Proceedings of the Working Group on Hillsides Research in Central America, 1-3 March, 1995, Trujillo, Colón, Honduras

CATIE•CIAT•CIMMYT
EAP•IFPRI•IICA•PASOLAC
Hillsides Working Group

October 1995

Tegucigalpa, Honduras
Central America

The Hillsides Research Working Group is an informal association of scientists active in agricultural and natural resource research in the hillsides of Central America. The views expressed do not necessarily represent those of their respective Institutions.

Hillsides Research Working Group. October 1995. Proceedings of the Working Group on Hillsides Research in Central America, 1-3 March, 1995, Trujillo, Colón, Honduras. Tegucigalpa, Honduras: Hillsides Research Working Group.

Copies of this proceedings, or a Spanish-language version, are available from any participant or from:

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PREFACE

On March 1-3, 1995, scientists currently working on sustainable agricultural and economic development in the hillsides of Central America under the auspices of international and regional centers assembled in Trujillo, Honduras. The objectives for the gathering were:

- to review the broad outlines of the productivity and resource conservation challenges facing agricultural and livestock production systems in the region, particularly on hillsides;
- to integrate approaches for meeting this challenge more effectively, with the ultimate aims of fostering the emergence of more productive farming systems, the conservation of soil, water and forest resources, and the alleviation of poverty;
- to exchange information on what each participating center could offer (and what each center felt that it needed) in the way of technologies, information and analysis, and research methods, in order to meet this challenge more efficiently;
- to forge specific agreements for inter-center collaboration; and
- to examine these agreements in relation to one another in order to define collaborative research themes.

The Trujillo meeting complemented priority-setting workshops with national program and other partners, and bilateral discussions concerning specific collaborative activities, by focusing on the processes of institutional collaboration of international and regional centers in an ecoregion. Participants were seeking to improve their own research by clarifying the processes of collaboration. In addition, it was recognized that colleagues in national programs, NGOs, donors and research managers would appreciate greater clarity in these mechanisms.

At the conclusion of the meeting, it was decided to prepare a memoria to provide collaborators, donors and other colleagues with information, in one document, on each of the Central American projects of the institutions participating in the working group. The project outlines constitute Section I.

Sections II and III are outcomes of the meetings held in March. Each project listed offers to collaborate --including activities that were being done or could be done collaboratively, and specific outputs that would be available. Conversely, each project listed inputs and support activities that would enhance its own effectiveness were other projects able to provide them. The "supply" of and "demand" for activities were then matched and grouped thematically. A matrix was constructed of activities linking institutions and themes, and is presented in Section II.

Some of the matrix elements represented activities already underway. In other cases, new areas of collaboration were identified. Many of these were negotiated during the Trujillo meeting, or arrangements were made to work out collaborative agreements in due course.

The themes around which the activities were organized in the matrix formed the bases for selected multi-institutional working groups. Each working group set its own agenda for discussion. The notes of these working groups appear in Section III.

A summary of the meeting appears in an appendix.

Although methods associated with participatory planning were used, this was not a priority-setting exercise. Most of the projects or institutions have other fora for setting priorities in collaboration with national scientists in the context of the agenda of the respective institutions. The matrix does provide a concrete view of how activities in the projects are related. It could be used as one step in the process of setting regional priorities.

We found this approach an effective one for describing research complementarities and a useful one for identifying opportunities for collaboration. Transactions costs were low, and results were concrete and immediate. Perhaps as important, goodwill, indispensable in effective collaboration, was engendered. The memoria has been prepared not only to make the results available, but also to illustrate a workable approach to inter-institutional collaboration. In our view, existing agreements with national programs, regional institutions and international institutions will be strengthened by this working consortium of scientists involved in Central America.

We welcome comments on and inquiries about the projects or the working group.

SECTION I

PROJECT OUTLINES

CATIE

Institution: CATIE, Turrialba, Costa Rica

Project leaders: Carlos Rivas P.[1] and Jorge Faustino[2]

Project title: Watershed management area of the RENARM (USAID) project.

Brief description of project objectives:

To reduce farm level soil erosion associated with inappropriate agricultural practices and to increase crop productivity and standards of living among small, subsistence, hillside farmers in Central America.

Basic working hypotheses and methodology:

Hillside farmers can reduce farm level soil erosion, and increase crop productivity through the:

- design and implementation (with national institutions) of demonstrative extension and training projects at both the farm and watershed level;

- training of extension agents and other natural resource professionals through short courses in the fields of: watershed management, extension, soil conservation, geographic information systems, and economic analyses (800 students in 40 courses between 1990 and 1995);

- the training of regional professionals through the Watershed Management M.Sc. program at CATIE (40 M.Sc. students between 1990-1995); and

- on-demand technical advice and training for a variety of resource management problems/projects throughout the Central America region.

Actual work sites (Primary Demonstrative Projects):

Río Los Canas, El Salvador
Río Nueve Pozas y Cerro Colopeca, Honduras
Cuenca Alta del Río Virilla, Costa Rica
Cuenca del Río Turrialba, Costa Rica
Cuenca del Río Purires, Costa Rica

---

[1] 1991 to 1994

[2] 1994 to present

Cuenca Alta del Río Caldera, Panamá
Cuenca del Río Itzapa, Guatemala
Proyecto Costanero del Lago de Managua, Nicaragua

Project documents (sample list):

- La Rehabilitación de Cuencas como Estrategia para el Desarrollo Sostenible
- Conservación de Suelos y Aguas: a) Prácticas Agronómicas y Culturales y
  b) Prácticas Mecánicas y Estructurales
- State of the Arte Methodological Packages for Planning & Implementation of Natural Resource Conservation Projects for Rural Development...

Expertise available:

- Soil conservation
- Extension methodology
- Watershed rehabilitation
- Geographic information systems
- Hydrology
- Meteorology
- Economic analyses

CIAT-LADERAS

Institution : Centro Internacional de Agricultura Tropical (CIAT)

Project title: Improving agricultural sustainability and livelihoods in the Central American hillsides

Project objectives:

- to provide hillsides farmers with technical and institutional innovations that will enable them to improve agricultural productivity and conserve natural resources; .

- to identify production and conservation problems that could be addressed effectively by strategic and basic research;

- to provide national research programs, and non-governmental and community organizations, with a greater repertoire of technological options, and methods for adapting improved technologies to local environments; and

- to provide policy-markers with information on the links between the policy environment, choices of technical components and institutional mechanisms, and the consequences for agricultural productivity and natural resource conservation.

Approach:

In treating the "hillsides of Central America" as an entity, it is assumed that there are features, and processes underlying agricultural production and change, that are common throughout the region, and distinguish it from others. One of the first tasks of the project is to specify those features and processes driving agricultural production and natural resource management. This provides the conceptual framework for a review of the literature, and a review of activities related to agricultural production, natural resource conservation and rural development that have been undertaken in the region.

For purposes of identifying appropriate technology types and priority research needs, and for extrapolating research results, hillside production systems within the region will be defined and characterized. Tentatively, characterization will be based on (a) descriptors of agricultural productivity and quality of the natural resource base; (b) forces driving system change, and (c) the strategies households have devised to respond to changing circumstances. This will enable us to identify where additional research is needed on current agricultural practices and rates of resource augmentation or degradation; and on the bio-physical and socio-economic processes underlying agricultural system change. Research on improved technologies will take into account existing household strategies.

These processes of research planning and design will be carried out in consultation with national scientists and organizations in the field, as well as through direct surveys of producers.

Methods:

- Participatory planning with local and national institutions
- Literature and data reviews
- Development and integration of geo-referenced databases*
- Land-use and socio-economic* field surveys
- Experiments in selected watersheds
- Participatory evaluation of technological components and institutions

* includes methods development

Schedule of activities:

Duration : 2 years[1]

Initial date: 1 October 1994

Activities: **October 1994 - April 1995**

- Initiative planning with local institutions in research sites
- Reviews and syntheses of literature on hillsides agriculture and natural resource conservation in Central America;
- Refinement of hypotheses
- Initiate database development using GIS at regional, national and local levels
- Field surveys of production systems and resource management practices in Central America hillsides

April 1995 - October 1996

- Continue database development
- Detailed agronomic and economic case studies on agricultural production technologies, conservation practices, institutional aspects of resource allocation, and resource improvement and degradation
- Implement field trials of experimental components and components combinations
- Identify medium-term (five-year) and long-term strategic research requirements

Locations:

Research activities are being developed at three scales:

[1] Initial funding is for two years, including identification of strategic research needs for a continuation of five years.

Regional (Central America);
National (Honduras and Nicaragua); and
Smaller watershed within sites (La Ceiba, Yorito and Danlí [Honduras], and Estelí and Matagalpa [Nicaragua])

Project documents:

Improving agricultural sustainability and livelihoods in the Central America Hillsides: A proposal for the Swiss Development Cooperation (SDC). November 1994. Cali, Colombia: Centro Internacional de Agricultura Tropical (CIAT).

Funding: SDC, CIAT, CIMMYT
Post Base: Tegucigalpa, Honduras
International Staff at Post: Hector J. Barreto, Karen Ann Dvorak, Charlotte G. Burpee
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across Hotel Honduras Maya, Colonia Palmira, Tegucigalpa

Expertise available and home base:

Soil scientist, Ph.D., Tegucigalpa, Honduras
Agronomist, M.S., La Ceiba, Honduras
* Agronomist, M.S., Nicaragua
Agricultural Economist, Ph.D., Tegucigalpa, Honduras
Agricultural Economist, M.S., Tegucigalpa, Honduras
* Agricultural Economist, M.S., Nicaragua
Soil Biologist, Ph.D., Tegucigalpa, Honduras
Administrative Assistant, Tegucigalpa, Honduras
Secretary, Tegucigalpa, Honduras
** Rural Sociologist, Ph.D., Cali, Colombia (15%)
Soil Scientist, Ph.D., Cali, Colombia (20%)

* Positions not yet filled.
** Vacant from march 1995.

CIAT/TFP

Institution : Centro Internacional de Agricultura Tropical (CIAT)

Project title: Tropical Forage Program (TFP)

Project Leader: Peter C. Kerridge; Pedro J. Argel, TFP and RIEPT (Pasture Network) Regional Coordinator for Mexico, Central America and the Caribbean (MCAC), San José, Costa Rica

Brief description of program objectives:

To develop forage components for farming systems on acid and moderately acid infertile soils of humid and sub-humid tropics which will contribute to:

- increased and more efficient meat and milk production;
- soil improvement; and
- erosion control and weed control.

TFP Projects:

Project areas:

I Forage diversity
Enhanced genetic resources of tropical forages

II Forage improvement
Genetic enhancement of Brachiaria
Improved forage Arachis gene pools
Stylosanthes cultivars with anthracnose resistance and good persistence

III Forage for acid soils
Forage ecotypes with high feed quality
Adaptive attributes of forage to acid soils
Forage components of known performance in production systems

Forages as crops for farming systems

Introduced or improved grasses and legumes have advantages over naturally occurring grasses and legumes in many situations, analogous to improved crop varieties. Likewise to obtain the full benefit from them some management input is required. There is a need for farmers, who often think of forage as something that is natural and free, to come to appreciate this. Education is an important part of the technology transfer process. This

applies particularly to legumes, which can have multiple benefits in farming systems - as a source of high protein food, as ground covers to prevent erosion and as soil improvers through fixation of atmospheric nitrogen.

Examples of prototype forage based farming systems

- Forest Margins
- Savannas
- Hillsides. Forages can be used for multiple purposes - as pasture, fodder, living fodder reserves, erosion barriers and soil covers. Because of the variability of the hillsides with respect to soil, climate and land use it is most important to involve local farmers in the development process to ensure relevance and acceptability.

