In process.
4. Training producers in postharvest management	The Instituto Nacional de Formación Profesional (INFOP) has been contacted and has advised the Comisión de Producción, Crédito, Comercialización y Microempresas (CPCCM) of the probable dates of activities

Table 17. Results and advances to August 2000 of the Comisión de Crédito, Microempresas y Comercialización (CMC), Yorito, Honduras.

Activities and subactivities of support service executed by the CMC in Yorito	Results and advances [a]
1. Administration of committee operative funds	An accountant was hired and a mechanism of control is in place. A mechanism of sustainability is in place and consists of charging a percentage of the budget gained from proposals generated for the committee funds.
2. Administration of funds for the formation of new projects or strengthening of existent companies	There is a guide for the elaboration of proposals. The PPI design for coffee is in process. Activities are in process for companies of organic compost, artisanal seeds, and market gardening products. A list is available of supporting financial sources. A database is being compiled on supply and demand of services (financing included).
3. Support to organic compost company	A market study is being made and results will be available later this year.
4. Support to the formation of an organic coffee company	The design of the coffee PPI is in process.
5. Support to the formation of small artisanal seed companies of maize and bean	A market study is in process and results will be available later this year.
6. Support to the market information system	Affiliation is effective: the net will communicate the supply and demand of Yorito and Sulaco with other regions, press information, contacts of buyers and sellers, and transport service of products. The SERTEDESO office is the headquarters of the center of information (information can be received and sent from Yorito, Yoro, Yorito, Victoria, and El Progreso) by telephone, Internet, and fax. Information will be diffused in the communities. Verbal contact was made with the local cooperatives and space will be rented according to storage needs. An inventory is being made of products and demands in Yorito and Sulaco.
7. Support to the certification of organic products	Information was identified on the certification process, handling of organic coffee, contacts in OCIA-AHPROCAFE in Honduras, Biolatina in Nicaragua, experiences of production of organic coffee for small-scale Honduran producers for an organized learning tour.
8. Support to companies of transformation of market garden products	Market garden products that are produced in comercializable quantities are being identified before beginning these activities.

a. Acronyms and abbreviations used: PPI = proyectos productivos integrados, SERTEDESO = Servicios Técnicos para el Desarrollo Sostenido, OCIA-AHPROCAFE = Organic Crop Improvement Association International-Asociación Hondureña de Productores de Café.

Interchange experiences of development and rural strengthening at local, national, and international levels

Highlight

✓ Lessons learned, hypotheses, principles, and openings for future research activities were identified for CLODEST and REDOLYS (Honduras) and the Asociación Campos Verdes(Nicaragua)

Objective

The aim was to elaborate an initial conceptual framework on organizational processes based on CIAT's experience in the reference sites of Central America, to establish learned lessons, to develop clear hypotheses, and to generate work principles.

Methods

Taking into account the different stages mentioned in logical order by Beltrán et al (1999)[15], a matrix was built for each stage:

- Select the site and reference framework
- Identify social actors and partners
- Facilitate organizational types
- Strengthen existing organizations
- Promote networks or associations of local community groups
- Coordinate interinstitutionally
- Generate bonds among the local, regional, national, and international levels

To facilitate construction of the matrix at each stage, the following questions were kept in mind: What have we done and why? With whom and why? With what objective and why? What methodology was used? What are the impacts / achievements, spaces / difficulties? For each stage, a "Force Field Analysis" (Hope and Timmel 1984[16]) was used to identify the different forces. We identified, from the analysis of forces for the organizational process carried out in Honduras and Nicaragua, the lessons learned, work hypothesis, and principles from the search for causes of problems.

Results

The diverse results were tabulated. To augment possibilities of success in organizational processes at local level, the following lessons learned from these experiences in Central America should be taken to heart:

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[15] Beltrán JA, Tijerino D, Vernooy R. 1999. Developing processes of organization at local level for collective management of natural resources. Guide no. 9 (in Spanish) of the series "Instrumentos metodológicos para la toma de decisiones en el manejo de los recursos naturales". CIAT, Cali, Colombia. 147 p.

[16] Hope A, Timmel S. 1984. Training for transformation. Mambo Press, Zimbabwe.

1. Begin with clearly defined objectives that are logically linked with strategies, products and indicators of impact, and results (either physical or in terms of the development of capacities).
2. Identify key actors, both their capacities and interests.
3. Evaluate demand.
4. Strengthen local organizations for collective action that assures the conservation or improvement of natural resources.
5. Actions with the objective of involving local organizations should contain principles of participation and decentralization; the process should be seen as something that will probably change and that should change over time, as local priorities change and institutions mature.

Output

This process of analysis and reflection will continue so that at local level collective decisions can be taken that allow communities to govern their own destiny, and to be more efficient and more effective.

Contributors: JA Beltrán, L Brizuela, D Tijerino, D Holland, O Westermann, M Lundy, CA Quiros

Collaborators: V Gottret (SN-1)

Activity 3.4. Support, through incorporating processes of participative investigation, local organizations oriented to agricultural investigation

Activities to do with systemizing the experiences of the use of the CIAL methodology are reported under 1.3. Other CIAL work is reported by Investigación Participativa en Agricultura/*Participatory Research in Agriculture* of CIAT (IPRA).

Work on the training of technicians /promoters in participative methodology to evaluate components of the SOL (groups of interest) is underway and will be reported on next year. Likewise the inventory of technologies of soil, water, and nutrient management in the region will be reported on next year.

Activity 3.5. Promote and support interinstitutional plans for sustainable rural development

For the sake of brevity, the many events in support of interinstitutional plans for sustainable rural development are reported in the form of joint tables with those for strengthening work with other projects and organizations. They can be found under Activity 5.4.

Output 4: Decision makers supported

103957

Activity 4.1. Identify, at different levels, decision makers related with Project tasks and diagnose their needs in terms of support for their work

Highlight

- ✓ Inventory of needs made from which agreements of collaboration were drawn up and signed with seven organizations of national importance in Honduras

Objective

The aim is to help decision makers at different levels with their work in NRM by diagnosing and fulfilling training needs.

HONDURAS
Methods and Results

At least two visits were made to each of the institutional partners and two collective meetings held with their leaders and the trainers of the national team to inform about the progress of activities and to explore new needs for training and consultancy.

As a result of these meetings an inventory of needs was made. From this agreements of interinstitutional collaboration were elaborated and signed with seven organizations of national importance. They were: the Association of Municipalities of Honduras, World Vision - Honduras, CARE - Honduras, Secretary of Natural Resources and the Environment, Christian Services of Development, Commission of Mennonite Social Action, and National School of Agriculture. These agreements were signed in August this year. This is a step that clears the way to sustainability of a mechanism (group of institutions) that, at country level, can incorporate research products in a permanent way.

NICARAGUA
Methods and Results

Two visits were made to partners and potential donors and two meetings held to give information of the strategy advances and of progress towards signature of interinstitutional collaboration agreements. Also, communication was made personally and in writing to a group of donors coordinated by the Programa del Trópico Seco Nicaraguense (TROPISEC). The result of these contacts has served so that the institutions involved in that project send their technicians for training, but we have not consolidated a more concrete collaboration.

Three personal contacts were established among officials of PE-3 and the United States Agency for International Development (USAID). Following their instructions, a proposal was prepared to attend the training needs of an important group of receivers of USAID economic help. The

proposal is being studied. An agreement of collaboration was established with the Proyecto Cuencas Matagalpa and a training project was written for 19 organizations that are involved in this project. The initiative initially presented to USAID received no affirmative answer and is now presented to the WK Kellogg Foundation.

Contacts were established with MAGFOR officials to explore the possibilities of a long-term agreement of collaboration with this Ministry. The constant changes of officials have hindered the concreting of a definitive proposal.

In a meeting of 2 August 2000 in CIAT-Managua, a proposal was outlined for the replanning of the training strategy for development, based on the experiences gained to date in the reference countries. Briefly, the planning concentrates efforts toward supporting institutional partners, with a wide mandate at geographic and program levels. To these partners we offer continuous support so that they can exercise the work of applying, analyzing, and diffusing the research results catalyzed by PE-3, maintaining the work of follow-up of training in a collaborative scheme with national trainers. To guarantee the sustainability of the training teams, new trainers will be trained within the institutional partners, in time for these to acquire the commitment of being linked to the national training team. For this reason, agreements of collaboration were drawn up with the Honduran institutions and we hope to proceed in similar form with those of Nicaragua.

COLOMBIA

Methods and Results

Support activities have mainly concentrated on the two action plans presently being carried out (1) in Bolívar -Valle, area of influence of the BRUT project (Represa de agua potable para los municipios de Bolivar, Roldanillo, La Unión, and Toro), and (2) in the Bolo and Frayle Rivers' watersheds, with Acuavalle.

This activity has brought together EcoFuturo, Corporación Vallecaucana de las Cuencas Hidrograficas y el Medio Ambiente (CORPOCUENCAS), and CIAT in an agreement of interinstitutional collaboration for the application of six of the CIAT Guides in 10 communities of the municipality of Bolivar. At the same time, we are supporting the application of four CIAT Guides in the two communities of the Bolo and Frayle Rivers.

Output

The collaborative agreements and support to other organizations should bring about more sustainable management of natural resources in the regions.

Contributors: V Zapata, JI Sanz, M Ayarza, B Barbier, JA Beltrán

Activity 4.2. Support decision taking at different levels using the information, tools, and methods generated by the project

Use of linear program modeling to support decision makers in Honduras

Land use in the Jalapa watershed

Highlights

- ✓ A linear programming model developed that simulates different land uses in the Jalapa watershed
- ✓ Feedback from community on results

Objective

A community from the Jalapa River watershed between the municipalities of Yorito and Sulaco has a conflict over the use of its remaining forest. The local tribe, which has the title for the land, wants to cut and sell the forest to a logger. The rest of the community, which represents the majority but has no say in the title, disagrees. We aimed to develop a model to compare different uses of this forest to help the decision makers in this conflict.

Methods

The model was developed and applied to the watershed. The first results were discussed with the community. We have developed a good relationship with the community of the Tascalapa watershed through the parents' association of the local school. This organization is the only one to be considered neutral in the conflict between the tribe and the mestizo community because parents from both groups attend the meetings. The problem of the forest is not discussed upfront and CIAT does not want to take sides. It is believed that the tools will help look into the future. To operationalize what might look too theoretic to the community, CIAT has started a computer-training program with the higher grades. They were given an old typewriter to learn how to use a keyboard so that they will start computer sessions in the municipality.

Results

Farmers did correct a few of our misconceptions such as the real use of the forest, which for them is as much a forest as a pasture. Farmers were skeptical about the environmental payment scenarios. They think this will never happen. In fact environmental payment to farmers is perhaps closer to reality than they think. In the same watershed many communities have received large donations to protect communal forests. The SDC is negotiating with the municipality of Yorito, which own a fraction of the Tascalapa watershed, to implement a tax to improve the water quality through more friendly land use in the upper watershed. Environmental payment has been implemented at a large scale in Colombia and Costa Rica.

Output

The model developed will help the community to better envision possible futures and resolve the conflict over use of remaining forest.

Contributors: A Hernandez (ESNACIFOR), O Mejía, G Leclerc (PE-4), B Barbier, A Iturbe

Trade off in the Jalapa watershed

Highlight

- ✓ Using a linear programming model CIAT and ESNACIFOR analyzed the trade off between erosion and incomes to help decision makers at government level. The form of the curve suggests that it would be cheap to change the land use to a more sustainable pattern

Objective

The Jalapa watershed is part of the bigger El Cajon watershed, which drains into the largest hydroelectric dam in Honduras. The Tascalapa watershed is considered a hotspot because the steep upper watershed is cultivated. The government's El Cajon Watershed Project wants to know how expensive it would be to change the land use so as to reduce erosive practice. The aim was to help decision makers with information on the expense involved.

Methods

Using an existing linear programming model from the Jalapa watershed, CIAT and COHDEFOR calculated the cost to the local community of respecting a more sustainable land use. To do so we put a constraint on total erosion produced by the watershed and ran the model. The model then changes the land use so as to maximize incomes while complying with the erosion restriction (Figure 15).

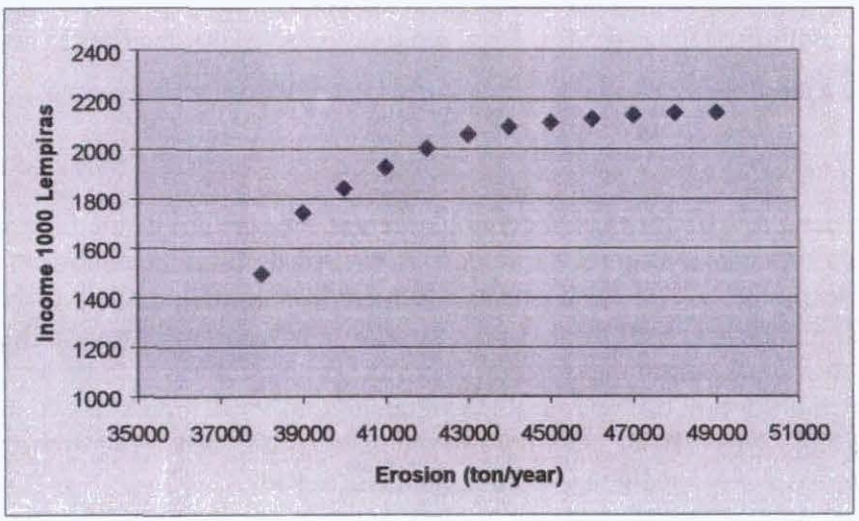


Figure 15. Modeling of trade off between erosion and income in the Jalapa watershed, Honduras.

Results

The results show that reducing erosion by putting the right land use in the right place would reduce erosion substantially without major cost for the community. This is good news for the proposed dam, for the El Cajon watershed project, and for the community, which has taken concrete steps in the past.

Output

Information was produced to help decision makers at government level with land use practices and soil conservation.