Systems under development:

(i) Ground covers for coffee and other crops. *Arachis pintoi* has proved to be suitable and is being used by some farmers; for sowing under cassava, a less competitive species. *Chamaecrista rotundifolia* is being evaluated.

(ii) Permanent pastures. In the more humid areas, *Arachis*-grass pastures are persistent and productive. In the drier areas, some of the Brachiaria have proved to be persistent and to stabilize the slopes but legumes, suitable for very heavy grazing have not been identified yet.

(iii) Fodders. Several grasses have been identified for multiple use as fodders and barriers. A potential legume, *Cratylia* argentea, that is well adapted to acid infertile soils, is being evaluated for use in erosion barriers and as fodder reserve for the dry season.

(iv) Fallow improvement. Legumes that will supplement the feed value of volunteer fallow and improve soil fertility are being evaluated. There is tremendous potential in increasing overall productivity and sustainability in the hillside system.

The basis of this systems is the identification of species adapted to soil and climate and acceptable to farmers.

Location:

Research activities are being developed at three contrasting sites in Costa Rica and through RIEPT-MCAC regional collaborators.

Present Activities of the TFP in Costa Rica

Activity	Present Status
Evaluation of *Arachis* collection	19 accessions established in Atenas
Evaluation of *Chamaecrista rotundifolia* collection	17 accessions established in Atenas
Evaluation of shrubs (*Calliandra, Cratylia and D. velutinum*)	Evaluation continues in both San Isidro and Atenas
Seed multiplication activities	Activities continue in Atenas
Evaluation of P. *maximum* germplasm	Continues in San Isidro
Evaluation of *Brachiaria spp* germplasm	Ended in 1994
Initiate evaluation of 3 accessions of A. pinto/under grazing*	Plots established and grazing started
Evaluation of *Gliricidia sepium* germplasm	Continues in San Isidro
Evaluation of *B. brizantha* and *A. pintoi* under grazing	Ended in 1994 in Guápiles
Evaluation of *Brachiaria spp* soil moisture tolerance	Continues for one more dry season in Guápiles
Plant and seed survival of *A. pintoi*	Ended in 1994 in Guápiles
Finalize mob grazing evaluation of macroplots of *Brachiaria spp*	Ended in 1994 in Guápiles
Reclamation of degraded pasture areas of the Río Picagres watershed**	Pastures established. Grazing started in Puriscal

* Join project with MAG
** Join project with UCR

CIMMYT

Institution name: International Maize and Wheat Improvement Center (CIMMYT)

Project title: Identification of the main factors that influence farmer adoption of productivity-enhancing, resource-conserving (PERC) technologies

Project leader: Gustavo Sain

Brief description of project objective: To uncover the factors that govern farmers' adoption decisions and to identify implications for research, extension and policy.

Basic working hypotheses and methodology:
The CEP, the PRM and the RCSE already have initiated a series of adoption studies in specific regions and cropping systems where PERC technologies have been adopted by farmers. The table below summarizes the current status of these studies. The usefulness of these studies will be extended by organizing regional workshops to synthesize their findings and communicate them to appropriate scientists in NARS and to policy makers.

Locations	Type of technology	Current status
1. San Andrés, Panamá	Zero tillage; residue management; improved variety; spatial arrangement-plant density; fertilization; wood control	Data collection completed
2. Azuero, Panamá	Zero - minimum tillage	Data collection completed
3. Region II, Nicaragua	Improved (stunt resistant) maize varieties	Data collection completed
4. Atlantic coast,Honduras	Legume (Mucuna) in rotation with maize	Data collection, and analysis completed; publication of results in process
5. Atlantic coast, Honduras	Legume (Mucuna) in rotation with maize	Data collection not yet initiated
6. Weat region, El Salvador	Zero tillage; residue management	Data collection completed; analysis partially completed
7. North east region, El Salvador	Improved (drought tolerant) maize varieties	Data collection not yet initiated
8. Southwest region, Guatemala	Improved maize varieties	Data collection and analysis completed
9. South pacific region, Guatemala	Improved (hybrids) maize varieties	Data collection not yet initiated

Duration and time schedule of project:

Duration: 6 years
Initial date: January 1992

Institution Name: International Maize and Wheat Improvement Center (CIMMYT)

Project title: Economic analysis of incorporating PERC technologies into different maize-based cropping systems

Project leader: Gustavo Sain, Larry Harrington

Brief description of project objectives: To develop and to test a model of farmers' decision to evaluate the cost and benefits of incorporating PERC technologies into different maize-based cropping systems.

Basic working hypotheses and methodology:

Information will be obtained on the costs and benefits of PERC technologies at the farm level. The farm level of analysis is chosen since farms are the primary units where decisions about adoption are made. To achieve this result it is necessary to develop a methodology for: 1) measuring the impacts of soil erosion/conservation in crop system productivity (yields); and 2) measuring the economic (opportunity) costs of introducing the new technology into the farming system. This second point is important in areas characterized by intensive land use system and a strong interaction between the new technology and other component of the farming system.

The CEP and the PRM have been working with two main PERC technologies -conservation tillage (residue management) and legume green manure- in three main maize based cropping systems: maize-sorghum in relay cropping; maize-beans in relay cropping and maize-other crop in rotation. This result will complement and strengthen the PRM efforts through the development and field test of a methodology that allows the evaluation of the costs/benefits of incorporating these technologies within these specific cropping systems.

Duration and time schedule of project:

Duration : 4 years
Initial date: January 1994

Institution name: International Maize and Wheat Improvement Center (CIMMYT)

Project title: Targeted policy workshops and policy change

Project leader: Gustavo Sain

Brief description of project objective: To develop a set of policy guidelines for facilitating farmers' adoption of PERC technologies in specific maize-based cropping systems

Basic working hypotheses and methodology: Targeted policy workshops (TPW) will be organized to foster debate among national, regional and local stakeholders (including farmers' organizations and NGOs) on specific problems in defined areas. These workshops will build on the results of the adoption studies and economic analysis produced in our complementary projects, as well as our links with other institutions working in the area.

The workshops will complement work undertaken by several international and regional institutions on natural resource policy issues in Central America.

Duration and time schedule of project:

Duration: 4 years
Initial date: January 1994

CIMMYT/PRM

Institution: Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT)

Project: Programa Regional de Maíz para Centro América y el Caribe (PRM)

Project Coordinators: Jorge Bolaños, CIMMYT, Guatemala
Gustavo Saín, CIMMYT, Costa Rica
Róger Urbina, PRM, INTA-Nicaragua

Main objectives:

The objective of the PRM is to increase the sustainable productivity of the principal maize production systems found in the region through the development, and validation of alternative technologies.

The specific objectives are the following:

- **Develop maize germplasm** through recurrent selection or hybridization to perform well agronomically, and tolerate the region's main biotic and abiotic stresses.
- **Develop and validate agronomic management** technologies that increase maize productivity while maintaining the productive capacity of the resource base (soil, water, nutriments). The activities concentrate on: the evaluation of elite germplasm of the PRM, the use/validity of simulation models, the insertion of cover crops, management of crop residues, and the efficient use of fertilizers, especially nitrogen, in the most important maize production systems found in the region.
- **Socioeconomic evaluation of existing alternative technologies.** This project contemplates ex-ante studies focused on the profitability of alternative technologies, and ex-post studies of adoption and impact.
- **Training.** The PRM organizes and conducts courses, workshops, and seminars at a regional and national level, stressing the active participation of the PRM's participants.
- **Collaboration with groups affiliated with PRM.** This project attempts to promote effective collaboration between the PRM and other affiliated groups in the region. It works closely with non-governmental organizations with an effective capacity to validate promising results.
- **PRM management.** In this area, the elements of efficient management of PRM are stressed, as well as the institutionalization of the group, the Regional Coordination Office, and the actual organization of the PRM.

The PRM has focused its research on the development of prototype technologies with solid scientific criteria and wide adaptability that maintain a certain plasticity to adjust to a varied range of maize production systems. The PRM's regional experiments have common treatments of regional interest, permitting the development of recommendations in a relatively short time because of the access to a diverse range of environments. The research

is undertaken through collaborative experiments with lead institutions, co-leaders and participants.

Duration of Project: 4 years

Beginning Date: January 1, 1995

Project Area: Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panamá, Haití, República Dominicana and Cuba (PRM member countries)

Financing: SDC, CIMMYT

Regional Offices: Guatemala, Costa Rica (CIMMYT)

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FAX 502-2-353407	506-229-2457
TEL 502-2-353418 - 353428	506-229-2457

Project Documents:

Annual Operating Plan 1994
Strategic Planning Workshop 1992-1994
Phase Operating Plan 1995-1998

Personnel Assigned to Project:

- Agronomist Physiologist, Ph.D., Guatemala
- Agricultural Economist, Ph.D., Costa Rica
- Plantbreeder, M.S., Nicaragua
- Administrative Assistant, Guatemala
- Computer Assistant, Guatemala
- Agricultural Economist, Ph.D., Guatemala (2 years of Postdoctorate, position still vacant)
- Counterparts in 9 National Programs which constitute the PRM, including plantbreeders, agronomists, soil scientist, agricultural economists.

EAP

Institution name: Escuela Agrícola Panamericana (EAP)

Program title: Work on hillsides in semi-dry regions of Central America (a research/extension program of work conducted by several departments)

Program leader: Ricardo Radulovich

Brief description of program objectives:

- Promote socioeconomic development and resource conservation in hillsides, combining bottom-up and top-down approaches; and

- establish a model ecosystem for training and research in the area surrounding the institution (Yeguare Valley, Honduras)

Specific objectives:

- Validate (through impact) an experimental extension system operating in the Yeguare Valley;

- attempt to establish equilibrium between forest, soil and water management and agriculture-based economic needs of rural dwellers;

- promote the widespread adoption of integrated pest management techniques; and

- promote community economic development through value-added and marketing approaches.

Basic working hypotheses and methodology:

The program is based on the fact that much information already exists that can be put to use, and the main problem is how to do that. Also, specific research problems can be addressed within the technology transfer/development process.

Thus, extension, training and technical assistance are the main focus of the program, both as tools and as research topics.

Duration and time schedule of the program:

This is an on-going institutional program, and has no time limit. Some components are projects that operate within time limits, such as the hillside IPM project throughout

Honduras, the Nicaragua IPM project, and the watershed management project in Lempira, Honduras (all three through 1997). Components that receive institutional support are those that operate in the Yeguare Valley: experimental extension system of the Dept. of Rural Development, the watershed and forest management projects, and the model ecosystem project (for the latter, however, Zamorano is in the process of securing funds to accelerate its implementation at a larger scale).

Expertise available: At present, approximately 20 faculty and 20 extensionists are involved in the program.

IFPRI

Institution name: International Food Policy Research Institute (IFPRI)

Project title: Policies analysis for sustainable development of the Central American Hillsides

Project leader: Sara J. Scherr

Brief description of project objectives:

a. Examine the modalities of hillside resource management as practiced by communities and smallholders, in order to understand patterns of resource degradation/improvement; and how these are affected by agricultural policies.

b. Evaluate alternate policy strategies for improving rural livelihoods while conserving and enriching the resource base in hillside environments.

c. Strengthen local research capacity to improve the design of agricultural and forest policies in hillside environments.

Basic working hypotheses and methodology:

The study is premised on two general hypothesis:

1. Small farmers respond dynamically and endogenously over time to increasing pressures on natural resources, through investments in their resource base and through organizational innovations.

2. Natural resource policies will be most effective where they build upon farmers' existing response patterns, by providing a supportive environment for farmer investment and for institutional innovation.

The methodology used is a two-step (inductive/deductive) approach, relying mainly on participatory approaches for the inductive part, and on economic analysis and modeling for the deductive part.

Duration and time schedule of project:

Duration: 5 years in total
Initial date: January 1st. 1994
Timeframe:
Year 1: methodology development
Year 2: implementation and validation of methodology
Year 3-4: replication in large number of sites
Year 5: development and implementation of projected output.

Project work sites:

Year 1:	Hillsides in Central Honduras
Year 2-3:	Hillsides in Honduras, Guatemala, El Salvador
Year 4-5:	Hillsides in Honduras, Guatemala, El Salvador

Project documents:

1. Scherr, Sara J. and Peter B. Hazell, 1994. Sustainable Agricultural Development Strategies in Fragile Lands. EPTD Discussion paper no. 1. Washington, D.C.; IFPRI.

2. Sara J. Scherr, Bergeron Gilles and Miguel López Pereira, 1994. Towards a Methodology for Policy Research on Natural Resource Management in the Central American Hillsides.

3. Bergeron Gilles. Sara J. Scherr and Miguel López Pereira. CMR Methodology Paper.

Expertise available:
3 agricultural economists (2 with Ph.D., 1 with M.A.), Honduras/USA
1 rural sociologist (Ph.D.), Guatemala
1 agronomist; (Ph.D.), Honduras
1 anthropologist (M.A.), Honduras
1 administrative assistant (B.A.), Honduras

IICA

Name of Institution: Instituto Interamericano de Cooperación para la Agricultura (IICA)

Name of project: Institutional Development for Sustainable Agricultural Production in the Central American Hillsides

Leader: Byron Miranda, San Salvador office

Brief Description of the Project:

This project has available $1.6 m to decrease deforestation and erosion, and promote agricultural sustainability in the Central America hillsides. The project will seek to develop consensus across the wide variety of agencies and national and international organizations involved in these problems and their solutions. Activities will be concentrated in four microwatersheds to generate experiences for use in other locations.

This project combines activities at three levels: regional (Central America), national (Honduras and El Salvador) and local (four watersheds). The watersheds will be in Honduras and El Salvador.

This project is financed through a donation from the Government of the Netherlands for three years. It will be administered by IICA. Project activities were initiated in March 1995.

The Problem

Deforestation and erosion in the Central American hillsides are having dramatic consequences on the well-being of the rural population, and on the users of the water which originates in the hillsides. To solve these problems new policies are required, as well as new institutional frameworks, and organizational and technological mechanisms. The majority of the strategies to reduce erosion and deforestation have been concentrated either on policy dialogue at the elite level with limited participation of agricultural organizations, NGOs, rural development projects, and municipal governments; or have been limited to intervention at the local level where policies and various institutions are taken at face value.

An integrated approach that conbines interventions at the macro and micro levels is necessary, as well as the participation of an ample array of institutional actors.

Given that the relevant environmental objectives cannot be identified without a focus on rural life, these activities should be undertaken with a wide perspective on rural development.

Project Goal

Improve the security of well-being of hillside farmers in Central America, by securing the sustainability of the natural resource base while satisfying the needs of water consumption for the urban populations.

Project objective

Assist in developing policies, working institutional frameworks, organizational mechanisms and training of human resource in order to promote a sustainable use of the soil in the Central American hillsides.

Results

The project's main results include:

- obtain consensus between key actors (public sector, NGOs, international agencies, unions, and communities) with respect to the causes of erosion and deforestation in the hillsides of Central America, and its possible solutions;

- organizations with analytical capacity, participatory methods, adequate interinstitutional coordination, and effective lending of services;

- policy guides and institutional innovations designed to contribute to sustainable development at the national and local levels;

- trained personnel: policymakers, institutional leaders, technicians and farmers; and

- implementation of territorial planning in selected watersheds in El Salvador and Honduras.

Activities

The project combines and integrates five principal activities:

- regional seminars related to policies and action plans influencing deforestation and erosion in the Central American hillsides;

- national workshops to discuss experiences which promote sustainable agricultural practices;

- training events at the national and watershed levels;

- technical assistance to solve problems which impede the coordination and lending of interinstitutional services, and proposals of possible solutions; and

- a pilot agroecological zoning activity.

Beneficiaries

The beneficiaries in the long run are hillside farmers with limited resources, and water users. Initially, improved land use with sustainable systems and agricultural practices, and, ultimately, lower water and energy costs and better quality water will enable beneficiaries to improve their well-being without land degradation.

The immediate beneficiaries will be personnel of public sector agencies, NGOs, local governments, farmers' organizations, and universities participating in project activities, and receiving training.

Project organization

Administration

The executing agency for the project is IICA, which will be responsible for reporting technical progress and program financing to the donor. The project will be coordinated full-time by an internal specialist of the Generation and Transfer of Technology Program. The project's head office will be located in the IICA office San Salvador, El Salvador. The staff will consist of a full-time national professional, responsible for training, located in Honduras, and a national professional in each of the selected countries who will be in charge of carrying out the pilot programs in the watersheds.

Institutional collaboration

The essence of this project is to bring together a varied group of national and local agencies of the public sector, NGOs, universities and farmer organizations to work conjuctively with IICA at the regional, national and watershed level, with the purpose of identifying and discussing alternative, appropriate policies, and institutional innovations which can effectively reduce the erosion, deforestation, and improve the well-being of the rural population.

IICA activities will be undertaken in coordination with a working group integrating CIAT, IFPRI, CATIE. All policy decisions will be made jointly with these institutions, and with representatives from public organizations, non-governmental, and with farmer organizations in El Salvador and Honduras.

Length of project:

September 1994 to September 1997.

Personnel assigned to project:

The project will consist of a director, a person responsible for training, and two professionals who will be working in the watersheds. It will receive support from a person in San José with some expertise in policies and other institutional issues.

PASOLAC

Institution name: INTERCOOPERATION/ SDC

Project title: Programa para la agricultura sostenible en laderas de América Central

Project leader: Adrian Maitre

Brief description of project objectives:

To contribute to the diffusion of appropriate soil use practices in the Central American hillsides, by supporting activities of national and local institutions in the fields of technology validation, extension, training of technical staff, training of farmers (especially promoters), interinstitutional exchange on different levels (technical collaboration, seminars,etc.) and monitoring and evaluation, PASOLAC acts as a second level program, giving some financial support to national or local institutions and providing them at the same time with technical and methodological assistance.

Basic working hypotheses and methodology:

The productivity of the soils in hillsides areas is declining. This process is caused by three principal factors, as defined during the planning workshop of PASOLAC held in 1993: (1) Land of high risk is used for agricultural production due to increasing population pressure and other factors; (2) where an agricultural land use is in principle possible, inappropriate techniques of soil preparation, sowing, etc. are applied; (3) the decision makers in the small farm production systems do not/ are not able to invest in soil conservation and soil fertility maintenance. (The planning workshop document gives more details about the analysis.)

Still according to the same planning document, farmers are not able to address the issues of soil and water conservation alone because their capacity to generate new local practices cannot handle the situation of urgency. On the other hand, the conventional system of research and extension as well as the general agricultural support system have not had a significant impact in removing the three principal causes. PASOLAC concentrates its efforts in improving the identification and the diffusion of appropriate soil use techniques, trying by this way to reduce the effects of cause (2).

As PASOLAC is not a research project - there are important initiatives in this respect by better endowed institutions - and as there are already many institutions involved in transfer and training in the field of sustainable soil and water management on local and national levels on the other hand, PASOLAC is organized in a network way as a second-level organization whose principal aim it is to support and to integrate relevant activities of important actors also relying thereby on the results of regional research networks or projects.

Duration and time schedule of project:

Duration:	12 - 15 years
Initial date:	July of 1992
Timeframe:	First ordinary period 1994-1996, concentrated in Nicaragua with some activities in Honduras and El Salvador. From 1997 onwards PASOLAC will work as a regional program in the 3 countries.

Project work sites:

Nicaragua: the whole central part of the country, where ever hillsides can be found; Honduras and El Salvador: has yet to be defined.

Project documents:

PASOLAC. INTERCOOPERATION. COSUDE. Informe de la misión de preplanificación. Berna, 1991.
PASOLAC. Plan operativo de fase (1994-1996). Managua, 1993.
PASOLAC. Zonificación geográfica del área de impacto de PASOLAC, para apoyo de actividades a nivel local. Managua, 1993.
PASOLAC. Inventario de técnicas de conservación de suelos y agua. Managua, 1993.
Miranda, Byron y Ulloa, Socorro. Transferencia de tecnología para el desarrollo rural. PASOLAC. Managua, 1994.
Obando, Miguel y Maitre, Adrian. La función de la validación en el Programa para la Agricultura Sostenible en Laderas de América Central (PASOLAC). Managua, 1995.
PASOLAC, Plan operativo anual (1995). Managua, 1995.

Expertise available:

5 Agronomists (including one international staff, the national coordinator, the head of extension, and the representatives in Honduras and El Salvador)
1 Anthropologist (project leader)
1 Economist
1 Training specialist
1 Administrative assistant

SECCION II

ACTIVITIES MATRIX

Second plenary session, Trujillo meetings: Identification of activities with potential for inter-institutional collaboration

TOPIC INSTITUTION	LITERATURE and REVIEWS	GIS and DATABASES	CHARACTERIZATION AND TYPOLOGIES	SITES
CATIE		Data, models, equipment, training (watershed level) *GIS data*		Case studies: El Salvador, Honduras, Costa Rica Rehabilitation watersheds
PASOLAC	Collection of documents on soil conservation in Central America			Hillsides in Nicaragua; some in Honduras and El Salvador
PRM		*Databases* *GIS* *Models*		Access to many environments
CIMMYT		Incidence of major problems, context	Problem definition: what, where, why, how fast, consequences	S Mexico & Central America (9 countries)
CIAT-LADERAS		Farming systems coverage *Farming systems data* Hon/Nic data collection 1:50,000 *Natl coverages Nic, Costa Rica, ElSal, Guat, Panama, Belize* *Methods: linking databases*	Building typologies Characterizing system change *Lowland-hillside-highland interactions* *Characterizing system change* *Selecting typology variables* *Social science methods of spatial analysis*	LaCeiba, Yoro and Danli, Honduras Estelí and Matagalpa, Nicaragua Regional sondeo
CIAT-PASTOS			*Define niches for forages in farming systems*	
PROFRIJOL		*Databases*	*Characterize system-limiting factors*	Access to network of technology transfer environments
IFPRI	Hillside policy (international & Honduras) *Review/analysis of adoption studies*	*Databases for 1:50,000 GIS*	Community resource mapping Landscape change *Zonation for site selection and monitoring* *Spatial analysis of improvement/ degradation*	Sites of collaborative research on hillsides Honduras: East of Tegucigalpa, Cajon, West Guatemala, El Salvador *Cooperation in strategic sites*
EAP		Develop regional agricultural maps		Honduras, Nicaragua, ElSalv (< sub humid) Structuring model agro-ecosystem at Zamorano *Model agroecosystem project collaborators*
IICA			*Participatory methods/results to use in watersheds*	Collaborate in specific watersheds Joint planning activities

Regular typeface indicates institutional resources available to collaborators. Italic typeface indicates activities for which institutions are seeking collaborative support.