Contributors: S Rivera (ESNACIFOR), A Hernandez (ESNACIFOR), O Mejía, G Leclerc (PE-4), B Barbier, A Iturbe

Land use changes in the Calan River watershed

Highlight

- ✓ Linear modeling applied to provide information on land use changes in the Calan River watershed for decision makers of the El Cajon Project

Objective

The aim was to support decision makers of the El Cajon Project who are promoting changes in land use (*Ordenamiento Territorial*). A recent study of the Forestry Department's GIS laboratory shows as much as a 60 % conflict between current land use and that which the Project believes to be sustainable. The next step is to create the right incentive to change the current land use. The challenge is that land is owned either by poor small-scale farmers or by large ranchers. Both groups are reluctant to reduce their income by returning cropland and pasture to trees, and to stop burning their pastures and their crop residues.

Methods and Results

The method links GIS and a linear programming model. An ESNACIFOR student determined the homogenous land units using a GIS. All farmers of the watershed were interviewed on their practices. Ten representative farmers were interviewed with more quantitative questions on their production system.

The watershed was divided into hundreds of homogenous categories based on slope, type of soil, altitude, distance to market, and land tenure.

Output

The information generated can be used by the El Cajon Project in making decisions on land use changes in the watershed.

Contributors: A Gonzalez (ESNACIFOR student), B Barbier

Application of a CIAT model to the San Nicolas watershed

Highlight

✓ Optimal size and location of coffee plant determined for the watershed

Objective

The Honduran hillsides have a serious problem of water contamination during the coffee-processing period because thousands of traditional coffee processing plants eject coffee residues into the river without any treatment. The Instituto Hondureño del Café (IHCAFE), following the example of all the neighboring countries, is trying to solve the problem by concentrating coffee processing in fewer modern plants of several types. The aim was to produce information for decision makers on the best location and size for the plants.

Methods

The centers CIAT and the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) developed a spatial model that determines the optimal allocation of processing plants under different scenarios of contamination. A student from CATIE who is also an IHCAFE long-time employee spent 6 months in collecting the data and building the model.

We developed an innovative procedure in a classic non-linear programming model. The model behaves like an Integer model and can be used in any similar situations. The model objective function is to minimize the cost of processing and transporting the coffee produced within the watershed and then to the exporter to the next large city. The cost incurs the transport from the farm to the plant, from the plant to the exporter, the operational cost of processing the coffee, and the annualization of the fixed costs. The model has to choose between five types of plants, from the traditional plants currently in use to the large modern plant. The model chooses the best plant for the best locations (along the river and close to the roads within the watershed).

The limitations introduced in the model are that all the coffee produced in the watershed has to be processed. A second limitation is stream water. The plants have to be located close to rivers because coffee processing uses a large quantity of water. In the model one plant leaves the remaining water to the next plant and so on until water is finished. Because it is a "central planner" problem no undue competition occurs between plants. The model chooses the best place for the society, not for a given individual.

Most of the watershed data were collected by IHCAFE, including coffee production and stream flows from the main rivers. The digital maps (Figure 16 is an example) were elaborated by CIAT and actualized by field observations by the student.

Results

The results show that the larger plants are the most cost effective, however, they also need the highest initial investment. When we limit the investment, the model chooses less costly plants, but ones that are smaller and more contaminating.

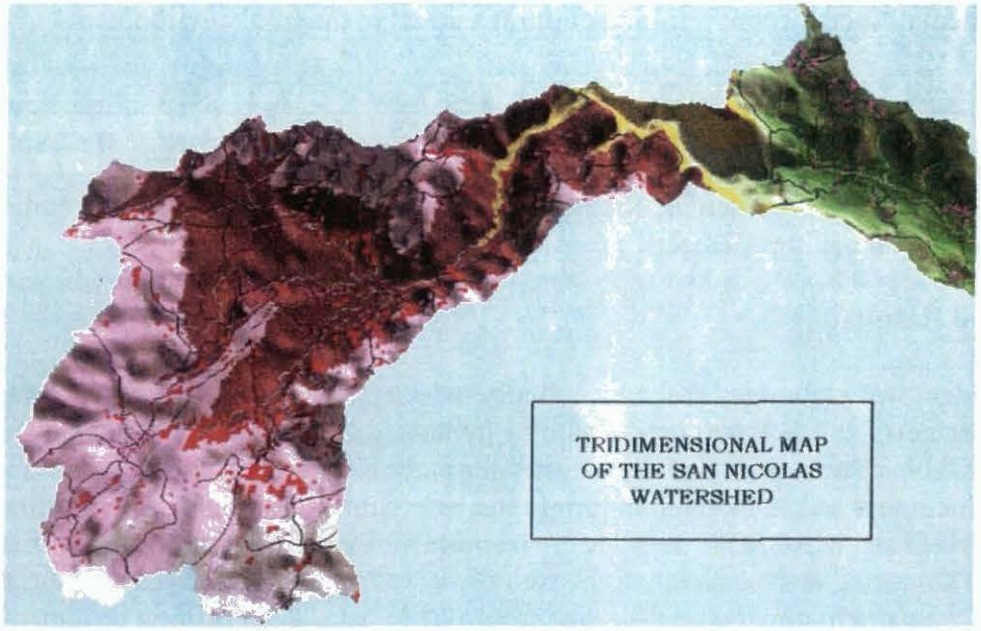


Figure 16. Tridimensional map of the San Nicolas watershed, Honduras.

Water was not a constraining factor in the scenarios based on the actual coffee production. In fact, a plant rejects most of the used water in the river meaning that water is not likely to be a problem as was initially thought. The scenario where coffee production doubles does not suggest a serious problem of water use, but it suggests a different plan of inversion. Instead of constructing the plants based on current production it would be wiser to build an investment plan based on the likely expansion of coffee in the area.

Outputs

The IHCAFE was pleased with the intermediary results. The Asociación Hondureña de Productores de Café (AHPROCAFE) showed interest in a study for a larger region.

Contributors: J Gonzalez (IHCAFE and CATIE student), B Barbier, R Hearn (CATIE professor), A Nelson, O Mejía, A Iturbe

The Rural Atlas of Nicaragua

Highlights

- ✓ An agreement of collaboration was established between CIAT, INEC, and MAGFOR to complete the rural National Atlas of Nicaragua

- ✓ Sixty thematic maps were elaborated describing and analyzing the most important environmental, social, economic, and cultural aspects in the rural environment of Nicaragua.

Objective

The aim is to allow different national and international organizations to make diverse decisions that involve the rural environment of Nicaragua using geographical maps of environmental, social, economic, and cultural aspects.

Methods and Results

First a document was elaborated that conceptually gave a preliminary thematic content of the Atlas, its main users, the different products to be generated, the cartographic model to use, a tentative timetable of activities, and the outlines for participation and support to develop the Atlas. This document was then given in turn to the two main institutions for generating data in Nicaragua, INEC and MAGFOR, in order to elaborate the Atlas together. The document was accepted and subjected to superficial modifications; it was redefined according to the available resources of the participating institutions and to available data. The resulting document is the "Conceptual design of the Rural National Atlas of Nicaragua."

The database was then developed. Both MAGFOR and INEC offered CIAT the geographical and statistical data in comparable digital format to be integrated in the Atlas. The MAGFOR data were then standardized and incorporated in the GIS software for use in elaborating the Atlas. All data were prepared to develop the mapping phase. The INEC provided data relative to the National Population Census of 1995 and the Agricultural Census of 1997. Those tabulated were organized, structured, and analyzed to derive indexes and values that will be represented in a cartographic way. An important process was the generation of the cartographic mould for replicating all the Atlas maps.

At present, the Atlas is in the mapping phase. About 60 thematic maps covering the general and physicogeographic medium, population, economics, housing, and education.

Output

The Atlas will be a tool that integrates diverse thematic data from official institutions of Nicaragua, standardizes scales, and allows the correlation of variables in a very simple way. These characteristics will allow many decision makers and other users to exploit the information contained in the Atlas.

Contributors: A Iturbe, JA Beltrán, EM Tejeda
Collaborators: PE-4, MAGFOR, INEC

Methodologies for integrating data across geographic scales in a data rich environment: Examples from Honduras

Highlights

- ✓ The *Spatial Data Exploration Toolbox* was developed as a useful tool for GIS experts working on ecoregional issues.
- ✓ Original methodologies were developed. The "ecoregional-shed" concept and methodology to address the modifiable areal unit problem are highly original and are a significant contribution to ecoregional research.
- ✓ The *Accessibility Wizard* has demonstrated that useful application tools can be derived from the methodologies developed by CIAT.

Objective

The rationale of the project is to facilitate collective action for NRM and agricultural development through the creation of methods and procedures for multi-scale analysis. This is a very powerful statement and one that has resulted in important contributions to ecoregional research and development.

Methodologies for cross-scale exploration of spatial data)

Methods and Results

Many methods were applied in the cross-scale exploration of spatial data. A highly novel application was the Geographically Weighted Regression (GWR) method combined with the use of the Self-Organizing Map (SOM), which is a type of artificial neural network.

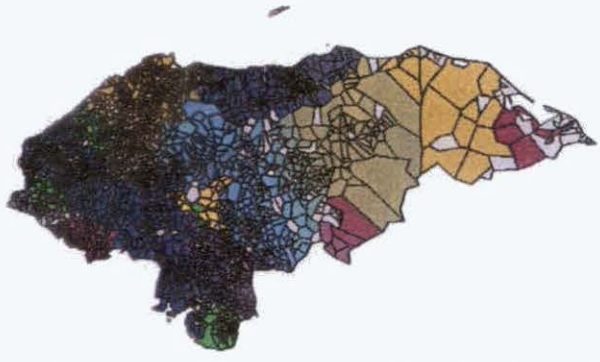
The GWR technique is based on a combination of existing theories and methods. It allows a calibrated regression model to vary spatially, such that "spatial drift" from the global relationships can be measured. Parameter variations can be mapped across space to improve understanding of the processes being modeled and to reveal system structure and boundaries. The parameters from a calibrated regression model can be analyzed through SOMs, to discover scale-dependent trends and patterns across an area. The patterns reveal a set of distinct system boundaries. These maps suggest a potential for revealing multivariate structure that would otherwise prove difficult to visualize or understand. The novelty lies not in the techniques themselves (they were already existent), but in their combination and application within ecoregional research. This method was tested in two case studies, using data from Honduras.

- The first analyzed average production per worker (dependent variable). It showed clear spatial trends, considering that the contribution of the independent variables changed over the study region, including changes in sign from positive to negative and vice versa.
- In the second case study, zones were identified that have common patterns of resource management. This analysis, conducted at the village level (3500 locations), showed strong patterns within the parameters, and that these patterns had a very strong geographic distribution.

Figure 17 describes the key features of the process. Figure 17a, displays a typical GWR parameter map, where the regression parameter clearly varies across space. Figure 17b indicates how this model permits the R^2 *goodness of fit* to be mapped and further analyzed. Figure 17c, is the final output, whereby the spatial trends across all the regression parameters have been analyzed by a SOM to generate regions that have common patterns of resource management.

17a. Technical Credit (left) and its regional effects on Agricultural Production (right)

17b. The map of R^2 from the GWR model, compared to the OLS R^2 value.



17c. The GWR outputs are combined into agricultural regions by the SOM.

Figure 17. Key features in cross-scale exploration of spatial data using the Geographically Weighted Regression (GWR) method combined with the use of the Self-Organizing Map (SOM).

This and other more standard methodologies were made operational by CIAT in the *Spatial Data Exploration* toolbox to generate the data sets for virtually all case studies conducted under this project.

Ecoregional-shed concept

Methods and Results

The concept of the "ecoregional-shed" was developed to address what is referred to as the modifiable areal unit problem. This problem is related to the use of meaningful spatial units when performing spatial analysis. For example, if one is interested in poverty, one should not base a spatial analysis on watersheds because no functional relation exists between poverty and watersheds. The solution is to create user-defined, meaningful spatial units (alternative ecoregions) at various scales (Figure 18). An example is the development of *econosheds*, which are defined by a set of economic, physical, and agricultural variables. These 'sheds' are potentially dynamic, because they will change with any change in the chosen variables.

Accessibility Wizard

Methods and Results

The Accessibility Wizard (an ArcView extension) is a tool based on the concept of the *econoshed*. Users can create and explore a variety of accessibility indicators using a grid-based, cost-distance algorithm. By means of a tutorial, users are guided along the most appropriate data sources for the cost-distance process.

The tool is implemented for Honduras, where it allows an assessment of accessibility based on selected variables. Many variables in the CD-ROM database of Honduras can be used to define accessibility. This tool was used to help prioritize and direct disaster relief after Hurricane Mitch hit Honduras in October 1998. Accessibility maps produced before and after Mitch were widely used and received wide coverage in the Honduran and international press. The tool requires an ArcView license and can only operate on up-to-date computer facilities (minimum requirements 90 MHz, 32 Mb RAM).

Methodologies to solve the Modifiable Areal Unit Problem (MAUP)

Methods and Results

The concept of accessibility was applied to the definition of *market catchments* or *econosheds*, that is, units in which the cost of reaching a market town are relatively homogeneous. Although this map of *econosheds* of Honduras is in itself a valuable product, the key issue that must be understood is that the same procedure can be used to derive other types of units that suit other research or development purposes: *healthsheds*, *schoolsheds*, *biodiversitysheds*, *extensionsheds*, and so on. Two of the case studies used to test and demonstrate this new procedure were:

- The development of a village-level index of well-being with 40 variables for 3730 villages in Honduras.
- An exploration of Honduran population census data to identify patterns and relationships about "population at risk" for hypothesis generation.

The Accessibility Wizard will help in moving this approach down the line to more applied use. Potential users of the methodology and the associated tool and procedures will be teams and individuals who have a good grasp of GIS. Fortunately, many organizations in Central and South America already have this capability. Training would also be an important activity for CIAT to undertake if it wants to promote the use of this product.