TOPIC INSTITUTION	GERMPLASM	STRATEGIC AGRONOMIC RESEARCH	PROTOTYPE TRIALS	WATERSHED MODELING
CATIE				Watershed modelling and land use planning
PASOLAC			Validate/transfer technologies Feedback on technology performance	
PRM	Maize Germplasm *Germplasm from other gene banks*	SAR maize-based systems *SAR in maize-bean systems* *IPM* *Postharvest*	Prototype technologies Feasibility of technology *Validation extension*	
CIMMYT				
CIAT-LADERAS				
CIAT-PASTOS	Forage germplasm adapted to production systems Seed technology for elite forage germplasm Database: multilocational performance on forages		Methodology for forage evaluation Development testing of prototype technologies (proc.)	*Joint projects on sustainable feeding systems for ruminant livestock systems on hillsides*
PROFRIJOL	Bean varieties (adaptation ; biotic /abiotic stress)	*SAR in maize-bean systems* *IPM*	BNF expertise Inoculants Low P management	
IFPRI				Watershed modelling for policy analysis *Input to develop watershed models*
EAP		IMP Storage Production (grains, animals)		Forest and watershed management
ICA				

Regular typeface indicates institutional resources available to collaborators. Italic typeface indicates activities for which institutions are seeking collaborative support.

TOPIC	INDICATORS	ADOPTION STUDIES	LOCAL ORGANIZATION	POLICY WORKSHOPS
INSTITUTION				
CATIE				
PASOLAC		Adoption studies with emphasis on soil conservation and incentives *Adoption studies*	Identify opportunities for intervention; Knowledge about local/national institutions	
PRM	Data/analysis impact on sustainability by PERC technologies	Factors effecting adoption of cropping systems; factors affecting adoption of types of technologies *Collaboration on adoption studies*		Targeted policy workshop *Collaboration on targeted policy workshop* *Building policy case studies*
CIMMYT				
CIAT-LADERAS		Technology introduction and system change Information and system change Forces for change and technological change Forces for change and institutional change *Collaboration and adoption case studies*	*Strengthening links with local groups*	
CIAT-PASTOS		Joint studies forage technology adoption		
PROFRIJOL		*Collaboration in adoption studies*	*Strengthening links with local groups*	
IFPRI	*Indicators of sustainability* *Indicators of system wealth*	Multi-site research : patterns of resource use (by pop density, market access, ecozone)-link welfare, income and environment Sources of change: technology, economic environment, policy, institutional environment Household surveys and models	Policies effecting local organizations in NRM Policies on local organization research collaboration	Policy research network support *Input in policy dialogues* DSE conference Honduras hillside policy workshop
EAP			Training and extension	Policy research and training
IICA	Indicators of sustainability		Identify counterparts for training, research activities	Access to ministers for presenting results Studies synthesizing institutional experiences and policy issues

Regular typeface indicates institutional resources available to collaborators. Italic typeface indicates activities for which institutions are seeking collaborative support.

TOPIC INSTITUTION	IMPACT	TRAINING	NETWORK SUPPORT	INFORMATION, OUTREACH AND PUBLICATIONS
CATIE		MSc program, short courses *Students for MSc program, short courses, workshops*		Data information/exchange: Internet site, library, GIS *Adoption research results*
PASOLAC	*Indicators to monitor project progress*	Training for member institutions (inputs from research networks)	Network of hillsides groups in Nicaragua, El Salvador and Honduras	Diffusion of information *Research results technologies* *Research results socioeconomic studies*
PRM	Impacts on specific areas *Building case studies* *Training social scientists (RSCE)*	Training courses *Training Social Science* *Course on green manures and modeling*		Information and analysis *Co-publication of research and results*
CIMMYT			RED Centro America de Socioeconomia Programa Regional de Maiz (PRM)	
CIAT-LADERAS	*Rural welfare indicators*	Forage technology		
CIAT-PASTOS			Central American and Caribbean forage network RIEPT-MCAC *Integration of crop & forage livestock networks*	Information systems on forages
PROFRIJOL		*Extension, proto-technologies*		Extension training *Adoption research results*
IFPRI	Sentinel site monitoring Ex-ante effects of policy	Community mapping of resources Policy analysis and research *Technical evaluation of forest, water, pasture management* Training materials for policy research	Support of networks and individuals in policy analysis research	
EAP	Extension work	Forest and watershed mgmt Value added and markets Extension		
IICA		Organize seminars/training events *Research results to present in events*		

Regular typeface indicates institutional resources available to collaborators. Italic typeface indicates activities for which institutions are seeking collaborative support.

SECTION III

WORKING GROUPS

TOWARDS A DEFINITION OF HILLSIDES[1]

Why do research in hillsides?

The task group began with examining why research in hillsides is needed. Several rationales can be put forward to justify this endeavor. Each one however relates specifically to one of the two main research clients of this effort, namely those who live with on-site consequences of hillside resource use (hillside dwellers themselves) and those who live with the off-site consequences (the state and the wider society). When looking at the latter, the research problems that take precedence generally have to do with watershed management issues (dam siltation, climatic change, water recharge, etc.). When looking at the local level, equity issues among hillsides populations generally emerge, as hillside dwellers often stand amongst the poorest, most marginalized groups in society.

The problems of the two groups are obviously related: in particular, off-site clients have a compelling interest in seeing on-site problems resolved. However, the technological and socio-economic solutions to the complex problems of hillside management are not well developed at present. The heterogeneous conditions found under hillsides require flexible and adaptable socio-technical systems, and resource-poor farmers are ill-equipped to develop these beyond what they already have. Such systems are also unlikely to be developed by NARS, who presently suffer from declining research resources. IARCs may hence have to play an important role addressing these issues.

Which hillsides?

It was next noted that, in order to undertake the kind of coherent, multidisciplinary program of research required by hillsides' complexity, scholars need a good definition of their study object. In its present, popular use, the term "hillsides" is rather unspecific: it does not clearly specify when flat lands (or mountains) become hillsides; neither what type of land use might occur on hillsides, nor what the dynamics of landscape transformation may be. For scientific purposes thus, this popular referent has limited utility. To be conceptually useful, the term has to be more rigorously specified, so that it becomes an analytical category in its own right[2].

As this conceptualization emerges, some key issues have to be kept in mind. First, the heterogeneity of hillsides has to be recognized: it is unlikely that a single descriptor will ever be developed that comes to grip with the diversity found among hillside landscape. Rather than a single concept, what must be sought is a typological device that allows to distinguish between various hillside environments, in a way that provides a robust categorization (i.e. each

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[1] Gilles Bergeron, Rapporteur.

[2] To this end, hillsides have to be orthogonally defined against other landscape categories, such as alpine environments, high plateaux and savanna lowlands. Some definitions in that regard have already been proposed in the literatura (for instance that of the Defence Mapping Agency, 1978) that could be reviewed and adopted by hillsides researchers.

category can accommodate degrees of variation) and a heuristic one (each category sends back to a number of well-specified correlates).

A second key issue is that the categorization will have to be practical enough to serve the needs both of bio-physical scientists, and of socio-economic analysts. Whereas a bio-physical categorization would certainly include aspects such as topography, altitude, hydrology, climate and vegetative cover, a social definition of hillsides would identify the strategies and practices employed by resource users in their management of the land. For instance, it seems fundamental to distinguish between hillsides where mainly commercial crops (e.g. coffee) are produced, from others where subsistence crops (e.g. maize and beans) are produced. Not only will income patterns and tenure systems vary between these, but also organic matter formation, nutrient recycling, and erosive processes.

A third issue is that both bio-physicists and social scientists would want to include in this categorization the transformative dynamics to which hillsides are subjected: too often, our mental maps are static. Given the fluidity of change in those areas, we need to go beyond such short-term vision. To this end, the categorization should define the forces that drive change in those environments. The play of market forces, infraestructural development, urbanization, population increases, resettlement policy, and the decreasing importance of agriculture as an economic sector, are all examples of such forces, changing endlessly the nature of the pressures on resources and thus the environmental processes to which hillsides are submitted.

In summary then the ingredients of the conceptualization would ideally comprise a set of bio-physical attributes --topography, altitude, hydrology, climate, vegetative cover, etc.; a set of social attributes --resource use strategies and technological practices; and a specification of the forces of change, to accommodate the transformative dynamics of each type.

A typological approach to define hillside

A matrix typology would appear to be the logical way to go in order to obtain such a categorization. The impracticality of this option soon appears however as one considers the large number of factors that potentially induce variation among hillsides. The work of Carter and colleagues for instance, provides a vivid example of this problem. Even after restricting their discriminating criteria to the most obvious bio-physical aspects (topography, climate, rainfall and soil types), they came up with a list of 72 possible hillsides categories, out of which 47 were retained as "plausible alternatives" (Carter, 1991). Once combined with socio economic features as we are advocating here (e.g., production systems, patterns of land use, and systems dynamics), the list of possible variants becomes endless. It seems futile, under these considerations, to search for a matrix typology of hillsides that is at once finite, practical and dynamic.

An inductive variant of the matrix typology approach may help overcome the problem: rather than proceeding from an a-priori (deductive) identification of possibilities (and then assign specific hillsides to a theoretical matrix cell), one could proceed from the empirical identification of most common hillsides features based on the specification of observed cases

along three axes: bio-physical variables, socio-economic indicators and systems dynamics. This triple specification shares many features with the matrix typology approach yet it is less constraining and more useful, for it automatically eliminates improbable associations, while it allows researchers to concentrate immediately on the most frequent occurrences of particular cases. Table 1 below present some of the specifications that could go under this approach to system characterization.

Bio-physical	Socio-economic	Dynamics
Topography (steep, moderate) Altitude (high, mid, low) Soils (acidic, alkaline) Climate (maritime, continental) Rainfall (less than 1200mm/yr, 1200-2000 mm/yr, >2000 mm/yr)	Vegetative cover (% cover under basic grains, pastures, forest/permanent crops) Production systems (subsistence vs commercial) Tenure systems (ownership, rental, common property)	Urbanization rate Rural population increase rate Rural-rural migration rate (expansion of agricultural land) Rural urban migration rate (reduction of rural population) Transport infrastructure Relative importance of agriculture as an economic sector (% share of GNP)

The usefulness of the resulting typification is that each type of hillsides, corresponding to an empirical reality, will be associated with a specific cluster of dimensions (e.g. levels of infrastructure, market access, environmental dynamics, etc.) that, beyond contributing to the specification, might also preside over system changes. Based on this typology, criteria for selection of priority areas can be made, and most urgent problems can be identified for research purposes.

Issues of scale

At the empirical level, the identification of hillside categories will be established taking into account type and scale of coverage. A coverage by topography at low resolution (>1:500,000) will allow to distinguish hillside-dominated areas from mountain-and flat land-dominated areas. At high resolution (<1:10,000), it can distinguish between land use patterns, and identify the separate components of hillside systems. At high resolution, hillsides should be perceived as assembly of components (as systems) rather than as homogenous entities. A detailed view will show for instance that, along with moderately sloping areas hillside systems also encompass cliffs, small *mesetas*, flat areas inserted between sloping lands and so on. This detailed perspective will also show how patterns of resource management take advantage of the natural diversity in land features: hillsides farmers may cultivate intensively their natural terraces, while leaving sloped fields under periodic fallow, etc. The best way to approach this heterogeneous ensembles of ecological niches, is to view them as interrelated parts of a diversified system.

Issues of data availability

The integration of databases that characterize the current status of Central American hillsides is fundamental to the above program. Serious shortcomings were identified however with the quality of existing geo-referenced data. A recommendation was made to pool resources among centers in that regard (see later, GIS inter-center collaboration), and to filter the resources among centers to determine the relative quality of each source.

RESEARCH METHODS[1]

The original topic was "adoption," but the group noted that the fundamental problem was the conceptual difficulties in tackling research problems in the hillsides. The group developed a list of topics for consideration: conceptual framework, division of labor, information on adoption, collaboration, level of adoption and institutional versus technical effects.

The group used a table containing a proposed framework for a research strategy on the hillsides, developed by CIAT-Laderas, as a starting point for the discussion (see Table 1). The framework can be applied at different scales, or levels, of analysis; for example, household, village, regional, or national.

The conceptual framework is composed of four elements: a clear definition of production systems on hillsides or hillside-dominated areas; the forces that explain change, especially in resource management; the responses by different individuals or groups to these changes; and indicators of how this process results in changed resource and human condition, such as welfare, productivity, and the condition of soil, water and forest resources.

The group discussed the elements of the framework and where each individual saw their organization fitting in the framework, as well as the types of activities each was doing and their effects on hillside production systems.

It was felt that the framework was a good starting point for developing a characterization of different hillside farming or production systems in the region and elsewhere, but that it needed more elaboration in some aspects. The following needs were identified: establish causality links (or lines of causality); revise the links across columns and also what each of the different stages in the framework contains; and revise the different stages to see if there are no missing issues. For example, issues related to resource degradation, policies, institutional changes and monitoring systems seem to be missing.

Most of the discussion about the proposed framework was whether one has to start with a definition of the problem and establish causality links, or with a classification of production systems to later define problems and possible solutions. Two approaches were proposed in this regard:

1. Begin with a problem statement and not with production systems. The proposed framework is not based on problems and causes and, so, introduces confusion as to the best course of action regarding research and technology development. One needs a problem statement (the how, where, when, how serious) in order to evaluate

[1] Miguel López-Pereira, Rapporteur. Participants: G. Sain (CIMMYT), L. Harrington (CIMMYT), D. Kaimowitz (IICA), H. Feldstein (CGIAR), I. Perez (EAP), C. Lascano (CIAT-Pastures), A. Maitre (PASOLAC), K. Dvorak (CIAT-Hillsides), S. Scherr (IFPRI), Miguel López Pereira (IFPRI).

possible actions to solve the problem, the policy implications of different actions, and the best policy levers to be applied to solve the problem.

2. Begin with well-identified production systems, categorize (map) them, and identify the technology requirements for these production systems. Some of the required technologies will already be available and others will have to be developed. Then follow the process of change, responses to change, and indicators to measure adoption and impact.

The group discussed at length the pros and cons of these two alternatives as models for research, as well as other issues that needed clarification in the framework. It is necessary, it was argued, to know very well the problem we are dealing with, and what caused it before we consider any actions. On the other hand, if one wants to do systematic and coordinated research, the second alternative seems more appropriate, as it will also help identify opportunities for research for all centers and organizations; for example, those with expertise in germplasm development, and those analyzing policy alternatives. Other issues introduced in the discussion were:

The need to add policies and their link to resource management decisions by farmers was proposed.

A problem focus might be good for some institutions such as germplasm centers, but might not be adequate for broader agro-ecology, systems-oriented research centers.

Inductive versus deductive approaches to explaining problems, their causes and their alternative solutions were considered. The approach used depends on what the problem is, so it is crucial that this be defined.

The framework covers a whole range of issues which one institution alone will never be able to address. Thus it should be viewed as a general framework from which each institution or organization will identify its comparative advantage for tackling some of the issues.

Sometimes it is better to start with a fact, not with a problem, and so we need to know much more about what's going on at the farm level.

The literature on adoption is mostly on 'barriers to adoption,' but we might be asking the wrong questions about adoption.

We have products, lots of new technologies, why is there no adoption of these technologies?

How do we put the framework, or a revised version of it, into practice?

After an in-depth discussion, each institution used the framework layout to identify some areas of concentration in research[1]; for example, profitability analysis (CIMMYT); policy effects (IFPRI); institutional change (IICA); traing and extension (EAP); incentives for adoption (PASOLAC); biophysical conditions (CIAT/Pastures); production systems characterization and technical change (CIAT/hillsides).

Finally, two agreements reached in the group were that a) a bottom-up approach to technology development is needed to really get win-win technologies that farmers will be interested in adopting; and b) the proposed framework is a good starting point as an approach to performing systematic hillside research in the region, and that it needs to be modified to include the other elements mentioned in the discussion.

[1]After the group discussion, each institution revised the areas of concentration according to the proposed framework. Later, an alternative list of concentration areas was proposed. The frameworks were useful for discussing comparative approaches to research, but would need substantially more work together to guide joint research decisions.

Table 1. Agricultural systems in the Central American hillsides

I Production Systems

A Cropping season
B Soils/Geology
C Terrain/Slope
D Settlement pattern
E Population
E1 Density
E2 Land/consumer
E3 Land/cultivator
E4 Ethnicity

II Forces for Change

A Cash markets
A1 Domestic use
A2 Export
B Changing population
C Emigration
D Accessibility
E Input supply markets
F Technology
F1 New inputs
F2 Indigenous innovation
G Project interventions
G1 Soil conservation
G2 Reforestation
G3 Agriculture
G4 Rural development
H Agricultural services
I Information
J Exogenous institutional change
J1 Local
J2 Public
J3 Other
K Policy
K1 Macroeconomic
K2 Tenure
K3 Relative prices

III Responses

A More land
B More inputs
C Immigrate
C1 Rural-urban
C2 Rural-rural
C2a for farming
C2b for employment
D Institutional change
D1 Labor recruitment
D2 Land usufruct
D3 Forest access
D4 Externalities
E Technological change
E1 Crop production
E2 Soil conservation
E2a introduced
E2ai non-formal
E2aii formal
E2b Adaptation
E2c Experimentation
F Policy change
F1 Resource use regulations and legislation
F2 Input and output pricing
F3 Public investments and subsidies
F4 Institutional services

IV Indicators

A Rural welfare
A1 Income
A1a level
A1b security
A2 Nutrition
A3 Life expectancy
A4 Infant mortality
B Agricultural productivity
C Natural resources
C1 Soil
C2 Water
C3 Vegetation

ADOPTION OF RESOURCE-IMPROVING PRACTICES IN HILLSIDES: KEY ISSUES[1]

The task group attempted to sketch a conceptual framework for explaining adoption of resource-improving practices by hillside farmers. At the center are the farmers, with their problems, needs and constraints. The broader policy and socioeconomic environment influences the overall context for adoption. Key factors affecting adoption include technology characteristics and incentives. Extension encompasses methods, information and training issues (Figure 1).

Farmer problems and needs

The group highlighted the importance of distinguishing a typology of farmer groups with different technology needs. Community factors are also important in promoting resource-improving practices, particularly in managing watersheds, forest resources and water resources.

Policy and socioeconomic environment

The group noted that farmers' adoption decisions take place within the broader context of national development strategies and the socioeconomic environment.

Priorities and approaches of technology and extension efforts in the hillsides reflect the overall development strategy of policymakers. The strategy selected in turn influences the specific policies on public investment, prices, land use regulations, etc., which may have direct or indirect effects on farmer adoption of resource-improving practices. Five common strategies for hillside intervention were noted:

- maintain hillside populations as a reserve for low-cost labor;
- ensure subsistence security for hillside populations;
- provide low-cost food supplies to the urban population;
- protect important environmental services of hillsides (e.g., water, biodiversity);
- promote economic development through increased hillside production and income.

Broader socioeconomic conditions in the country also influence incentives for farmer adoption of particular practices. The group discussed three particular factors: population movements, opportunity costs for farmers' labor, and relative prices. In some parts of Central America, more intensive technologies are not used because extensifi-cation is occurring. There have been large population movements from the hillsides to the cities, or to the sparcely-populated humid hillsides. Farmers similarly respond to shifts in relative prices for farm products. Some resource-conserving farm investments (e.g., in soil conservation) are more likely to be adopted by farmers producing higher-value products.

[1] Sara J. Scherr, Rapporteur. Participants: Gustavo Sain, Carlos Lascano, Byron Miranda, Isabel Perez, Sara J. Scherr, Roduel Rodriguez, Adrian Maitre.

One member noted that the Minister of Agriculture of El Salvador had predicted that with trade liberalization and a sharply declining relative price for maize, that the numer of maize farmers--now 244,000--was likely to decline to only 100,000 of the most efficient ones.

Technology characteristics

In hillside environments, better resource management involves both improved techniques and improved systems. Both short- and long-term benefits need to be considered. The example was given of Guaymango, where a special incentive system was needed to encourage farmers to conserve soil at a point well before erosion-induced crop yield declines had become a problem. In addition to technology costs and benefits, farmers will also consider the management complexity, in light of other management tasks.

Because of the heterogeneity of hillside environments, there will be considerable site-specificity in the design and combinations of practices. For example, different tree species or agroforestry technologies may be needed for trees established in crop fields pastures, or fences. This places greater importance on the role of farmers in generating innovations, and adapting new practices introduced by research or through diffusion. The group argued that more farmer input needs to be built into research and technology design efforts. Also there is a need to link technologies to specific uses and users. It is unrealistic to expect generalized dissemination of specific practices.

Factors influencing adoption

The group discussed four factors considered by farmers in their adoption decisions for resource-improving technologies in the Central American hillsides: incentives, the opportunity cost of labor, access to resources and inputs, and effective adaptation of technology design.

It was observed that the most important incentives for adoption are those which stem from the market. There was some discussion of policy incentives (such as subsidies), but it was felt that these should be used sparingly and for limited time periods.

Farmers also respond sensitively to shifts in the opportunity cost for their labor. Even very profitable resource-conserving technologies will not be adopted, if better opportunities for using farm or household labor are available.

Adoption is influenced by farmers' access to the necessary inputs. Thus, farmers with different asset or resource mixes are likely to be interested in different technologies.

Farmers are more likely to adopt technologies which have been developed or adapted to fit hillside conditions generally; they will further adapt technologies to fit their own farm and household conditions. The importance of finding an "entry point" for new technologies, in the farming system, was highlighted. An example was the introduction of new forage material. Initially, forages were promoted for use in ley systems; later it was found that farmers were much more interested in using the species in fodder strips or other configurations, and often in other plots besides the crop fields.

The group identified some of the documented "successes" of farmer adoption of resource-improving practices: use of mucuna cover crop in southern Guatemala, zero-tillage in Panama, improved coffee systems (?), and replacement of *jaragua* pastures in Colombia, Panama and Costa Rica. They noted, however, that there are generally not large areas in a particular technology; solutions seem to be "localized." In the case of widespread adoption of improved pastures, the key element was availability of inexpensive Brazilian seed. There has been no effort to survey hillside farmers in general to document the extent to which resource-improvement generally, as opposed to adoption of specific technologies, is taking place.

Technology dissemination and diffusion

The current shortage of institutional resources for extension in Central America was discussed at length. There was concern that research oriented more towards principles of management in fact required greater investment in extension and more follow-up with farmers, at a time of declining total resources, and a trend to substitute more highly trained extensionists with local para-technicians. Human resource capacity at the farmer and technician level will need to be enhanced.

Possible approaches were briefly discussed. A suggestion was made to develop training courses based on management principles, rather than many different courses on specific practices. The need for specific advice on technologies or species does not, however, disappear. Another suggestion was the development of a user-friendly, easily accessible database on resource-improving practices. Both research findings and farmer innovations could be stored here, along with information about appropriateness for different types of farmers and problems.

Implications for research and extension

The group concluded the discussion by identifying six priority issues which need to be addressed in on-going hillsides research and extension efforts in Central America:

1) We need to consider ways to develop information systems about resource-improving practices and systems, which can be inputted to and drawn from all of the actors, including farmers and grass-roots organizations, extension workers, and researchers. Such an information system might be managed by a regional institution.