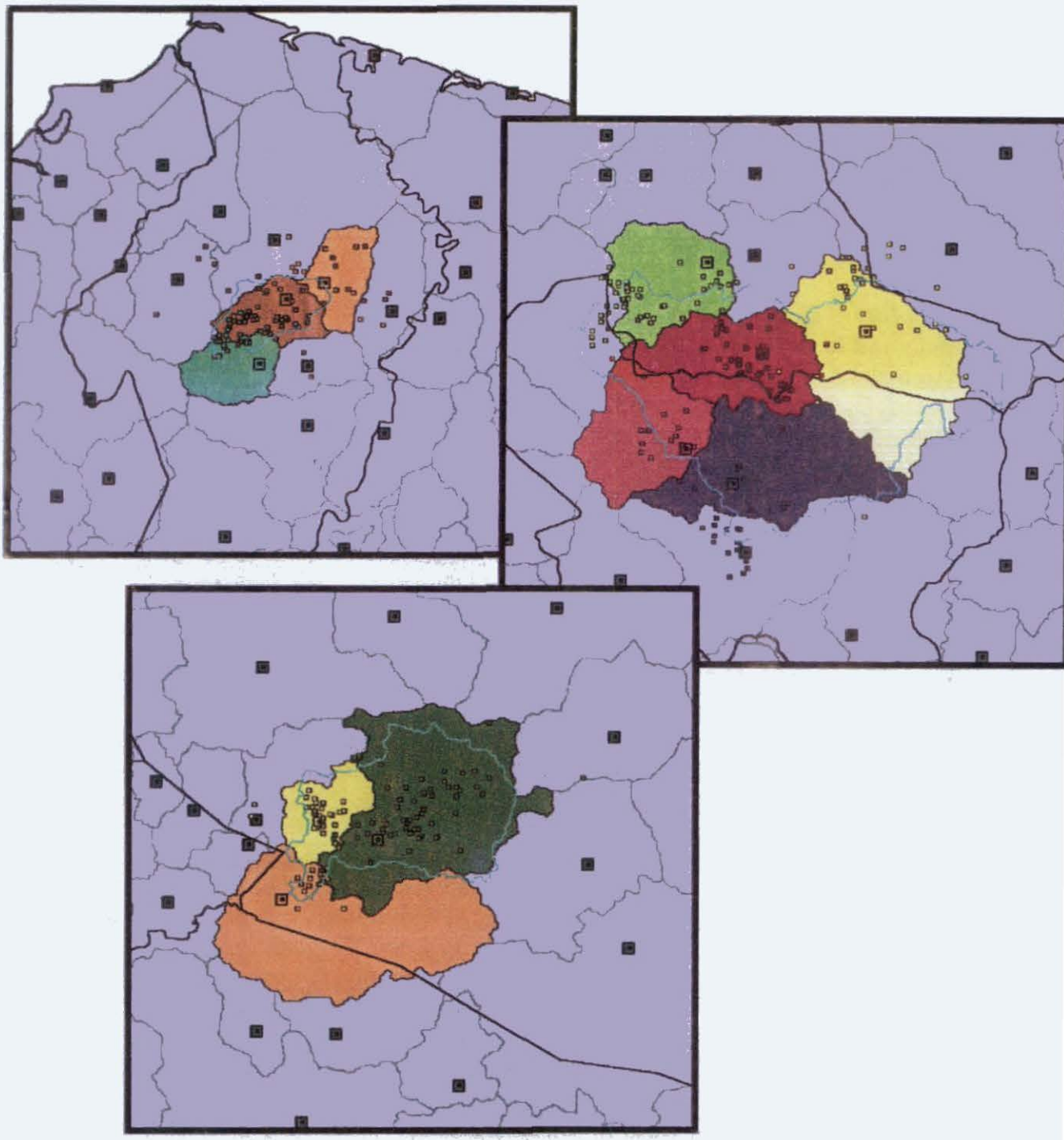


Figure 18. Validation of *Ecoregional-shed*. Dots correspond to plots, large squares to *aldeas*, and polygons to *Ecoregional-shed*. Colors match almost perfectly demonstrating the importance of accessibility.

Neural networks for non-parametric data generalization and reduction

This methodology allows the generation of reduced spatial data sets, which retain the original fundamental spatial characteristics. Two methods of data generalization or reduction can be used to generalize (1) the multivariate basic data by clustering, classification etc. and (2) by means of spatial aggregation. The use of a neural network called the SOM combines both approaches: visualization of clusters in the data set and representation of the set on a map by means of patterns. The methodology itself is not new, but it has not previously been applied to ecoregional issues.

Outputs

The project has made a substantial and innovative contribution to the development of methodologies that will allow researchers and policy makers to conduct user-controlled and purpose-specific cross-scale analysis using large and complex sets of georeferenced data. It has also produced a valuable extensive database for Honduras. It is expected that these methodologies will serve as the basis for the development of standard sensitivity tools for cross-scale research within GIS environments. The project also made substantial progress in developing procedures to generate cross-scale databases starting from unit-level data.

The *Spatial Data Exploration Toolbox* is powerful and can be applied to a wide range of NRM and agricultural development problems whose solution requires the use of complex cross-scale data sets. Given the exponential growth in the availability of information, the need for this type of method is likely to increase with time.

The use of neural networks eases data handling and increases processing speed. The generalized spatial data sets produced by means of neural network and SOMs are potentially powerful aids for problem definition and hypothesis generation.

Contributors: A Nelson, G Leclerc (PE-4), M Winograd (PE-4), A Farrow (PE-4)
Collaborators: PE-4, EB Knapp

Spatial determinants of labor productivity in Honduras

Highlights

- ✓ Geographical regression method and tool produced
- ✓ Link between agricultural labor productivity and natural resource variables examined at national level in Honduras
- ✓ Causality proved difficult to establish at national level, but strong regional effects present

Methods and Results

The study examines the link between agricultural labor productivity and natural resource variables at the national level in Honduras using correlations, multivariate regression, both standard and quantile, and cluster analysis. We show through spatial-statistical analysis of

georeferenced, village-level data that causality is difficult to establish at national scale and strong regional effects are present. This is done through examination of multi-panel scatter plots, correlation, standard and quantile multivariate regression, and clustering.

The theoretical model explaining labor productivity is:

$$PW = b1 \cdot NR + b2 \cdot PD + b3 \cdot AC + b4 \cdot TEC + b5 \cdot LC + b6 \cdot ED + b7 \cdot EX + b8 \cdot CR + b9 \cdot PR$$

Where PW is production per worker, NR is natural resource conditions, PD is population density, AC is access to market, TEC is technology, LC is land concentration, ED is education, EX is extension, CR is credit, and PR is property right.

At country level, the length of the rainy season has a strong and quasi-linear relation with income. Soil has little impact on productivity as well as slope and altitude because coffee production in the mountains has a strong relation to productivity. Access to the main cities and seaports has little relation with productivity because some of the main cities are located in unproductive areas. Improving the small road network would have a more positive impact. Figure 19 is an example of the mapping done.

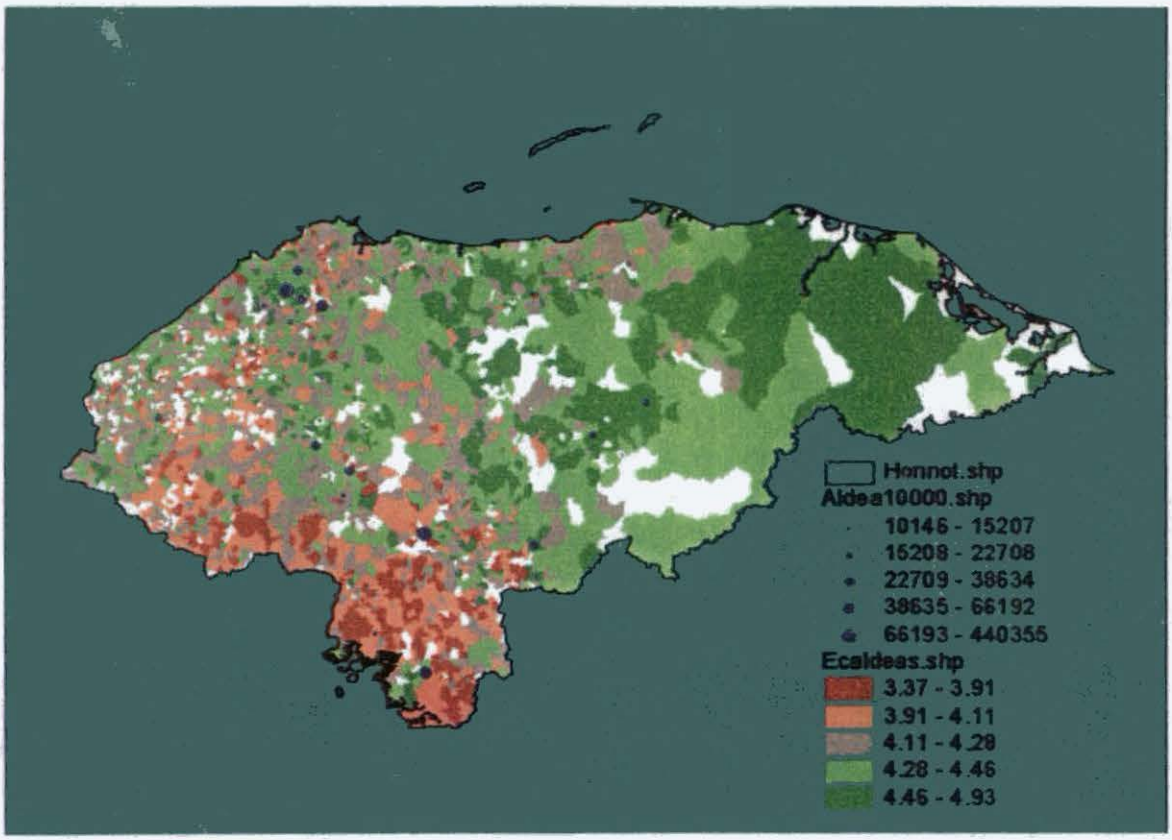


Figure 19. The dependent variable per capita income, Honduras.

System boundaries are discovered by cluster analysis, and by performing multivariate regressions at different spatial scales. Coefficients of regression vary across the country, and mapping them helps the policy maker anticipate the impact of a policy designed from country-level data. Analysis at department scale is vastly superior to municipal scale, mainly because too many municipalities do not include enough villages to permit regression. The improvement of the coefficient of determination at regional level suggests that many hidden variables, which contribute to the "error" term of the regression, are monotonous at smaller scale. For the particular spatial distribution of the 3700 villages the optimum scale is found to be 50 km. We examine how policies derived from analysis at country scale are being modified at regional scale.

Output

The methodology performs spatial analysis of census data to determine system boundaries and anticipate the impact of policies. The tool replaces the use of *maquetas* and flat maps to help decision makers with such questions as those of land use.

Contributors: G Leclerc (PE-4), B Barbier, O Mejía, O Madrid (PE-4)

Determinant of land productivity in Honduras

Highlight

✓ The main determinant of production per hectare is months of rainfall

Objective

The aim was to provide information for an analysis of determinants of land productivity to help decision makers when planning cropping systems and planting.

Methods and Results

An analysis was made of the determinants of land productivity in Honduras. The analysis is based on regression. We have produced a study on land productivity based on the 1993 census and other maps of Honduras. The study produced first a map of the value of production per hectare in Honduras. To show the results on a map the production is averaged at the village level.

The results suggest that months of rainfall are the first determinant of land productivity. A surprise in the result is that the more productive areas are also less populated. Thus there might be room to ease the current pattern of migrations. Production per land unit is higher in the north and usually higher in the valleys. The main determinant of production per hectare is the number of months of rainfall because these allow an extension of the cropping period from one cycle in the south to two or three cycles per year in the north or at higher altitudes.

Output

The information generated will be of use to decision makers when analyzing questions of land productivity and migration.

Contributor: B Barbier

Decision support to the Inter-American Development Bank

Highlights

- ✓ We are providing decision support to the top level of decision makers
- ✓ CD-ROM of diagnostic and prioritization of Honduran watersheds available

Objective

The overall aim is to stop the vicious circle of poverty and the process of degradation of natural resources. The first consultancy aimed at providing the information and analytical tools for characterizing and prioritizing small watersheds and specific areas in the large watersheds of Nacaome, Chamelecón, and Ulúa where the Program HO-179 was to intervene.

Methods

This initiative has yielded a preliminary consultancy with IDB and two consultancy biddings approved. The preliminary consultancy was an evaluation of the project results (Valdez 2000[17]). This was based on the revision of various CIAT documents and interviews and meetings with researchers and participants, especially those related with GIS, databases, and poverty indicators and well-being methodologies.

The first consultancy bidding was for the diagnostic and prioritization of Honduran watersheds. The small watersheds within the Ulúa, Chamelecón, and Naca watersheds were delimited. They were characterized along with specific areas using physico-geographic and socioeconomic data (over 100 variables). A support matrix was generated to identify in an interactive way the prioritization, and maps were produced. During the project development a series of meetings were held with members of SERNA, COPECO, UCP, SAG, PRONADERS, COHDEFOR, BID, the Finance Secretariat, and other institutions who fed into and helped define results.[18]

We have also won a second consultancy bidding with CATIE on the "Study of technical-financial feasibility and design of the program for NRM in the prioritized watersheds of Ulúa, Chamelecón, and Nacaome. Work has begun.

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[17] Valdez RA. 2000. Evaluación del proyecto agricultura y manejo de los recursos naturales. Información y tecnología para el manejo de los recursos naturales y para el alivio de la probreza. Subproyecto 1: Enfocando la probreza rural y la investigación en el manejo de los recursos naturales. Internal Report, CIAT-Hillsides, Cali, Colombia. 23 p plus annexes.

[18] For acronyms see page 138.

Results

For the first consultancy, a characterization was made of each of the large watersheds based on selected indicators. Specific areas at small watershed level were defined where the principal problems of deterioration of natural resources and vulnerability occurred. The areas defined exist in all three main watersheds. Full results are available on the CD-ROM[19]. The areas proposed for intervention (total area 20, 174 km) were:

- Chamelecón, southern zone (high areas),
- Ulúa, eastern zone (actual area of the El Cajón Project),
- Ulúa, central-south zone,
- Ulúa, south-western zone, and
- Nacaome, northern zone (high areas).