2) Because of the wide variety of biophysical and socioeconomic contexts for resource management, as well as the number of different practices and the need for site-specific adaptation, it is neither feasible nor desirable to focus research and extension efforts on specific practices. Rather, research, extension and training should focus on understanding management principles. The example was given of cover crops: rather than focus on development of a particular system, such as 'mucuna,' research should focus on principles of cover crop management, principles for matching cover crop species with site conditions, etc.

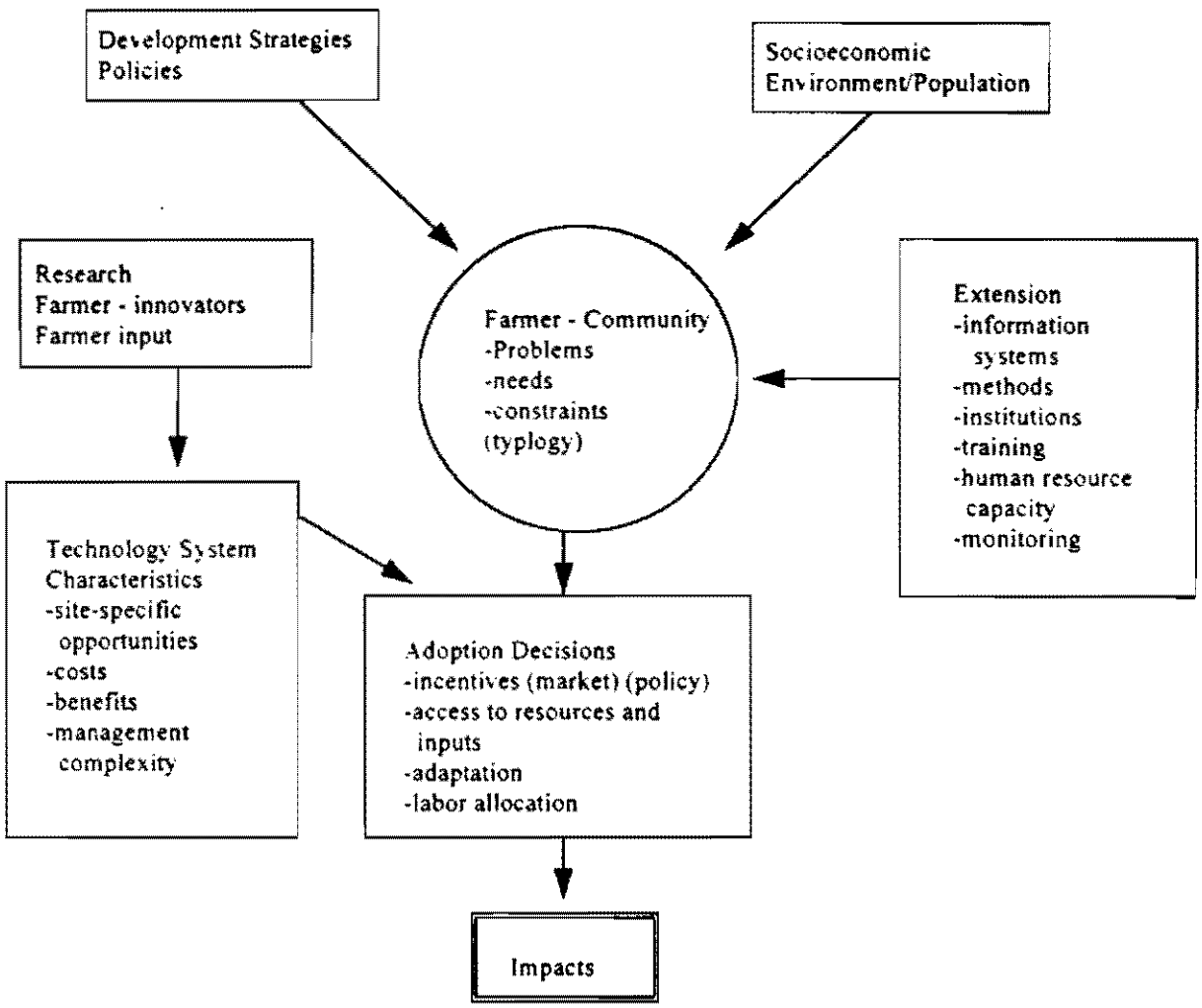
3) Both research and extension need to pay greater attention to farmers' own innovations in resource management. These may provide the basis for transfer of effective farmer innovations across the region, or suggest new approaches for technology design.

4) Despite the large number of site studies which are available on adoption of specific resource-improving practices in Central America, there has been no systematic effort to assess the scale, scope or temporal sequence of farmer improvements. Such information was deemed to be essential for formulating research and extension policies.

5) Both research and extension efforts need to be based on a more thoughtful, and empirically-derived, typology of groups of farmers and their different technology options. There should be a better match between proposed technology management and farmers' resource availability and objectives.

6) Strategies for hillside research and extension on resource-improving practices need to take into account, explicitly, the implications for training of farmers and technicians. Given the weakening public agency resources for extension, alternative or complementary training approaches directly with farmers, or through farmer groups or NGOs, should be explored.

Figure 1. Factors influencing adoption of resource-conserving practices.



GERMPLASM DEVELOPMENT[1]

Several of the centers/institutions present at Trujillo identified improved germplasm as one of the products they offered in the supply/demand matrix of collaboration. However, limited possibilities for collaboration were identified in this area of germplasm development. Each center/institution has a comparative advantage in germplasm development (breeding) of their specific crops. Each of the participating center/institutions has an array of improved germplasm available for different production systems. No need for joint activities in breeding per se of maize-beans or pastures-legumes were identified. Possibilities for collaboration were identified in relay systems and rotation of crops and pastures.

a) For example, the tropical pastures program of CIAT can collaborate with CIMMYT-PRM in evaluation of new legume germplasm for green manures, for fallow enrichment and for intercropping within maize-based production systems to enhance the feeding value of corn residues when used for animal feed. In addition, the tropical pastures program of CIAT would also be interested in evaluating the feed value of different maize germplasm emerging from CIMMYT and the PRMs breeding programs.

b) Another example is evaluation of improved maize and bean germplasm for many production systems involving the maize-bean system, trough collaboration between CIMMYT-PRM and CIAT-PROFRIJOL.

c) Another area where collaboration between center/institutions is obvious is in the use of appropriate germplasm to enhance productivity and sustainability of different production systems. Diffusion of improved germplasm of maize, beans, pastures, legumes, etc., after careful validation should be encouraged. Organizations and centers more active in extension-validation (i.e., PASOLAC) should also assist in diffusion of improved germplasm being generated by the different centers/institutions.

[1] Jorge Bolaños, Rapporteur. Participants: Jorge Bolaños, CIMMYT-PRM; Douglas Beck, CIAT-Beans; Pedro Argel, CIAT-Forages; Carlos Lascano, CIAT -Forages.

POLICY WORKSHOPS, CONFERENCES AND COURSES[1]

Background

During the Trujillo meeting there was some time dedicated to identifying different areas of common interest among the institutions represented. This task was accomplished by first developing a matrix, containing activities and needs, and then organizing working teams. One of the areas in which several of the participants were interested in was the policy workshops, conferences and courses.

Institutions

Among the institutions interested in the organization of such events were:

1. IICA. Through the Institutional Development Program, based in El Salvador.

2. IFPRI. As a component of the Hillsides Project, in collaboration with the Escuela Agrícola Panamericana (EAP) in Honduras and other national institutions in El Salvador and Guatemala.

3. CIMMYT. Through the socio-economic technical support for the Regional Maize Program (PRM), in collaboration with INCAE.

Areas of collaboration

Four areas of future potential collaboration were identified:

1. Organization of the workshops

Even though one of the institutions takes the lead, the others agreed to collaborate in the organizational activities prior, during and after the event has taken place. This includes planning, logistics, proceedings, etc.

2. Identification of issues

Although the issues/topics have been set by each lead organization, the events will be adapted to include the interests of the other organizations as appropriate.

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[1] Roduel Rodríguez, Rapporteur.

3. Selection of participants

Two kinds of participants are considered: the lecturers/speakers and the audience. In both cases, selection will be made by all the organizers involved, through discussion sessions.

4. Funding of the workshops

The different projects are funded by different agencies. The funding of a particular event will rely upon agreements among the representatives of projects interested, in the same fashion as in items 1 to 3.

More details on the specific areas of collaboration will require additional meetings among the participating organizations.

Policy workshops/conferences/courses

The following events were identified, not only at Trujillo, but also at subsequent meetings, as indicated in Table 1.

1. Information Exchange Workshops

The leader in the organization of this workshop is IICA. The objective of the workshop is to promote information exchange among participants (international and national counterparts) on the developments and outputs of current local projects related to policy research. Two workshops will be held in 1995 (end of the year): one in Honduras and one in El Salvador. IFPRI will cooperate in the organization of such seminars.

2. Synthesis Workshops

The leader is IICA. The objective of this workshop is to synthesize the experience learned throughout the Institutional Development Program's local projects. One workshop each in 1996 and 1997 will be held in each of the two countries (El Salvador and Honduras). IFPRI will cooperate in the organization.

3. Targeted Policy Workshops

CIMMYT is the leader of this workshops. The objective is to promote specific policy actions at the sub-regional level in a particular country. In 1995 one will be held in El Salvador on the issue of cover crop management, especially as it relates to the Metalio-Guaymango experience. In 1996 one will be held in Panama on a topic to be decided. IFPRI and IICA will cooperate in the organization and subsequent activities of the workshop.

4. National Hillsides Policy Workshops

IFPRI is the leader, and IICA will be a co-organizer. The objective of these workshops is to examine the history of agricultural policies and their effects on the managing of natural resources, especially on the hillsides. In 1995 (mid-September) one workshop will be held in Honduras. In 1996 there will be one in Guatemala and one in El Salvador.

5. Regional Policy Workshops

IICA is the leader and IFPRI has agreed to co-organize them. The objective is to provide spaces for the regional leaders in agriculture to express and discuss their opinion on policy issues. There will be three regional workshops, one every year (1995, 1996, 1997), with attendance of the same group. The location of the workshops has not been decided yet.

6. Policy Network Support Workshops

IFPRI is the leader with cooperation from IICA. This workshop is part of the Policy Network Support Project whose objective is to develop a common framework for the research on policy issues and identify ways to support the regional networks, and to provide support to the networks for the preparation of funding proposals for policy research. The objective of the workshops is to set priorities on policy research and identify the kind of support from IFPRI that is needed. One workshop will be held in Honduras in May 1996.

7. Conference on "Agricultural Sustainability, Growth and Poverty Alleviation in Latin America"

IFPRI is the leader with support from DSE (German International Development Agency) and collaboration from IICA. The conference will be held in Honduras in December 1995 and will place special emphasis on hillside environments. Besides following up of the 1991 Malaysia conference, the objective is to promote interest on the policy issues for people that manage agricultural research in the region.

Participants will be invited from nine Latin American countries for which the hillsides are an important resource for production.

8. Course on Natural Resource Economics

EAP is the leader of this course. IFPRI has a minor cooperating role. The objective is to train EAP faculty and members of other institutions in Honduras on the economics of resource management. The course will be held at Zamorano, no date has been set but can be October 1995 or January 1996.

Table 1. Summary of workshops, conferences and courses related to policy research, Trujillo Meeting.

Level	Description/type	Objective	Leader	Cooperat.
Country	Information exchange (workshop)	Promote information exchange among policy makers and research relaated projects.	IICA	IFPRI CIMMYT
Country	Project synthesis (workshop)	Sinthesiz the experience of local projects	IICA	IFPRI CIMMYT
Country/ region	Targeted policy issues (workshop)	Promote specific policy actions	CIMMYT	IICA IFPRI
Country	National hillsides policies (workshop)	Exmaine the history of agricultural policies and their effects on natural resources in hillsides	IFPRI	IICA
Region	Regional hillside policies (workshop)	Provide spaces for regional leaders to discuss policy issues	IFPRI	IICA
Region	Policy network support (workshop)	Strengthen policy research in the region	IFPRI	IICA CIMMYT
Latin America	Sustainability, growth and poverty (conference)	Promote debate on policy issues for agriculture research managers	IFPRI	DSE IICA
Country	Natural resource economics (course)	Train on economics of resource management	EAP	IFPRI

VALIDATION AND EXTENSION[1]

1. A need has been expressed on behalf of the research networks to intensify their contacts with NGO's in order to be able to spread more quickly and more evenly new technologies with the help of validation trials and extension work. IICA and PASOLAC offered their help by providing the research networks with lists of potential collaborators among the NGO's or by facilitating individual contacts.

It has been stressed, however, that not every NGO has the technical capacity to implement validation or demonstration trials, so care should be taken of a good selection of the collaborators.

2. An interesting proposal has been discussed in the working group. It has to do with en event of supply and demand of technologies for hillside areas. This event would be attended by institutions that supply technologies (the research networks of the Centers, the NARS and some other projects like FOMENTA, POSTCOSECHA, etc.) as well as by institutions that demand technologies (the NARS, NGO's and others). These events which would be organized separately in each country would be held on a yearly basis. An appropriate time would be around november of each year in order to plan the validation and extension work for the following year. These events would help to spread the new technologies and would at the same time enable the research networks to identify areas where an important demand of technologies cannot be satisfied for the time being and where additional research should be undertaken.

In more concrete terms it has been suggested that the following institutions could be involved in the organization of the events in each country:

Honduras: EAP-Zamorano, supported by IICA and PASOLAC

Nicaragua: PASOLAC, supported by EAP-Zamorano

El Salvador: IICA, supported by PASOLAC

The organizing institutions should coordinate the national events with the NARS.

It has been clear to the participants that the technologies involved should address both issues, production as well as conservation of the natural resources and should therefore by no means be limited to conservation. A restriction to hillside agriculture and animal production is, however, warranted.

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[1] Adrian Maitre, Rapporteur. Participants in the working group: CIAT-Tropical Pastures, EAP-Zamorano, IICA, PASOLAC, PRM.

3. It has further been discussed that the PCCMCA should provide the interested parties with a forum where the agreements of the national events are made public to the representatives of the other countries and where the very same agreements could be consolidated. This would be possible in the light of the fact that the PCCMCA is generally held towards the end of the first quarter of the year, while the national events would be held towards the end of the previous year.

There was an opinion according to which the PCCMCA should not just provide us with such a forum but should be transformed completely in such a forum. However, it seems that the national events would still be necessary in this case so that the organization of these events does not depend very much on the future of the PCCMCA.

4. A certain link to the policy workshops (preceding section) has been observed but not sufficiently analyzed yet.

GIS AND DATABASES[1]

The group started by developing a general list of institutions believed to be potential sources for digital geo-referenced information for the Central America region. The list included both international and local institutions indicating for each the kind and scope of the data available (regional, national or local). Other possible national institutions included INETER (Nicaragua), ESNACIFOR (Honduras), Department of Geography University of Costa Rica, UNEPET (Flores Peten), IUCN (Costa Rica). The group agreed that these and possibly other relevant institutions should be contacted formally as soon as possible.

Most of the discussion centered about the urgency to develop an inventory of what is currently available and develop appropriate mechanisms for accessing the data. This was consider to be a first, yet essential step in understanding variability in space for production systems on the hillsides of Central America.

It was proposed that a format for describing the characteristics of each the GIS coverages available should include at the very least the following information:

Type of data:
Location of coverage:
Scale:
Software format:
Year (if applicable)
Source/ owner:
Availability:

The group discussed the possibility of developing joint inter-institutional projects for the region possibly under the CGIAR ecoregional initiative for Latin America (e.g. characterization of production systems on hillsides).

CIAT discussed the possible availability of recent LANSAT and SPOT imagery bought for about 85% of Honduras and the northern part of Nicaragua. Currently there is a pre-doctoral student at CIAT working on interpretation of LANSAT satellite imagery for the areas of Yoro in Honduras.

Other issues introduced in the discussion were:

- explore the possibility of developing research thesis projects on GIS under the auspices of CATIE or other training institutions in the region;
- possible participation of personnel in the training courses on GIS taught by CATIE;

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[1] Hector Barreto, Rapporteur. Participants: Stephen Shultz (CATIE), Ricardo Radulovich (EAP), Roduel Rodriguez (IFPRI), Gilles Bergeron (IFPRI), Ron Knapp (CIAT-Hillsides), Hector Barreto (CIAT-Hillsides).

- explore the possibility of training technicians for short periods at the GIS unit at CIAT;
- need to provide adequate linkages among data sources; and
- ways of determining the quality and reliability of some data sources.

Institution	Kind and scope of data
CIAT	Biophysical, climate, and socioeconomic coverages. Regional/ National
CATIE	Biophysical, climate; Regional/ National/ Local
CIMMYT	Climate coverages; Regional
FAO	long term meteorological data;/ Soils & agroecological zoning coverages; Regional
WMO	long term metereological data; Regional
EAP	Biophysical, climate, and socioeconomic coverages; Local (mostly for Zamorano valley in Honduras)
COHDEFOR	Topographic coverages (1:50000) for Honduras; Coverages for Roads and villages

INDICATORS OF SUSTAINABILITY[1]

There was a short general discussion of the utility and nature of sutainability indicators at which the following points were raised.

(1) Indicators should be a form of characterization after problems have been identified.
(2) The indicators should register the causes and dynamics of change. The problem is that the chains of causality may be long, indirect, and/or difficult to trace.
(3) Indicators which provide only a 'yes' or 'no' are not sufficient. They need to indicate action which will result in the conservation of the resource base; i.e., an identification of best practices.
(4) As indicated below, a number of institutions are engaged in developing sets of sustainability indicators. Collaboration and comparison would be helpful.

CIAT, CIMMYT, IFPRI, and Zamorano, described their hillsides research activities with respect to developing and testing sustainability indicators. The presentations were organized around (a) conceptual and methodology development and (b) associated testing. Information on institutions not present at this was added.

CIAT

(A) Soil indicators and indices at different scales
(1) Soil indicators and indexes at different scales are being identified using a standard quality of water defined or measured differently at different scales--plot, farm, watershed-- in the field.

(2) CIAT is conducting watershed studies using the variation of water flow and quality to examine biological filters, productivity, partitioning and regulation of water through management of vegetation. They are also testing spatial variability at the plot level is being tested.

(B) Land use change evaluation

(1) Testing will be used to identify soil thresholds of irreversibility of soil quality and potential poverty.

CIMMYT (general program)

(A) Chronosequencing method
(1) CIMMYT has been developing a methodology for chronosequencing at the plot to subwatershed level. There is a need to identify methods and pitfalls in using spatial variability

[1] Hilary Feldstein, Rapporteur. Participants: Hector Barreto, Larry Harrington, Ricardo Radulovich, Gustavo Sain, and Sara Scherr.

to simulate time trends in productivity and resource capacity. The level of analysis is still unclear.

(2) A PhD student from Michigan State University is looking at sustainability indicators at the farm and plot level in Nepal. The focus will be on identifying threats to sustainability. Data sources from farmer monitoring, long-term trials, chronosequencing and community recall will be compared, after a thorough search of the literature and evaluation of data source for measuring productivity and sustainability. Indicators used by community groups in their history of their past will be examined as will more recent work and the method of chronosequencing. The supervisors at Michigan State University are Sandra Batie and Dick Harwood.

(B) Total factor productivity
(1) Methods of using total factor productivity as a measure of on-farm sustainability are being developed.
(2) A PhD candidate in economics from the University of Florida working in Southern Mexico is examining the long-term consequences of green cover crops at the farm, plot, and watershed levels. The research is not yet explicitly about sustainability.

CIMMYT (Central America)

(A) Responses to and forces for change
(1) The research question originally being examined was the identification of responses to the introduction of improved techniques. They have looked at indigenous innovations and introductions from both external institutions. The research focus is shifting from responses to forces which promote or limit change.
(2) Indicators, such as chronosequencing and the impact of adoption on the resources and natural resources of an area where new technologies are introduced, are being tested.

IFPRI

(A) Sentinel site indicators
(1) IFPRI is developing a system of sentinel site monitoring at the sub-watershed level to assess changes in environmental, production and social variables. The question is how to characterize social and economic access to resources and policy impact on such access. Process indicators such as deforestation at higher levels of aggregation, the sub-watershed, watershed, and region are being identified.

(2) Local knowledge of indicators and scientifically derived indicators in field studies at the sub-watershed and farm levels will be compared. The indicators use GIS, community interview and household information.

IFPRI is collaborating with a Wisconsin PhD student doing modeling and GIS work to evaluate soil quality at the watershed level and compare that with local people's interpretation.

Zamorano

(1) Zamorano is training extension workers to identify problems, and bring them to the attention of scientists.
(2) Zamorano scientist are working with the SANREM CRSP in Honduras. In this project, soil quality monitoring indicators using both indigenous technical knowledge and scientific measures are being tested.

CATIE
(1) CATIE is developing OLAFO indicators of forest sustainability.
(2) Indicators of long-term soil productivity are being tested in El Salvador.

IICA
(A) Conceptualization of indicators
(1) IICA is addressing the conceptualization of indicators of sustainable development at various scales.
(2) Indicators at selected watersheds at the watershed, farm, and field level are being measured using weighted scoring.

(B) Development of indicators for Latin America
(1) Indicators at the ecoregional level of sustainable development for Latin America will be developed.
(2) In partnership with World Resources Institute-Winograd workshop with CLADES indicators observable by field staff are being sought. This has been undertaken in collaboration with the University of Costa Rica.

World Bank
The World Bank is identifying indictors of the sustainability of sloping land s at the watershed and regional levels.

IDRC
There is interest in indigenous indicators of sustainability.

Opportunities for collaboration on outcome indicators were identified. These included:

1) exchange of information on methods being tested and results;
2) organization of joint site visits;
3) collaboration on chronosequencing methodology (CIAT-CIMMYT);
4) selection of rural welfare indicators by IFPRI and perhaps IICA. This needs follow up with IICA scientists. Rural welfare indicators will be linked to resource dynamic variables;
5) joint sub-watershed monitoring (IFPRI-CIAT-CATIE);
6) collaboration on associations between indigenous and scientific/technical indicators (IFPRI-CIMMYT-CIAT); and
7) seek support from Zamorano on water quality monitoring.

APPENDIX A

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TRUJILLO, HONDURAS, MARCH 1-3, 1995

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APPENDIX B

HILLSIDES RESEARCH MEETING
TRUJILLO, HONDURAS 1-3 MARCH, 1995

Wednesday 1 March

1. Terms of reference **3:00-3:30pm**

- 1.1 Discuss approaches to hillsides research in Central America
- 1.2 Exchange information on research plans
- 1.3 Identify and develop joint research activities
- 1.4 Write draft proceedings
  - 1.4.1 Summaries of the project plans
  - 1.4.2 Compilation of joint workplans, and description of joint research activities
  - 1.4.3 A concept paper developed from the plenary sessions
- 1.5 Write position paper (see 8 below)

2. Report on Eco-regional initiative (L Harrington) **3:30-4:00pm**

The history of the eco-regional initiative(s) and the current status: the aim(s), resources, institutions involved and future development. Other initiatives and sonsortia and how they are related to hillsides research in Central America.