Output

By providing decision support to top level decision makers, we are trying to influence the policy and approaches of those providing funds to the country and, ultimately, alleviating the situation of the rural poor.

Contributors: CIAT-Hillsides, A Hernández (consultant)
Collaborators: SERNA, COHDEFOR, Dirección General de Estadisticas y Censos (DGEC), Fondo Hondureño de Inversión Social (FHIS), Comisionado Permanente de Contingencias (COPECO), United States Geological Survey (USGS)

Activity 4.3. Strengthen capacity for management and use of information, tools, and methods (train, diffuse, and follow up the process)

Hold thematic workshops for divulging and evaluating information generated by the project

Highlight

✓ Results of the project "Methodologies for integrating data across geographic scales in a data-rich environment: Examples from Honduras" were diffused, discussed, and demonstrated

Objectives

[19] CIAT-Hillsides. 2000. Diagnóstico y priorización de cuencas hidrográficas para el Programa de Manejo de Recursos Naturales en Cuencas Prioritarias (HO-179): fase II. Reporte final de consultaria. CD-ROM, CIAT, Honduras.

The workshop on scale effect in decision making for ecoregional development (July 4-6, Costa Rica) aimed at summarizing and reviewing the main achievements of the research project. It also aimed at establishing the bases and contacts for the production of a book and for collaborations in ecoregional research.

Methods and Results

The workshop established bases and contacts for the production of a book and for collaborations in ecoregional research. In total, 35 people from 10 countries attended the workshop. All participants were selected from a multidisciplinary perspective, having in common a system's approach and experience with dealing simultaneously with a range of scales. We believed that the achievements of the Project, which were far from being exhaustive, would be better understood in a broader context that highlights the complexity of the ecoregional research. The participants acted as speakers and reviewers of the ecoregional process. They participated in hands-on demonstrations of a few software tools developed by the Project.

Output

The book proposed at the workshop, a primer in this mainstream subject, is intended to reach a large audience of scientists and students. Collaborations with Agricultural Research Institutes (ARIs) and Central American partners should lead to improved methodologies and fund raising capacity.

Contributors: G Leclerc (PE-4), P Ross (International Service for National Agricultural Research [ISNAR]), A Zuniga (ISNAR)

Other workshops

Training was given on Guide no. 5 (Identifying levels of well-being to construct local profiles of rural poverty) to students of UCA's Technology of the Environment Faculty in Managua. Five workshops were held over 2 months. The Guide was also applied in two studies in communities of Matagalpa, Nicaragua.

A presentation was given of the results of the study on improvement of water quality, San Dionisio (N Johnson), at the World Congress of Students in Mexico.

Other workshops are shown in Table 19 under Activity 5.4.

Activity 4.4. Provide technical support for decision making

The Intelligent Team Decision Assistant (ITDEA): Collaborative decision making in the information age

Highlight

✓ ITDEA version 1 available

Methods and Results

After years of experience following the participatory planning by objectives methodology, it became apparent that circumstances exist where its efficiency and accuracy can be questioned. It becomes more problematic in circumstances where a diverse group of stakeholders attempt to address imprecisely defined core issues and desired future conditions. For example, a "problem-focused" planning approach will inevitably overlook prevention of future risks to currently desirable, non-problematic issues.

The ITDEA is an extension of group decision support system techniques that already have been shown to increase the effectiveness of group decision making. Essentially, the process is based on a series of templates that guide the group in a systematic process consisting of defining goals and desirable future conditions, evaluating problems and alliances, defining indicators and projected future conditions, and elaborating an action plan. In its first version, the ITDEA is developed as a stand-alone interface to a database that stores the information associated with every step of the decision-making process. Analysis of the data reveals important factors to incorporate in the decision process itself.

The entire process aims at helping users take generic concerns, such as those mentioned above, and turn them into concrete statements of values and goals in a way that allows stakeholders to see their significance, and that gives them a chance to enact compromises within a collaborative environment.

Two important characteristics of the ITDEA are (1) the specific checks along the process for keeping it manageable ("pruning"), and (2) the database underlying the process. A main characteristic of the ITDEA originates in the concern for maintaining the development of the decision as focused as possible, preventing eventual bottlenecks. This is achieved through a series of specific checks along the way, which we refer to as "pruning". Because the Central Issue is intended to be relatively broad to encompass multiple stakeholders' interests, we found that without pruning the complexity of the decision components was increasing geometrically as we were progressing towards the action plan. Pruning may look restrictive at times, one may think that important points are being left out, but going back is always possible as the need arises.

A complex database design underlies ITDEA. This is required in order to:

- Keep track of the process (e.g., represent past states),
- Store and give access to information (e.g., web links, contacts, documents, and GIS),
- Allow customized reporting (e.g., logical framework, goal hierarchy), and
- Allow knowledge discovery on the decision process (e.g., identify key stakeholders, "universal" goals, problems, or indicators).

In prevision of a Web-based version, two types of users can access ITDEA: the participant and the facilitator. Participants log on as such, identify themselves, and state their responsibility towards a Central Issue that they select. Facilitators log on as such and have control of all templates that require participation of the group (such as Central Issues, General Goals, Shared Goals, etc.). The database stores the information filled in by participants and facilitators in a way that allows going back in time, i.e., represents the state of the decision process at a given point in the past.

Output

The ITDEA helps build partnerships and expedites the planning process. It advantageously replaces the participatory planning by objectives, and can be used for strategic planning. The Canadian International Development Agency (CIDA) has manifested interest for its Sahel division. Impact can be enormous if adequately promoted.

Contributors: G Leclerc (PE-4), EB Knapp, G Narvaez

Data management strategy for the Cauca study region

Highlight

✓ Database of geographical information for the Cauca study region is being recovered and organized

Objective

The objective was to improve the delivery of scientific output of geographical data for the Cauca study region to a wider audience of data users.

Methods and Results

The first step was to retrieve as many data as possible then organize these into a logical framework. Figure 20 shows the five main directory subdivisions chosen. The greatest challenge was in the organization of spatial data. Two directory structures were chosen. The first is geared towards inside users; the data were split into a two-directory structure that includes "basemaps" and "projects". "Basemaps" includes all the initial data sets that were derived from hard copy maps. This directory is further subdivided into regions, reflecting the different study area scales: Cauca, Ovejas, Caucanor, and Cabuyal. Cabuyal is further subdivided into scales 1 to 3, depending on whether the data layers are cropped to include the whole of the administration

units (*veredas*), or just the true watershed, or small local watersheds. The data were then arranged according to type, i.e., whether they are ArcInfo coverages or ArcView shapefiles.

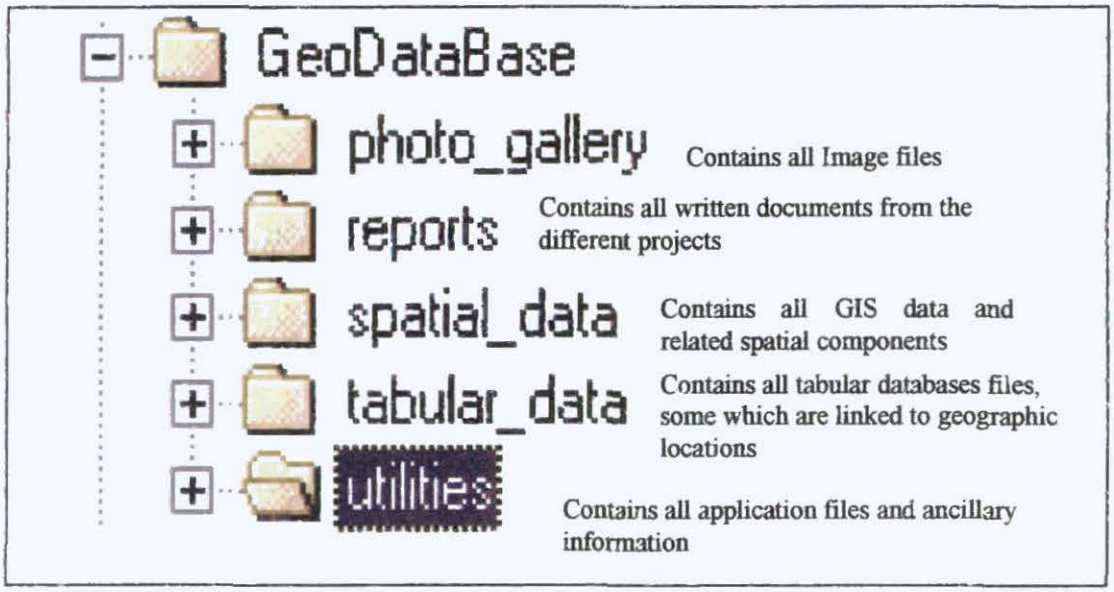

Figure 20. Main database structure of geographical information for the Cauca study region.

"Projects", includes all the derived data from the different projects that were carried out in the area. These were divided by researcher name, and then by project topic area. However, it was also felt that, although researchers within CIAT are likely to associate projects to researchers themselves, such a structure would not be so user friendly to outside users. Therefore, a second structural framework was devised, again stemming from the same two main directories. Here, only one data format type (i.e., shapefiles) will be included, making the data more transferable. In this case, both the "basemaps" and project maps ("projmaps") have been subdivided thematically. A disadvantage of this structure is that scale is not considered. This should not be a problem, as often the data layers relating to different regions can be differentiated by their name. However, this is not universally true, thus we recognize that data naming conventions need to be applied in the future to ensure that each data layer is given a unique and meaningful name.

Output

The database when completed will improve the efficient retrieval and use of data for researchers and decision makers working in the Cauca region.

Contributor: K Pallaris (consultant)

Support punctual training on the use of decision-making tools on the request of collaborating institutions

The requirements for training requested by project collaborating institutes were identified (see under 4.1). For ease of reporting and reading, the numerous training workshops are listed in Table 19, under Activity 5.4.

Contributors: V Zapata, M Trejo, D Tijerino

Output 5: Efficient, participatory project management

Activity 5.1. Foster the active participation of partners in the planning of project activities in the region

Develop an organizational structure for the SOL sites

HONDURAS

Objectives

The aims were to:

1. Design and implement an operational structure to ensure effective coordination of activities among SOL sites in Yorito.
2. Develop strategies to guarantee technical relevance of outputs, stakeholder participation, and financial sustainability of the SOL sites.

Methods and Results

A main strategy of the SOL concept is the location of strategic research experiments across landscape in a network of sites including different types of experiments: *to provide an innovative approach to technology development for production systems in complex, highly variable tropical environments.*

The SOL strategic research experiments may share the same site with applied or adaptive trials run by other organizations, including NGOs or farmer research committees (CIALs). In addition, the SOL includes sites that are purely demonstration trials run by extension; or are adaptive research trials that farmers manage. Any SOL site may be used in different ways by different partners: for strategic research; for adaptive testing; for demonstration purposes, for training and extension; or for participatory research with farmers, for example. All types of trials are networked through joint planning, monitoring and evaluation meetings of the different partners and a shared annual plan of operations. This interactive network of many different research and development partners is the SOL, or supermarket of technology options.

A meeting was held in Yorito with the participation of representatives of CIAT-Laderas, IPCA, EAP-Zamorano, SERTEDESO, CLODEST, and a coffee growers association to establish a coordination mechanism that ensures a truly interaction among SOL sites.

Figure 21 shows the main structure approved by participating institutions. This structure attempts to integrate the efforts of stakeholders across different scales of decision making of institutions involved in the SOL.

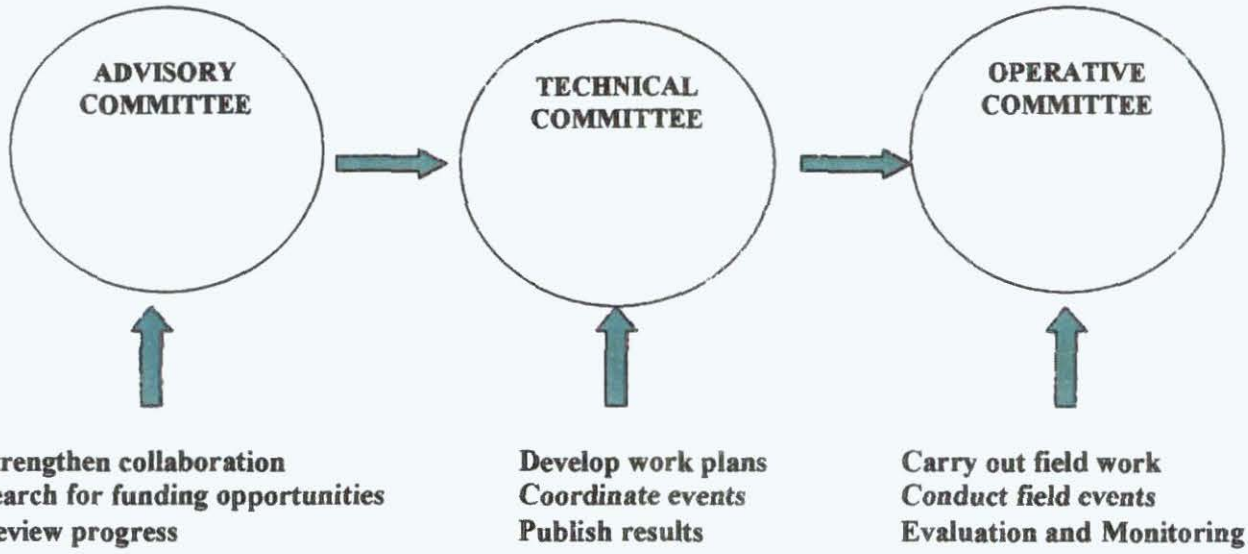

Figure 21. Structure and responsibilities of the coordination mechanism for the Supermercado de Opciones para Ladera (SOL) sites in Yorito, Honduras.

Output

The operational structure will make the use of SOL sites more effective.

Contributors: L Brizuela, M Ayarza, J Jimenez (IPCA), JC Rosas (EAP-Zamorano), M Gonzales (SERTEDESO)
Collaborators: B Ferrera (CLODEST), farmers from Santa Cruz

NICARAGUA

The operative Technical Committee of the SOL in Nicaragua was formed with the participation of representatives of PRODESSA, ADDAC, INTA, and the CIALs. We are also seeking a way of involving the local organizations of farmers so that they form of this Committee. During the year 2000, three meetings were carried out to define the regulations of the Committee and to present the research activities to carry out during the year.

Hold a SOL annual planning workshop

HONDURAS
Highlight

- ✓ Main activities in the three SOL sites in Yorito, Honduras were defined among partner institutions (CIAT, IPCA, EAP-Zamorano, SERTEDESO, and a farmer's group)

Objective

The aim was to develop a common framework among partner institutions collaborating in the SOL.

Methods and Results

The SOL sites are located in different locations in the landscape and represent contrasting land-use systems. The Luquigue site represents the lower part of the Tascalapa River watershed and is characterized by heavy soils of low fertility. The site in Mina Honda is located in the highest and steeper part of the watershed with soils of moderate fertility used for bean and maize production with low inputs. The SOL site in Santa Cruz is in a coffee area with soils of moderate fertility.

The planning meeting was held in Yorito with representatives from IPCA, EAP-Zamorano, SERTEDESO, CIAT-PE-3, Grupo 3 de Marzo, and CLODEST.

Research on soil fertility improvement and improved legume-based silvopastoral systems will be conducted by CIAT at the Luquigue site. Fertility improvement is based on the use of improved fallows, organic residues, and multipurpose legume species. The institutions IPCA and EAP-Zamorano will be doing participatory breeding on maize and bean at the Mina Honda site. Crop adaptation trials will be carried out at both sites. The SOL in Santa Cruz is devoted to the development of improved coffee production systems.

Table 18 presents the research activities proposed by each institution. Some of these activities are under implementation and others are in the planning phase.

Output

The SOL initiative is beginning to play an important role in fostering collaboration among research and development institutions in Yorito.

Table 18. Research activities proposed by institutions involved in the Supermercado de Opciones para Ladera (SOL) sites, Honduras.

Research proposed[a]	Status of the work[a]	Duration of the work	SOL sites
CIAT and IPCA: Evaluate adaptation of improved crop cultivars (beans, maize, soybean, cassava, upland rice, and sweet potato)	*Collection of local materials and* introduction of improved materials from CIAT, CIP, CIMMYT, CIRAD, and FHIA	2-3 years	Luquigue Mina Honda
CIAT: Identification of alternative sources as organic fertilizers	Preliminary testing of two sources (Calliandra and Inga)	3-5 years	Luquigue
CIAT: Effect of improved pastures on animal performance and soil protection	A pasture trial is under establishment	3-5 years	Luquigue
IPCA- EAP-Zamorano: Participatory breeding of beans and maize	Preliminary selection of crosses	5 years	Mina Honda
SERTEDESO: Improved coffee production systems	Not started yet	3-5 years	Santa Cruz

a. Acronyms used: IPCA = Investigación Participativa para Centro América, CIP = Centro Internacional de la Papa, CIMMYT = Centro Internacional de Mejoramiento de Maíz y Trigo, CIRAD = Centre de coopération internationale en recherche agronomique pour le développement, FHIA = Fondo Hondureño para Inversion Agricola, EAP-Zamorano = Escuela Agrícola Panamerican-Zamorano, and SERTEDESO = Servicios Técnicos para el Desarrollo Sostenido

Contributors: L Brizuela, M Ayarza, J Jimenez (IPCA), JC Rosas (EAP-Zamorano), O Gallardo (EAP-Zamorano), M Gonzales (SERTEDESO)

Collaborators: B Ferrera (CLODEST), farmers from Santa Cruz

NICARAGUA

Highlight

✓ Main activities defined for SOL sites in Nicaragua

Objective

The aim was to plan the different activities to be developed during the year 2000 through an agreement with the institutions and farmers, to be able to take better decisions that contribute to the well-being of the region.

Methods

Before the workshop, seven work topics related with products of the project's logical framework were identified in order to present them to the community and institutional local organizations.

The prioritization of the topics was carried out through the group method. Three main topics were defined and then activities defined by themes. In May 2000, the participatory planning by objectives workshop was held in San Dionisio to form the SOL. In this workshop, different technologies to be evaluated in the region were identified. Topics of interest were defined and some activities incorporated into the SOL. An order of priority was established.

Results

Three topics were agreed upon for prioritizing:

- New field technologies (SOL)
- Local organizational processes
- CIALs

It should be mentioned that producers felt the PES to be of most importance, because of the difficulty of getting seed at low cost and of good quality. However, technicians cited bad experiences in this field, resulting from concentrating on a single crop and little initial exploration of the local and regional markets. At the same time, the use of modeling alone was important only to technicians, and GIS had a low priority for both groups.

The prioritization of activities based on demand allowed the definition of the different activities to be established in the SOL for the year 2000. Among these research activities are:

- Systems research including intensification and diversification of the traditional systems of maize-bean rotation,
- Limiting nutrient trials,
- Coverages and green manure trials,
- Testing adaptation of fallows,
- Live barriers, and
- Germplasm evaluation.

Figure 22 indicates the research (germplasm, soils, water, nutrients) that the SOL is developing in the year 2000 in collaboration with INTA, PRODESSA, CARE, and ADDAC.

Contributors: P Orozco, T Reyes, E Barrios (PE-2), M Ayarza, JI Sanz, JA Beltrán
Collaborators: INTA, PRODESSA, CARE, ADDAC

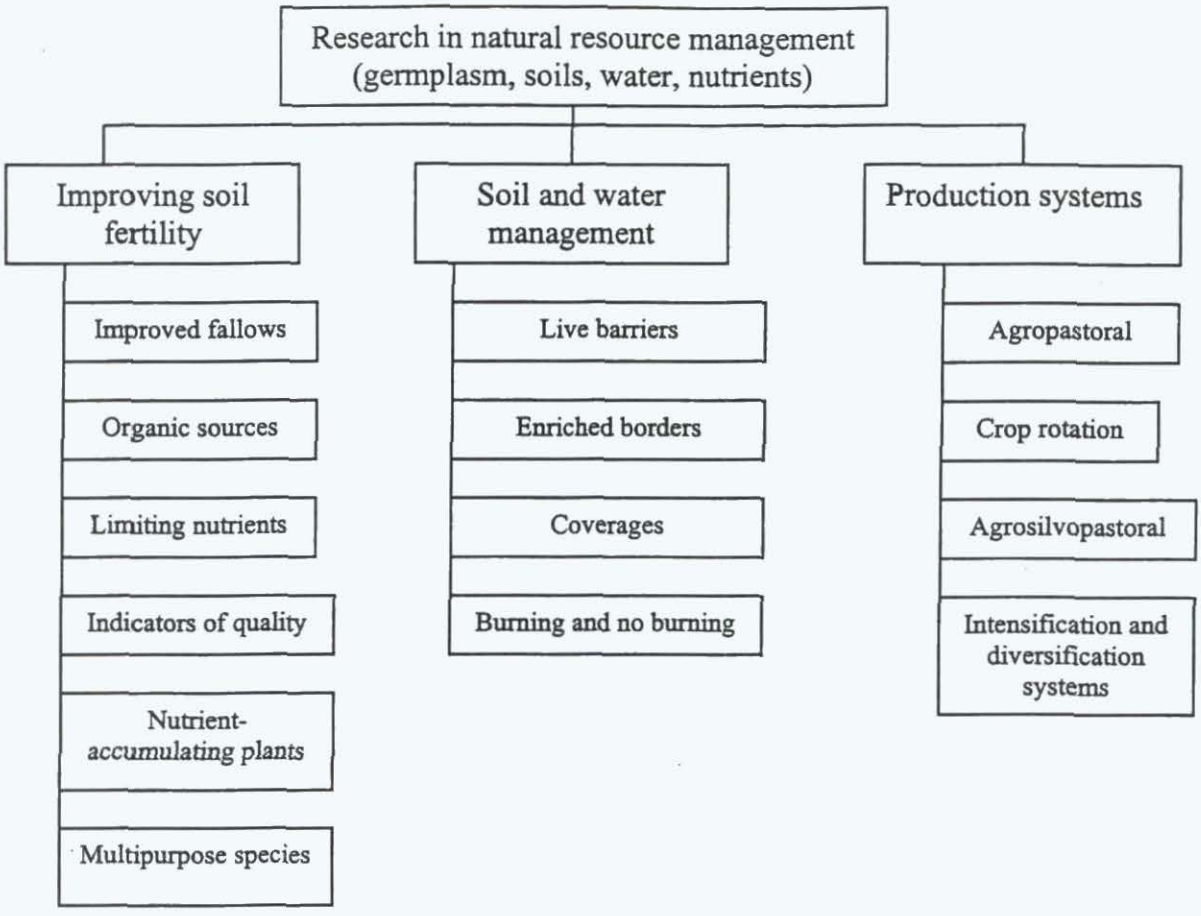

Figure 22. Supermercado de Opciones para Ladera (SOL) research planned for the year 2000 in Nicaragua SOL sites.

Activity 5.2 Actively and permanently coordinate the reference sites, projects, and individuals working in the region

Research in the reference sites is continually being coordinated and validated and organizational activities strengthened. The many meetings and workshops that work towards this end are shown in Table 19 of Activity 5.4. The SOL coordination workshops are reported in Activity 5.1.

Activity 5.3. Maintain an efficient information system within the project and with its partners

Monthly updating the project Web page

Objective

The aim is to keep all our researchers, collaborators, interested institutions, and individuals up to date with project progress.

Methods and Results

After the team acceptance of the design for the Web page for Colombia, it was implemented and was one of the first of all CIAT project Web pages to be changed with several sublevels:

Level 1: Presentation
Level 2: Activities, collaborators, contacts, history, strategy, news, personnel, tools, sites
Level 3: Donors, publications

For the presentation of the page we have followed the CIAT norms. Because these will shortly be changing, we will also be making some changes to the project Web page. Some sites are being worked on and will be finalized with the information from the internal workshop in Montelimar. Figure 23 shows a sample page under construction. The text gives a general outline of what the project's aims are, its strategies, research being done, the tools being used, and the participatory approach.

Figure 22. Web page under construction for the community management of own resources in hillside zones.

Output

The Web page is an important means of communication for the project.

Contributors: V Escobar, A Jimenez
Collaborator: A Iturbe

Circulate the project bulletin

The project bulletin is published quarterly. The August Bulletin included articles on small rural agroenterprises, the Seeds of Hope Project, processes of strengthening local organizations, and important events occurring in the month.

Contributors: M Ayarza, JA Beltrán, V Escober

Compile, systematize, and disseminate information and experiences generated in the reference sites

The Project's Center of Documentation was created and already has a physical space where its institutional memory, CIAT documentation, and different documents necessary to the development of our work are kept. They are indexed in a database of easy access, and thus the information service is offered to interested people within CIAT and outside of the project. The documents are also lent out for short time periods.

Visitors are attended to, either personally or by phone or mail trying to give them precise information or help them locate where it is available within or outside CIAT. For this purpose, written and digital information elaborated by different project members over time has been collected. These include documents related with development work, that is, those that serve as a base for research, research results, annual reports, documentation sent by donors and partners, documents elaborated by other CIAT projects with a direct or indirect relationship with us, and the documents from different project members that have left.

New documentation is in the process of revision, systematization, and location including photographic files and slides. The Center of Documentation gives a scanning service of photos and documents to project members and officials of other projects. We are working on the elaboration of documents written by project members for their publication and distribution. Likewise we are distributing the methodological Guides and other published documents.

Contributors: V Escober, A Jiménez, I Espinal

Activity 5.4. Strengthen joint work with other projects and organizations

Table 19 shows workshops, training courses, meetings, and other collaborative functions that all strengthen joint work with other projects and organizations, sometimes even forging new links. Many of these events are also an integral part of the participative management of the project. The follow-up on partners' demands for training and management of small funds are included here. Table 20 shows the work of thesis students of educational centers at local, national, and international levels. All the project team contributed.

Table 19. Workshops, meetings, and other interinstitutional events Sept 1999-10 Oct 2000 (for acronyms and abbreviations, see p 138).

Activity	Organizers	Date	Participating Institutions	Participants (no.)	Overall results
Training course on postharvest management of bean seed, Honduras	CARE CIAT-SOH	**1999** 26-27 Aug	CARE	4 technicians 8 farmers	12 people trained in improved postharvest technologies for artisanal seed production.
Workshop "Support to the commercialization and development of agroenterprises in Yorito and Sulaco"	M Totobesola, V Gottret, M Lundy (SN-1)	5 Oct	ACELY, AGASUL, AHPROCAFE, AMCY, Asociación 10 de Octubre Gruertas, ASOCIAL, CIAL Guaco, CIAL Río Arriba, CIAL-Mina Honda, CIDES, CLODEST, CODESA, COOPACYL,COOPACYL-FONCREDY. DIPAC-CARE, IPCA, PDA-Yoro, SERTEDESO, Visión Mundial	37	Database of supply data/support supply and demand to Yorito and Sulaco agroenterprises. Producers and institutions of the zone familiarized with results of the process and mechanisms in place to continue. Workshop Proceedings.
Training course "Methods for analysis of agricultural markets" and on Guide 7 in ICRAF, Kenya	ICRAF, CIP, ILRI, CIAT, ICRISAT, IITA-Foodnet	Nov	Foodnet, IITA, ICRAF, ICRISAT, ILRI, CIP, World Vision, MAG-Tanzania, MARD, Sokoine University, MAG&I, MAG&RD, NAAPRI, AIMA, EARO, KARI, USAID-FEWS project, ICRAF, ARC, ISABU, ARI, ISAB, NPRC, MARI, KRRC, NARO, SAARI, FIFAMANOR, INERA	30	Participants familiarized with standard methods of analysis of market options and with CGIAR research in the field. Information given on financial opportunities for research on subject.
Second national training course on use of DS tools in NRM at watershed level (Candelaria, Lempira, Honduras)	FAO, CIAT team, V Zapata, M Trejo, Team of local trainers	19-20 Nov	CIAT, PRODERCO, PROLESUR-FAO, SERNA – DGA, CARE, ENA, CASM, DICTA, CURLA, IHCAFE, COHDEFOR, GUAYAPE, PROLANCHO, JICATUYO, PAAR, FEPROH, COCEPRADIL	45 reps of 17 institutions	18 action plans defined to use the tools.
Second training course on the use of DS tools for NRM, Candelaria, Lempira	CIAT – FAO, V Zapata, M Trejo, Local team of trainers	21-25 Nov	CIAT, PRODERCO, PROLESUR-FAO, SERNA – DGA, CARE, ENA, CASM, DICTA, CURLA, IHCAFE, COHDEFOR, GUAYAPE, PROLANCHO, JICATUYO, PAAR, FEPROH, COCEPRADIL	45 people from 16 institutions	30 technicians trained. 18 action plans defined. 30 producers familiarized with the tools.