3. Approaches to Hillsides Research in Central America **4:00pm-5:00pm**

3.1 Brainstorming session addressing broad issues; e.g.,

The Ecoregion: The Hillsides vis-a-vis the rest-of-the-world (defining "The Hillsides"). The Hillsides in Central America vis-a-vis hillsides elsewhere. Are research and methods development being done in the Central America hillsides applicable to other regions? The Hillsides and the Lowlands in Central America: ecoregional and country approaches. Characterizing the hillsides of Central America. How diverse are the hillsides? What are the time-horizons? What are the scales of description? Status of: literature, historical experience, databases.

The Processess: What processes are driving change in rural areas in Central America? Where are natural resource degradation and improvement occurring in Central America? What are the processes of resource degradation and resource enhancement? What are their causes? What are the time-horizons? What are the scales of analysis? How ;important is heterogeneity and what are the implications for extrapolation? Status of: theories, historical experience, experimental evidence, data.

The Institutions: To what extent have institutions driven change in hillsides agriculture? To what extent and in what ways have crop improvement and resource management research driven system change? What are the potential contributions of different institutions and

organizations to improving productivity and conserving natural resources in the hillsides? What are the time-horizons? Does the concept of scale apply to social spaces?

3.2 Decide how best to organize continuing discussions tomorrow morning.

Thursday March 2

3. Big Questions to address (continue) 8:00am-11:00am

4. Short project presentations: who does what, where, how 11:00am-12:30pm
Presentations will be requested from one representative of every project. These presentations should be brief (no more than 15 minutes) and be based on the reaction of every participant to the project summary sheets previously circulated. The common thrust should be to see what each project can offer to the others, and what they would like to see coming from others.
Please give the secretary revisions of project material as soon as ready, but no later than 8:00 am Friday morning.

5. Areas of mutual interest (Working teams) 1:30-7:00pm
5.1 How to organize these working teams 1:30-2:00 pm
5.2 Teams meet 2:00-3:30pm
5.3 Swim/break 3:30-4:30
5.4 Teams meet 4:30-7:00
After laying out areas of overlap and possible collaboration, specific mechanisms for inter-institutional collaboration (one-to-one, as well as one-to-all and all-to-one) will be examined.
One-to-one meetings in the evening to work on joint plans may be arranged to work on specific institutional arrangements.
Please turn in joint workplans to the secretary as soon as they are finished, but no later than 8:00 am Friday morning.

Friday March 3

Note:
Revisions of project description sheets due in to secretary.
Draft joint workplans due in to secretary **8:00am**

6. Recap 8:00-10:00am
Do we answer the questions laid out at the first plenary session? Which ones are well covered, which ones are left out? How could we go about addressing the latter?

7. Reporting 11:00am-12:30am
We should already have revisions of project descriptions (Proceedings Part 1.4.1).
This morning session will be devoted to:
*methods of continuing communications and information exchange;
*refining joint workplans (Proceedings Part 1.4.2); and
*writing a description of the joint research activities (Proceedings Part 1.4.2).

7. **Reporting (continue)** **2:00pm-4:00pm**
This session will be devoted to outlining and writing Proceedings Part 1.4.3.

8. **Reporting to the Regional initiative(s)** **3:00-6:00pm**
A position paper--about three pages--from the Trujillo meeting to research managers designing cross-center initiatives and ecoregional research programs. This should be completed before the end of the day.

9. **Closure (Reception and dinner)** **7:00**

Appendix C

Meeting of an Ad Hoc Working Group on Hillsides Research in Central America: Summary

OBJECTIVES AND PARTICIPANTS

On March 1-3, 1995, scientists currently working on sustainable agricultural and economic development in the hillsides of Central America under the auspices of international and regional centers assembled in Trujillo, Honduras. Participants were from CATIE, CIAT, CIMMYT, EAP, IFPRI, IICA, PASOLAC, PRM, and PROFRIJOL (Appendix A). The objectives for this gathering were:

- to review the broad outlines of the productivity and resource conservation challenges facing agricultural and livestock production systems in the region, particularly on hillsides;
- to integrate approaches for meeting this challenge more effectively, with the ultimate aims of fostering the emergence of more productive farming systems, the conservation of soil, water and forest resources, and the alleviation of poverty;
- to exchange information on what each participating center could offer (and what each center felt that it needed) in the way of technologies, information and analysis, and research methods, in order to meet this challenge more efficiently;
- to forge specific agreements for inter-center collaboration; and
- to examine these agreements in relation to one another in order to define collaborative research themes.

The Trujillo meeting complemented priority-setting workshops with national program and other partners, and bilateral discussions concerning specific collaborative activities, by focusing on the processes of institutional collaboration of international and regional centers in an ecoregion. Participants were seeking to improve their own research by clarifying the processes of collaboration. In addition, it was recognized that colleagues in national programs, NGOs, donors and research managers would appreciate greater clarity in these mechanisms.

A *memoria* is being prepared to document the meeting results. This brief summary of the meeting was prepared because the Trujillo meeting has contributions to make to the many discussions of inter-center initiatives underway.

AGENDA AND ACTIVITIES

SESSION ONE: CONTEXT AND RATIONALE

The meeting began with a session on the context and rationale for hillsides research in the region. Why, it was asked, is there an emphasis on hillsides at all? Which hillsides

should be the focus of attention? And how does this emphasis relate to important productivity and sustainability problems?

It was noted that the "hillsides" are conventionally portrayed as the locus of a downward spiral of deforestation, inappropriate management of crop and pastures land, and widespread, swift resource degradation, leading to substantial losses in on-site productivity, and rapid impoverishment of farm families, as well as the imposition of substantial costs on downstream water users. Some hillside environments are more vulnerable than others; similarly, some farmers have adapted better than others to the threats associated with resource degradation. Besides, farmers are not the sole users of hillside resources, and the threats created by non-agricultural activities, such as logging, mining, and road building may at times be greater than those created by farmers. In addition, a single-minded focus on resource degradation as such often ignores possibilities to dramatically upgrade system productivity. It was agreed that an improved characterization of hillside systems was needed, and that there was a need to more clearly define the incidence, pace, processes, causes and consequences associated with productivity and sustainability problems and opportunities in the hillside systems in Central America.

Session Two: A Matrix of Supply and Demand for Research and Extension Activities

Each project listed specific outputs that would become available--ranging from literature reviews to germplasm to methods to databases--and activities that could form the basis for collaboration--such as GIS development, community resource mapping, or prototype testing. Conversely, each project listed outputs and support activities that, if available from other projects, would enhance its effectiveness. Resources, activities and outputs were grouped into topics: bibliographies, literature reviews, geographic information systems and databases, system characterization and site selection, germplasm improvement, strategic agronomic research and crop modeling, sustainability indicators, watershed modeling, studies of factors governing adoption, adaptive research and extension, technology validation and extension, policy workshops, work with local organizations and network support, training and human resource development, and impact assessment. Each topic constituted the column of a matrix in which institutions with activities under way or resources available were matched with institutions seeking support in the forms of information, methods, or joint research or extension activities.

Session Three: Small Group Discussions and the Forging of Agreements:

The topics were consolidated into themes around which opportunities for cross-center collaboration appeared to be greatest, and small working groups were formed. The matrix elements provided the raw material for discussions and the forging of specific agreements on inter-center cooperation. Information on approaches, methods and activities were exchanged. The group discussions tended to be free-wheeling but task-oriented. Typically, themes were refined, supporting concepts were developed, and sets of collaborative agreements among centers were developed. The thematic working groups were: the overarching research and development process, GIS and system characterization,

understanding and fostering adoption of suitable practices, germplasm improvement and strategic technical research, assessing impact, extension and validation methods, the development of sustainability indicators, and policy workshops. Working groups on training, strategic agronomic research and crop modeling, and watershed modeling were formed to meet in future.

Appendix B is a condensed matrix illustrating the nature of the collaborative activities that are being developed.

NEXT STEPS

- A *memoria* will be produced for circulation to all interested parties, including regional NARs and NGOs, development assistance agencies, TAC and the Directors General of CG centers, colleagues working on similar issues in other ecoregions of the world, and other technical collaborators and friends. The document will facilitate identification of "which centers are doing what" in Central America, and help other actors in the region to identify contacts and mutual areas of interest.
- Some working groups will continue.
- Specific inter-center agreements reached during the workshop will be consolidated. Communications among individuals via E-mail and other channels undoubtedly will continue as usual.
- At the end of the year, the need for a meeting in order to "take stock" of problems and achievements to date and to plan any further follow-up will be ascertained.

REINVENTING THE CONSORTIUM

The Trujillo meeting represents a continuing effort of center scientists within an ecoregion to develop an effective process of collaboration. The working group is technical in nature, voluntary in spirit, and "bottom-up." There were and are no *a priori* restrictions on the nature of this collaboration. Efforts have been made to minimize transactions costs; e.g., there is no formal steering committee, and superstructure is minimal.

Relatively little duplication of effort exists[2]. Rather, gains were made by being able to effectively use work being undertaken by others to enhance one's own current work program. Possibilities for new bilateral activities were identified. Activities with several collaborators are significantly greater in number. The themes unifying those collaborative activities have been identified, and the themes themselves have become "richer." Progress has been made on using common or compatible research methods. Good progress was made on sharing information on site-selection criteria. Benefits include joint research sites, better coverage of bio-physical and socio-economic environments, and greatly improved

[2] A partial exception was the consolidation of fora, such as workshops, designed for collaboration with and among national and local programs and organizations. Several cases were identified where fora could be consolidated and co-sponsored. In other cases, the target groups were clarified in relation to one another. This will ease the burden of meetings on some national program collaborators, and at the same time, result in the participation of a greater overall number of national and local scientists, extension and NGO personnel.

opportunities to use data being generated by other projects in other sites. The overall costs of achieving this synergy has been notably low.

The degree of formality of collaborative planning varies, and informal agreements are vulnerable. The range of agreements could be assessed after a year for durability.

We do not view the process as ended. The *memoria* will provide a practical reference for other organizations in the region so that the collaborations can grow. Moreover, the successes to date have been associated with the better use of existing research resources, given "internal" priorities. The group started the process of developing a common "conceptual framework," but this is by no means complete, and perhaps the development of "consonant" conceptual frameworks will be the result. More progress would be required on this to address the issues of setting priorities and allocating incoming research resources across activities. Nevertheless, the positive spirit and concrete achievements of work-to-date provide a sound foundation for tackling these more difficult issues.

APPENDIX A: PARTICIPANTS

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Appendix B. Examples of areas of collaborative activies among regional organizations in Central America

Institution	CATIE	PASOLAC	PRM	CIMMYT	CIAT- Laderas	CIAT- Pastos	PROFRIJOL	IFPRI	EAP	IICA
CATIE										
PASOLAC	Adoption studies									
PRM		Agronomy training Adoption studies								
CIMMYT										
CIAT- Laderas	Inventory GIS databases	Adoption studies	Adoption studies Prototype technologies Regional typologies	Sustainability indicators						
CIAT- Pastos					Production niches					
PROFRIJOL		Agronomy training	Agronomy training Adoption studies System typologies		Prototype technologies	Agronomy training				
IFPRI				Policy workshops Sustainability indicators	Sustainability indicators Regional typologies Watershed models					
EAP	Inventory GIS databases	Ferias de tecnologias			Inventory GIS databases Regional typologies			Community mapping Workshops		
IICA		Ferias de tecnologias		Policy workshops	Sustainability indicators Regional typologies Local organizations			Policy workshops	Ferias de tecnologias	

The table is illustrative and does not include the results of all working groups, or all collaborative activities.