Continued.

Table 19. Continued.

Activity	Organizers	Date	Participating Institutions	Participants (no.)	Overall results
Meeting with team of local trainers and directors of institutions, Honduras	V Zapata, M Trejo	**1999** Dec	CIAT, FEPROH, PROLESUR-FAO, SERNA - DGA, CARE, ENA , CASM, DICTA	20 people	Directors approved action plans for the year 2000. Date for signing of collaboration agreements defined.
Soils Fair	M Trejo M Escoto	**2000** 27-28 Jan	ENA CIAT	20 students 30 producers	Students and producers familiarized with the use of soil quality indicators.
Soils Fair, Quimistán, Honduras	M Trejo M Villanueva	4-5 Feb 2 May	CARE, CIAT COOP CALEL, COOP CASFUL	12 technicians from CARE 30 cooperative members	Technicians and farmers familiarized with the soil quality indicators tool.
ECAR 1999 Evaluation Workshop	CIAT, IPCA	9 Feb	CIALs	24 producers	Selection of four varieties of bean seed.
Meeting to report achievements of the SOH project	CIAT-SOH	17 Feb	DICTA, SAG, SENASA, USAID, CIDA, CIAT, CARE, CCD, La Tribuna, PRONADERS, IPCA	23 people	Government representatives, donor community, and several NGOs were informed about project impact.
Workshop "Vision, mission, principles, methodologies of development of PPI and SAL of CIAT's SN-1 and development of APs by local committees of agroenterprises"	M Lundy, M Totobesola, SN-1	17 Feb	Committee members of local agroenterprises, CLODEST, AMCY, SERTEDESO, REDOLYS, ASOCIAL, CIDES, AGASUL	11	Clarification of vision, mission, and principles of SN-1 project as work logframe. Clarification of steps in PPI and SAL methods. Workshop Procs.
Meeting with directors of partner institutions to review the general agreement and action plan for training, Honduras	V Zapata M Trejo	29 Feb	SERNA – DGA, CARE, ENA, CASM	4 reps of institutions	First draft of agreement presented and discussed then sent to other institutions involved in training.
Training course on M&E of APs on the application of tools on NRM	V Zapata, M Trejo	1-2 Mar	PROLESUR-FAO, SERNA – DGA, CARE, FEPROH, ENA, CASM, DICTA	18 people (CIAT and local training group)	Training group familiarized with methodologies to monitor progress of action plans.

Continued.

Table 19. Continued.

Activity	Organizers	Date	Participating Institutions	Participants (no.)	Overall results
First Workshop for the "Design of PPI for coffee in the municipalities of Yorito and Sulaco"	M Totobesola, Mark Lundy SN-1	**2000** 16 Mar	Coffee producers 3 de marzo, Santa Cruz, AHPROCAFE, SERTEDESO, REDOLYS, Employers Association Quebrada Vieja, local Council local El Plantel, CIAL-paratechnic El Portillo, AMCY	20	Actors in Yorito and Sulaco identify and characterize the coffee chain. Identification of support opportunities for coffee sector in zone. Evaluation, analysis, and prioritization of difficulties or bottlenecks for actors in Yorito and Sulaco.
Workshop on experiences in developing production projects at local level	CIAT - PE-3/ IICA-Holland	17 Mar, 2000	SERTEDESO, IPCA, ISP		Lessons and experiences identified in project management.
Training in elaboration of projects	L Brizuela REDOLYS	March		40 producers	Training in the Guide for elaborating projects.
Planning workshop of project Participatory Evaluation of Multi-use Germplasm for the Central American Region	CIAT-(PE-5) M Peters H Cruz	21-25 Mar	DICTA, CIAT, SERTEDESO, INTA, MAG-Costa Rica, GTZ		Operative Plan elaborated, Technical Committee formed.
Planning Meeting SOL Network for year 2000	L Brizuela, M Ayarza	28 Mar	IPCA, SERTEDESO, EAP		Structure of Net and joint action plan established.
Planning Meeting SOL-Santa Cruz	CIAT, SERTEDESO	28-29 Mar	SERTEDESO	10 producers 4 technicians	Plan of definite activities. Diagnostic of coffee problematic. Themes of identification defined.
Workshop on experiences in organizational strengthening in reference sites	CIAT		CIAT	8 technicians	Principles, lessons, and hypothesis defined by CIAT's group work process.
Meeting with trainers to develop monitoring reports	M Trejo	26 April	FEPROH, PROLESUR-FAO, SERNA – DGA, CARE, ENA, CASM, DICTA	10 trainers	Training group able to report progress of action plans.
Training course on postharvest management of maize seed, Honduras	CIAT-SOH	30 Apr – 5 May	CARE, FEPROH, CIAT, SERTEDESO, PDA-YORO, EACSF, IPCA, Proyecto Fonseca, Cooperativa Nueva Lucha, COMUCAMNEL	8 technicians 15 farmers	23 people trained in postharvest technologies for artisanal seed production.

Continued.

Table 19. Continued.

Activity	Organizers	Date	Participating Institutions	Participants (no.)	Overall results
Training course on postharvest management of maize seed, Nicaragua	CIAT-SOH	**2000** 2-27 May	CARE, PASA-DANIDA, INPRHU/CRS, FIDER/CRS, CIAL, Asociacion Campos Verdes, CIAT-SOL/ PE-3, Asociacion Productores de Carazo, INTA Semillas	6 technicians 9 farmers	15 people trained on postharvest technologies for artisanal seed production.
Technical Committee Meeting SOL Network	L Brizuela	17 May	IPCA		Activities developed jointly.
Workshop to present results of ECAR 99	CIAT	22 May	IPCA, CIALs	21 producers 3 technicians	Distribution of bean seed of varieties selected by CIALs.
Training in Groups of Interest Methodology	CIAT-(PE-5)	25 May	SERTEDESO	3 technicians	Technicians can manage the methodology.
Support Group CLODEST Meeting	CIAT/IICA IPCA-Holland	29 May	CIAT, IPCA, IICA		Lines of action defined for strengthening CLODEST.
Review of monitoring reports on progress of APs on the use of NRM tools	M Trejo, V Zapata	7 June, 2000	FEPROH, PROLESUR-FAO, SERNA – DGA, CARE, ENA	2 trainers 6 technicians of local institutions	M&E reports available.
Soils Fair, Quisimaca, Lempira, Honduras	E Navarro, M Villanueva, C Amaya	16 - 17 June	PROLESUR – FAO, CIAT, CARE, SCD, CONCERN	10 technicians 30 farmers	Technicians and farmers familiarized with the soil quality indicators tool.
Forages Field Day	DICTA, CIAT (PE-5)	29 June	CIAT, DICTA, SERTEDESO	22 producers 5 technicians	Producers informed on management of improved pastures. Demand for *Brachiaria* seed 26110 identified.
Workshop for presentation of Methodologies for evaluating impact, constructing vision of development	L Brizuela O Westermann V Gottret	5 July	IHCAFE, CODESA, Médicins sans frontières, SERTEDESO, IPLA, POA-Yoro, Instituto San Pedro, Salud Publica	15 professionals/ technicians	Construction of a vision for local partners.
Workshop for presentation of Methodologies for evaluating impact, constructing vision of development	L Brizuela O Westermann V Gottret	6 July	Residents of 12 local communities, Yorito	25 producers	Construction of a vision for local partners.

Continued.

Table 19. Continued.

Activity	Organizers	Date	Participating Institutions	Participants (no.)	Overall results
Meeting with DIMA SPS to review progress on the organization of a training course	M Trejo	**2000** 1 Aug	CIAT - DIMA	6 reps from DIMA	Course postponed until Oct.
Field tour of SOL network	CIAT (PE-3) IPCA		CIAT, IPCA, FHIA, COSAVY, ISP		Activities defined jointly.
Training in use of soil quality indicators tool, Marcala, La Paz, Honduras	M Villanueva, C Amaya, C Barahona	4 and 5 Aug	CARE DIPPAC, CIAT, CARE EXTENSA	11 CARE technicians 43 farmers	Technicians and farmers familiarized with the soil quality indicators tool.
Course on business management	CIAT - SOH EAP-Zamorano	21- 25 Aug	CIAT, PDA-Yoro, PDA-San Matias, SERTEDESO, Proyecto Fonseca, CIAT-SOL/PE-3	9 technicians	People trained in business management.
Exposition on intensifying production with cover legumes	CIAT	29 Sept	ESA consultants, COSAVY		
Field Day SOL site, Luquigue	CIAT (PE-3), IPCA	31 Aug	IPCA, ISP, CIAT	29 producers	Producers of community informed of activities and the demand for seed established in the SOL.
Meeting of CIAT trainers with local trainers to formalize the national training team for the use of DS tools for NRM, Tegucigalpa, Honduras	V Zapata, M Trejo, CIAT instructors	13-16 Sept	CIAT, FEPROH, PROLESUR-FAO, SERNA – DGA, CARE, ENA, CASM, DICTA	26 representatives of 8 institutions	National team of 16 trainers set up.
First training course in the use of DS tools for NRM, Lago de Yojoa, Honduras	CIAT - ENA	17-22 Sept	CIAT, FEPROH, PROLESUR-FAO, SERNA – DGA, CARE, ENA , CASM, DICTA, CURLA, UNAH, IHCAFE, COHDEFOR, PRODERCO, PDA-YORO	56 people from 14 institutions	30 technicians trained. 13 action plans defined. 30 producers familiarized with the use of the tools.

Table 20. PE-3 thesis students 1999-2000 (for acronyms and abbreviations see page 138).

Student	Institution	Theme	Reference site	Dates		Funding	Person/s responsible
				Start	Finish		
Jaime Aguilar	FARENA/UNA School of Soils	Hydrological modeling of the Calico River watershed	San Dionisio, Nicaragua	May 1999	Nov 2000	CIAT	B Barbier ME Baltodano
Sigrid de Barbentane	NORAGRIC, Norway	Study on decision-making processes in seed supply and seed distribution interventions in emergency situations – case of Honduras	Areas affected by Hurricane Mitch, Honduras	Feb 2000	Nov 2000	University	G Giraldo
Gines Calderón	FARENA/UNA School of Forestry	Agroforestry simulation model	San Dionisio, Nicaragua	May 1999	Nov 2000	CIAT	B Barbier ME Baltodano
Abner Jiménez	ESNACIFOR	Bioeconomic simulation modeling Calan River	Calan River watershed, Siguatepeque, Honduras	Feb 2000	Nov 2000	CIAT	B Barbier O Mejía
José Gonzalez	CATIE	Optimization model for placement of coffee benefits	San Nicolas, Santa Bárbara Department, Honduras	Feb 2000	Nov 2000	CATIE	B Barbier O Mejía
Ramón Gonzalez	FARENA/UNA School of Soils	Hydrological modeling of the Calico River watershed	San Dionisio, Nicaragua	May 1999	Nov 2000	CIAT	B Barbier ME Baltodano
Tom Gurther	Swiss Federal Institute of Science and Technology	Evaluation of changes in the forest frontier	San Dionisio, Nicaragua	Nov 1999	May 2000	ETHZ	JA Beltrán ME Baltodano
Matias Gurtner	Swiss Federal Institute of Science and Technology	Evaluation of sustainable development GIS method	San Dionisio, Nicaragua	Oct 2000	Feb 2001	ETHZ	JA Beltrán ME Baltodano
Jon Magnar Haugen	NORAGRIC, Norway	Seed systems of small farmers in Honduras – their relevance for interventions	Yorito, Choluteca, Honduras	Feb 2000	Nov 2000	University	G Giraldo
Ramón Hernandez	ESNACIFOR	Bioeconomic simulation model	Choluteca, Honduras	Feb 2000	Nov 2000	SERNA	B Barbier O Mejía
Daniel Larios	FARENA/UNA - School of Soils	Evaluation of soil losses from hydrological erosion	San Dionisio (Wibuse), Nicaragua	May 1999	Feb 2000 (1st year)	CIAT	B Barbier ME Baltodano

Continued.

Table 20. Continued.

Student	Institution	Theme	Reference site	Dates		Funding	Person/s responsible
Esther Leeman	Swiss Federal Institute of Science and Technology	The impact of trade reform and other policies on rural poverty and the enviroment	San Dionisio, Nicaragua	Nov 1999	Aug 2002	ETHZ EAWAG	M Ayarza B Barbier
Josue Anibal León	ESNACIFOR	Erosion plots and the WEPP model	Siguatepeque, Honduras	Feb 2000	Nov 2000	CIAT	B Barbier O Mejía
Luz Maria Medina	Laval University, Canada	Women and market gardens: Conservation and management of biodiversity and natural resources in the hillside zones of Honduras	Yorito, Yoro, Guinope, El Paraiso, Honduras	June 2000	Oct 2000	CRDI	M Ayarza
Ninoska Moreno	FARENA/UNA School of Forestry	Agroforestry simulation model	San Dionisio, Nicaragua	May 1999	Nov 2000	CIAT	B Barbier ME Baltodano
Freddy Obando	FARENA/UNA School of Soils	Evaluation of soil losses from hydrological erosion	San Dionisio (Wibuse), Nicaragua	May 1999	Feb 2000 (1st year)	CIAT	B Barbier ME Baltodano
Francisca Pfister	Swiss Federal Institute of Science and Technology	The impact of trade reform and other policies on rural poverty and the enviroment	San Dionisio (six communities), Nicaragua	Nov 1999	Aug 2002	ETHZ EAWAG	M Ayarza B Barbier
Javiera Pichardo	FARENA/UNA	Application of simulation models in production systems	San Dionisio, Nicaragua	May 1999	Nov 2000	CIAT	B Barbier ME Baltodano
Kirsten Probst	Hohenheim University, Germany	Participative monitoring and evaluation	Yorito, Yoro, and Yuscarán, Honduras	Mar 1999	Sept 2000	CIAT	J Ashby
Jose Fernando Escolán Rodezno	ENA, Honduras	Farm consultancy for small producers in hillsides in Yorito and Sulaco: Use of a linear programming model. Thesis for Ingeniero Agrónomo	Yorito and Sulaco, Honduras	May 2000	Sept 2000	SN-1 and PE-3	M Totobesola
Dorivar Ruiz	EAP-Zamorano	Quantification of local indicators of soil quality in the Luquigüe watershed, Yoro, Honduras. Thesis for Ingeniero Agrónomo	Yorito, Honduras	June 1999	Apr 2000	CIAT/EAP-Zamorano	M Ayarza

Continued.

Table 20. Continued.

Student	Institution	Theme	Reference site	Dates		Funding	Person/s responsible
Alejandra Sierra	EAP-Zamorano	Floristic and structural characterization of the arboreal and arbustive vegetation of the Luquigue watershed, Yoro, Honduras. Thesis for Ingeniero Agrónomo	Yorito, Honduras	June 1999	Oct 2000	CIAT/EAP-Zamorano	M Ayarza
Alma Soza	ESNACIFOR	Hydrological balance at plot level of different land uses	Jalapa watershed, Yorito, Honduras	Feb 2000	Nov 2000	CIAT	B Barbier O Mejía
Bettina Springer	Swiss Federal Institute of Science and Technology	Comparison of nutrient balance in coffee plantations with high and low use of inputs	San Dionisio, Nicaragua	Nov 1999	May 2000	ETHZ	JA Beltrán ME Baltodano
Francisco Zaconeta	EAP-Zamorano	Identification of plants as indicators of soil quality in agricultural plots, Luquigüe watershed, Yoro, Honduras. Thesis for Ingeniero Agrónomo	Yorito, Honduras	June 1999	April 2000	CIAT/EAP-Zamorano	M Ayarza
Pablo Zúniga	FARENA/UNA	Application of simulation models in production systems	San Dionisio, Nicaragua	May 1999	Nov 2000	CIAT	B Barbier ME Baltodano

Activity 5.5. Establish a participative system of monitoring and evaluation of the project to monitor its performance and feed back to planning

Highlight

✓ Participative valuation of project performance, readjustment of its vision and purpose, and strategy planning

Objectives

The objectives of the Hillsides Strategic Planning Workshop, Montelimar, Nicaragua were to:

- Reach a clear understanding of the significance of the internal and external evaluations that the Hillsides Project has undergone during the 1999-2000 period.
- Gain a shared vision about the Hillsides Project and its endeavors.
- Achieve an enhanced understanding of the "development problems" at reference sites.
- Obtain a better picture of present and foreseen research activities and their relationships with the "development problems" at research sites.
- Achieve an increased understanding of the Hillsides Project Mission and its relationships with future research activities and their expected impact.
- Gain an enhanced understanding of the "causal uptake paths" methodology.
- Guide the Hillsides Project activities in obtaining the expected research impacts.
- Reach a clearer understanding of research gaps that need to be overcome to achieve the research objectives.
- Gain a better understanding of evaluation methods and instruments for the Hillsides Project activities and results.

Methods and Results

Among several important ground rules, participation of all members was stressed as well as the collective construction of knowledge through workgroup and team presentations throughout the workshop. Although time was a constraint in achieving the desired objectives, participants had sufficient for group discussion and for collecting their thoughts. Diversity among group members in terms of experience and formal training was counted an advantage to ensuring richness of opinions. Finally, participants were encouraged to synthesize thinking and produce tangible results for their immediate application.

The eight objectives were worked through, some with group activities, some as presentations. Analyses of the various points were recorded. The workshop clarified the group's ideas and thoughts into a single vision and way forward. The full results of work done will be published in a report. A preliminary draft report is available.

Output

The main output of the workshop is a clearer concept of the project's aims and strategies and the stronger participatory fellowship of the PE-3 team.

Contributors: Whole team

Activity 5.6. Initiate on-site activities of impact evaluation

Build a causality chain by product and define indicators of development

Highlights

- ✓ Elaboration of a conceptual framework and casual uptake paths for output 5.1 (Interinstitutional Consortiums), 5.4 (Community Organization Networks), 2.3 (Bio-Economic Modeling), and 4.1 (Cropping Systems Options - SOL) in the NRM logical framework
- ✓ Collection of data and initial analysis of a collaborative effort in Yorito and San Dionisio and initial impact evaluation of milestone related to output 5.1 and 5.4

Objectives

1. To develop a conceptual framework for monitoring, evaluation, and impact assessment of PE-3 work in the reference sites with specific emphasis on organizational models.
2. To conduct an initial and explorative survey with the objective of gathering data and experience from the reference sites for further elaboration and refinement of the impact assessment methodology.

Methods

The process started by developing our vision or final development objectives of the research output defined in the conceptual framework for the CIAT-NRM division. These were redefined and discussed at a 2-day seminar on organizational processes held in Cali with the objective of interchanging experiences between the researchers in the reference sites in Pucalpa, Cauca, San Dionisio, and Yorito. Then causal uptake paths were developed for each of the Hillsides outputs to the desired development impact or goal. Intermediate indicators for each step in the causal uptake path were selected, as well as final "development indicators". Afterwards, methodologies and models for impact assessment analysis were defined to ensure that data collected would be the most appropriate for the analysis. Finally, data collection methodologies, protocols and sampling strategies (including reference sites boundaries and limits) were defined and tested in the field with specific emphasis on institutional and community collaboration.

The fieldwork conducted in Honduras and Nicaragua consisted mainly of semi-structured interviews and participatory exercises with regional and local institutions and community organizations both individually and in focus groups. We also conducted some interviews with selected communities.

The goals, objectives, and conceptual frameworks for outputs 5.1 (interinstitutional consortium), 5.4 (community organizations network) were elaborated. Frameworks for outputs 2.3 (bioeconomic modeling) and 4.1 (cropping systems options – SOL) were also elaborated. These conceptual frameworks are very extensive especially for the organizational models but the exercise has been very useful as a planning tool for the elaboration of the impact evaluation methodology and for future directions of our research with institutional and community organization. Such planning is seen as a learning process in itself that interacts closely with experiences from action research in the field and with the informal process of interchange of experience on organizational processes that has been started between the reference sites in Honduras, Nicaragua, Colombia, and Peru.

Results

Analysis of the fieldwork is underway and will be available later this year. All the interviews and workshops were taped and are transcribed. A summary of all interviews was written in a chronological order (almost complete). An inventory of the different surveys and interviews conducted in San Dionisio and Yorito was made. This inventory includes (a) the name of the study, (b) the content of the survey and/or interview, (c) the sampling procedure if available, and (d) the availability of the data set in the CIAT offices, or if an agreement with the institution that owns the data set is needed.

Based on the above information an analysis for each critical path is being conducted including:
(a) A list of proposed indicators for the critical path,
(b) The degree in which this critical path was achieved or not is analyzed,
(c) The usefulness of the proposed indicators is evaluated, and
(d) Needs for further information and analysis.

The set of preliminary development impact indicators developed for the four types of capitals (human, social, economic/financial, and natural) are being contrasted with the "development visions" defined in the workshops with CLODEST, REDOLYS, and Campos Verdes. Also the short-term expected changes are contrasted with the "paths to development impact" developed for the PE-3 and SN-1 projects.

An initial analysis was made of the degree to which the critical path towards development was achieved. This analysis follows the process indicated in the diagram showing the critical path for PE-3 research towards development. It should be noted that this path has been generated as a result of ongoing research and continued feedback, and not as a preplanned process. Thus many steps have not or only partly been completed.

Outputs

The commitment to establish a long-term impact evaluation process in the PE-3 reference sites ensures the long-term development impact of our research, guides our process of research, and provides feedback into the research processes.

Contributors: O Westermann
Collaborators: V Gottret, ME Baltodano, D Tijerino, O Mejía, L Brizuela, B Barbier, Impact Assessment Working Group

Impact assessment of El Cajon watershed

Highlight

✓ Evaluation of NRM El Cajon project and proposal of new monitoring plan

Objective

The aim is to analyze the impact of the El Cajon project and propose a new monitoring plan as requested by the government of Honduras.

Methods and Results

The NRM project El Cajon has contracted CIAT to evaluate its $US 20 million project, which is ending next year. We are studying the project's data to elaborate a baseline. We are also evaluating the project's evolution and proposing a new monitoring plan. We are conducting an impact assessment study using the data generated by the 4-year-old project. The project data include only project activities and adoption of techniques. Few indicators of impact were found. CIAT is using its experience in indicators and monitoring of natural resources to propose a new M&E plan. Results are preliminary because the study has not been published yet. The El Cajon watershed project seems to have difficulties in proving its relevance because a problem is lacking and there are some misconceptions. Current land use is not reasonable. Less than 10% of land is cultivated. Sedimentation levels are too low to reduce the life expectancy of the dam in a way that requires intervention in the upper watershed. The program of reforestation is more likely to reduce the amount of water available to the dam than to increase it. The agricultural program has shown a very high rate of adoption of land conservation practices. The project has further difficulties in proving that it has improved the life of the population living in the watershed.

Outputs

The study is expected to feed into the design of the large IDB project that the consortium CIAT/CATIE is now writing. Also the real impact of the privatization of extension services is strongly debated. The payment of private enterprise by kilometer of land conservation practices, although impressive in term of adoption level, is being criticized by many as unsustainable. Our study is likely to have a strong impact in the design of future projects.

Contributors: B Barbier, O Mejía, A Iturbe, S Rivera (Professor ESNACIFOR), A Hernandez (GIS COHDEFOR), J Suazo (consultant)

Activity 5.7. Establish an efficient and participatory administrative system within the Project

Project proposals and initiatives

We have been working closely with the Project's Office to identify new, untraditional donors as yet without much success. Amongst others we have been invited by NORAD to submit a proposal around the generic term of water. We are developing a concept note cutting across several CIAT projects while waiting for NORAD guidelines. We have a proposal submitted to DANIDA on the SOL and SOH work to merge the two. It is delayed because of the slow leadership of INTA of which the donors are aware. A proposal was elaborated for the next phase of SOH Central America with USAID who came to visit and explore the possibilities because they liked our results to date. We are preparing a proposal for the second phase Central America, first phase Mozambique, SOH. We have applied for and won two bids with IDB, the second of which is with CATIE, both on the prioritization of Honduran watersheds. We are working on the possibility for a second phase of the ISNAR project.

The project resources have been allocated to different scientists in an activity-based manner and in accordance with contracts with donors.

The project leader gave a seminar on the role of a leader, available in PowerPoint form. The ideas of a new kind of leadership are expounded. First the old type of top-down "boss" leadership is shown and the steps in its evolution to the new type of participatory leadership. Empowerment is the mainstay of the system and it is explained with its effects on groups and the construction of an empowered "self-directed" work team. The role of leader versus that of "boss" is also outlined. The ideas were also worked through at the project's Montelimar meeting.

Contributor: JI Sanz
Collaborators: All the PE-3 team

Publications

Book and Journal

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Collaborators

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Centro Internacional para el Mejoramiento del Maíz y el Trigo (CIMMYT)
Centro Internacional del la Papa (CIP)
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Swiss Federal Institute for Environmental Science and Technology (EAWAG)
Univesidad Nacional Agraria (Nicaragua)
University of Florida (United States)
University of Georgia (United States)
University of Wageningen (The Netherlands)

PE-3 Staff List

International Staff

Honduras:

Miguel Ayarza	PhD Soils, Regional Coordinator Honduras.
Bruno Barbier	PhD Economics, Bioeconomic modeling Honduras.
Mireille Totobesola	MSc Food, Rural agroenterprises Honduras
Guillermo Giraldo	MSc Agronomy, Local strengthening official Nicaragua

Nicaragua:

Jorge Alonso Beltrán	MSc Agronomy, Local strengthening official Nicaragua
Antonio Iturbe	MSc Geography, GIS Nicaragua

Colombia:

José Ignacio Sanz	PhD Soils, Project Manager
Olaf Westermann	MSc Sociology, Landscape management Colombia
Vicente Zapata	PhD Communications, Capacity building Colombia (Consultant)

Support Staff

Colombia:

Carlos Guillermo Meléndez	Agronomic Engineer, Administrative Assistant
Arancibia Jiménez	Agronomic Engineer, Research Assistant
Sandra Dossman	Graphic Designer, Communications Assistant
Adriana Domínguez	Bilingual Secretary
María Cecilia Roa	MSc Development, Research and Administrative Assistant

Honduras:

Luis Brizuela	Agronomic Engineer, Production Systems and Local Strengthening
Vilia Escober	Journalist, Administrative Assistant
Marco Tulio Trejo	Agronomic Engineer, Soils and Capacity Building
Orlando Mejía	Agronomic Engineer, Biophisical models
Miguel Angel Méndez	Agronomic Engineer, Seeds of Hope (5%)
Heraldo Cruz	Agronomic Engineer, Multi-purpose forages (50%)
Gilman Palma	Technician, Production Systems
Willmer Nolasco	Driver
María Olimpia Ramírez	Maintenance
Iveth Espinal	Secretary
Erundina Espinoza	Caretaker
Denis Espinal Rodriguez	Field Assistant
Denisse Rosdeli Alas Castro	Secretary Yorito
Arturo Nuñez	Security Guard
Isaul Martinez	Para-technician SOL project Luquigue
Mario Rolando Pineda	Field Assistant SOL project Luquigue

Nicaragua:

Jorge Alonso Beltrán	MSc Agronomy, Local strengthening official Nicaragua
María Eugenia Baltodano	Economist, *Bioeconomic* modeling
Dominga Tijerino	MSc Sociology, Local strengthening and capacity building
Trinidad Reyes	Agronomic Engineer, Research Assistant
Nohemí Espinosa	Agronomic Engineer, Research Assistant
Martha Lorena Lacayo	Accountant, Administrative Assistant
Juan Bosco Franco	Agronomic Engineer, Seeds of Hope (5%)
Fátima Sandoval	Secretary
Pedro Pablo Orozco	Agronomic Engineer, Production Systems
Yuritza Zamora	Secretary San Dionisio
Pedro Torres	Driver
Sandra Palacios	Caretaker (50%)

Students

Colombia:
Claudia Marysol Buitrago (Universidad Nacional)
Alexander Feijoo (Universidad Nacional)

Honduras:
Dorivar Ruíz (EAP - Zamorano)
Francisco Zaconeta (EAP - Zamorano)
Abner Jiménez (ESNACIFOR)
Alma Soza (ESNACIFOR)
Josue Anibal León (ESNACIFOR)
José González – (CATIE)
Ramón Hernandez (ESNACIFOR)
Alejandra Sierra (EAP - Zamorano)
Dorivar Ruiz (Zamorano, Honduras)
Kirsten Probst (University of Hohenheim, Germany)
Luz Maria Medina (Laval University, Canada)
Jon Magnar Haugen (NORAGRIC, Norway)
Sigrid de Barbentane (NORAGRIC, Norway)
Jose Fernando Escolán Rodezno (ENA, Olancho, Honduras)

Nicaragua:
Gines Calderón (UNA)
Ninoska Moreno (UNA)
Jaime Aguilar González (UNA)
Ramón Reyes Blanco (UNA)
Pable Zúñiga (UNA)
Javiera Pichardo (UNA)
Freddy Obando (UNA)
Daniel Trinidad Larios (UNA)

List of Abbreviations and Acronyms

Acronyms

ACELY	Asociación de Enlaces de Ladera
ACIAR	Australian Center for International Agricultural Research
ACV	Asociación Campos Verdes, Nicaragua
ADDAC	Asociación para la Diversificación y Desarrollo Agrícola Comunal, Matagalpa, Nicaragua
AHI	African Highlands Initiative
AHPROCAFE	Asociación Hondureña de Productores de Café, Honduras
AIMA	Agri-Industrial Management Agency, Uganda
ALCON	Alimentos Concentrados agroindustry, Honduras
AMCY	Asociación de Mujeres Campesinas de Yoro, Honduras
ARC	Agricultural Research Corporation, Sudan
ARIs	Agricultural Research Institutes
ASOCIAL	Asociación de CIAL, Honduras
BRUT	Represa de agua potable para los municipios de Bolivar, Roldanillo, La Unión, and Toro
BSP	Burundi Sweet potato Programme, ISABU, Burundi
CADECA	Compañia Avícola de Centro América
CALEL	Cooperativa Agrícola Lempira Limitida, Honduras
CAP	Comité de Agua Potable
CAPRI	Systemwide Program for Collective Action and Property Rights of the CGIAR
CARE	Cooperative for American Remittances Everywhere
CASFUL	Cooperativa Agrícola San Francisco Unión Limitida, Honduras
CASM	Comisión de Acción Social Menonita, Honduras
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica
CCD	Comisión Cristiana de Desarrollo, Honduras
CDR	Center for Development Research, Denmark
CEA	Centro Experimental del Algodón, Nicaragua
CEPRODEL	Centro de Promoción del Desarrollo Local, Nicaragua
CGIAR	Consultative Group on International Agricultural Research
CIALs	Comités de Investigación Agricola Local
CIDA	Canadian International Development Agency
CIDES	Comité Interinstitucional para el Desarrollo de Sulaco, Honduras
CIIETS	Centro Intereclesial de Estudios Teológicos y Sociales, Nicaragua
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo, Mexico
CIP	Centro Internacional de la Papa, Peru
CIPASLA	Consorcio Interinstitucional para una Agricultura Sostenible en Laderas, Colombia
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement, France
CLBRR	Canadian Center for Land and Biological Resources Research

CLODEST	Comité Local para el Desarrollo Sostenible de la Cuenca del río Tascalapa, Honduras
CMC	Comisión de Crédito, Microempresas y Comercialización of CLODEST, Yorito, Honduras
COCEPRADIL	Consejo Central de Proyectos de Agua y Desarrollo Integral de Lempira, Honduras
CODESA	Consultores para el Desarrollo Sostenible, Honduras
COHDEFOR	Corporación Hondureña de Desarrollo Forestal
COMUCAMNEL	Cooperativa Mixta Unión de Campesinos en Nueva Esperanza Limitida, Honduras
CONCERN	International nongovernmental organization of volunteers
COOPACYL	Cooperativa de Ahorro y Crédito Yoro Limitida, Honduras
COPECO	Comisionado Permanente de Contingencias, Honduras
CORPOCUENCAS	Corporación Vallecaucana de las Cuencas Hidrograficas y el Medio Ambiente
CPCCM	Comisión de Producción, Crédito, Comercialización y Microempresas of CIDES, Sulaco, Honduras
CRDI	Centro Regional de Investigación, Honduras
CRS	Catholic Relief Service, Honduras
CURLA	Centro Universitario Regional del Litoral Atlántico, Honduras
DANIDA	Danish International Development Agency
DEC	Dirección Ejecutiva de Catastro, Honduras
DER	Desarrollo de Empresas Rurales
DGA	Dirección Gestión Ambiental, Honduras
DGEC	Dirección General de Estadísticas y Censos, Honduras
DICTA	Dirección de Investigación de Ciencias y Tecnología Agrícola, Honduras
DIMA	División Municipal de Aguas, Honduras
DIPPAC	Diversificación del Proyecto Agroforestal Comunitario, Honduras
DSSAT	Decision Support System for Agrotechnology Transfer model
EACSF	Empresa Asociativa Campesina San Francisco, Honduras
EAP-Zamorano	Escuela Agrícola Panamerican-Zamorano
EARO	Ethiopian Agricultural Research Institute
EAWAG	Swiss Federal Institute for Science and Technology
ECAR	Ensayo Centroamericano de Apaptacion y Rendimiento
ENA	Escuela Nacional Agricola de Olancho, Honduras
ESNACIFOR	Escuela Nacional de Ciencias Forestales, Honduras
ETHZ	Eidgenössische Technische Hochschule-Zentrum (*Swiss Federal Institute of Technology*), Zurich
FADCANIC	Fondo de Desarrollo para la Costa Atlántica de Nicaragua
FAO	Food and Agriculture Organization of United Nations, Italy
FARENA	Facultad de Recursos Naturales, UNA, Nicaragua
FEPROH	Fomento Evnagélico para el Progreso de Honduras
FEWS	Famine Early Warning System of USAID
FHIA	Fondo Hondureño para Inversion Agricola
FHIS	Fondo Hondureño de Inversion Social
FIDER	Fundación de Investigación de Desarrollo Rural, Nicaragua

FODA	Fortalezas, Opciones, Deficiencias, Acciones
FONCREDY	Fondo de Crédito COOPACYL, Yoro, Honduras
GTZ	Deutsche Gesellschaft für Techische Zusammenarbeit (*German Agency for Technical Cooperation*)
GUAYAPE	Proyecto de Desarrollo del Valle del Guayape, Honduras
GWR	Geographically Weighted Regression
IASCP	International Association for the Study of Common Property, USA
IASS	International Association of Agronomy Students
IBSRAM	International Board of Soil Resources and Management, Thailand
ICARDA	International Center for Agricultural Research in the Dry Areas, Syria
ICASA	International Consortium for Agricultural Systems Application
ICLARM	International Center for Living Aquatic Research Management, Philippines
ICRAF	International Center for Research in Agroforestry, Kenya
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics, India
IDB	Inter-American Development Bank, USA
IDRC	International Development Research Centre, Canada
IFPRI	International Food Policy Research Institute, USA
IHCAFE	Instituto Hondureño del Café
IICA	Instituto Interamericano de Cooperación para la Agricultura
IITA	International Institute for Tropical Agriculture, Uganda
ILRI	International Livestock Research Institute, Nairobi, Kenya
INEC	Instituto Nacional de Estadisticas y Censos, Nicaragua
INERA	Institut national pour l'étude et la recherche agronomique, Democratic Republic of Congo
INETER	Instituto Nicaraguense de Estudios Territoriales
INFOP	Instituto Nacional de Formación Profesional, Honduras
INPHRU	Instituto de Promoción Humana, Honduras
INTA	Instituto Nacional de Tecnología Agropecuaria, Nicaragua
IPCA	Investigación Participativa para Centro América
IPGRI	International Plant Genetics Research Institute
IPRA	Investigación Participativa en Agricultura/*Participatory Research in Agriculture* of CIAT
ISABU	Institut des sciences agronomiques du Burundi
ISNAR	International Service for National Agricultural Research
ISP	Instituto San Pedro, Yorito, Honduras
ITDEA	Intelligent Team Decision Assistant
JICATUYO	Proyecto de Desarrollo del río Jicatuyo, Honduras
KARI	Kenya Agricultural Research Institute
KRRC	Kakamega Regional Research Centre, KARI, Kenya
MAG	Ministerio de Agricultura, Costa Rica, Honduras
MAG	Ministry of Agriculture, Tanzania
MAG&I	Ministry of Agriculture and Irrigation, Malawi
MAG&RD	Ministry of Agriculture and Rural Development, Kenya
MAGFOR	Ministerio Agropecuario y Forestal, Nicaragua
MARD	Ministry of Agriculture and Rural Development, Kenya

MARI	Maruku Agricultural Research Institute, Tanzania
MAUP	Modifiable Areal Unit Problem
MIS	Manejo Integrado de los Suelos de Centro América consortium
NAAPRI	Namulonge Agricultural and Animal Production Research Institute, Uganda
NARO	National Agricultural Research Organisation, SAARI, Uganda
NPRC	National Potato Research Centre, Kenya
OCIA	Organic Crop Improvement Association International
OLUP	Office of Land Use Planning of SERNA, Honduras
PAAR	Programa de Administración de Areas Rurales, Honduras
PASA	Programa de Apoyo al Sector Agrícola, Nicaragua
PASOLAC	Programa de Agricultura Sostenible en las Laderas de Centro América
PDA	Proyecto de Desarrollo de Area, Yoro, Honduras
PDAER	Proyecto de Desarrollo de Agroempresas Rurales
PES	Productores Empresarios de Semillas Artesanales
PRGA	Participatory Research and Gender Analysis for Technology Development and Institutional Innovation, systemwide Program of the CGIAR
PRODERCO	Proyecto de Desarrollo Región Centro Oriente, Honduras
PRODESSA	Proyecto de Desarrollo de San Dionisio, Nicaragua
PROFRIJOL	Proyecto Regional de Frijol para Centro América, México y el Caribe
PROLANCHO	Proyecto de Desarrollo de Olancho, Honduras
PROLESUR	Proyecto Lempira Sur, Honduras
PRONADERS	Programa Nacional de Desarrollo Sostenible
REDOLYS	Red de Organizaciones Locales de Yorito y Sulaco, Honduras
SAAD	Systems Analysis for Agricultural Development
SAARI	Serere Agricultural and Animal Production Research Institute, Uganda
SAG	Secretaria de Agricultura y Ganadería, Honduras
SDC	Swiss Development Cooperation
SENASA	Servicio Nacional de Sanidad Agropecuaria, El Salvador
SERNA	Secretaria de Recursos Naturales y Ambiente, Honduras
SERTEDESO	Servicios Técnicos para el Desarrollo Sostenido, Honduras
SOH	Seeds of Hope Project
SOL	Supermercado de Opciones para Ladera (*Hillsides Options Supermarket)*
SOM	Self-Organizing Map
SPS	San Pedro Sula, Honduras
SWAT	Soil and Water Assessment Tool
SWBM	Spatial Water Budget Model
SWNM	Soil Water and Nutrient Management program
TROPILECHE	Sistemas de Alimentación a base de leguminosas mejoradas para pequeños productores con ganado de doble proposito en América Latina tropical ("Improved legume-based feeding system for smallholder dual-purpose cattle production in tropical Latin America"), a CGIAR project
TROPISEC	Programa del Trópico Seco Nicaraguense
TSBF	Tropical Soils Biology and Fertility Program, Kenya
UCA	Universidad Centroamericana

UNA	Universidad Nacional Agraria, Nicaragua
UNAH	Universidad Nacional Autónoma de Honduras
UNALM	Universidad Nacional Agraria "La Molina", Peru
UNICAM	Universidad Campesina Estelí, Nicaragua
USAID	United States Agency for International Development, WA
USDA	United Sates Department of Agriculture
USGS	United States Geological Survey
VIDAC	Vivero de Adaptación Centro Americano de grano rojo
WEPP	Water Erosion Prediction Project of USDA and Makerere University

Abbreviations

APs	action plans
CAL	*Calliandra calothyrsus*
DEM	digital elevation model
DS	decision support
DSS	decision support system
EXAC	exchangeable acidity
GDP	gross domestic product
GIS	geographic information systems
GOs	government organizations
HLU	homogenized land units
IDOP	identificación de oportunidades de mercados
IND	*Indigofera constricta*
LP	linear programming
LUT	land-use type
M&E	monitoring and evaluation
NARS	national agricultural research systems
NAT	natural fallow
NGO	nongovernmental organization
NRM	natural resource management
PM&E	participatory monitoring and evaluation
PPI	proyectos productivos integrados
RCBD	randomized complete block design
SAL	sistema de apoyo local
SOM	soil organic matter
TEB	total exchangeable bases
TTH	*Tithonia diversifolia*
t.u.	taxonomic units
VR	virtual reality