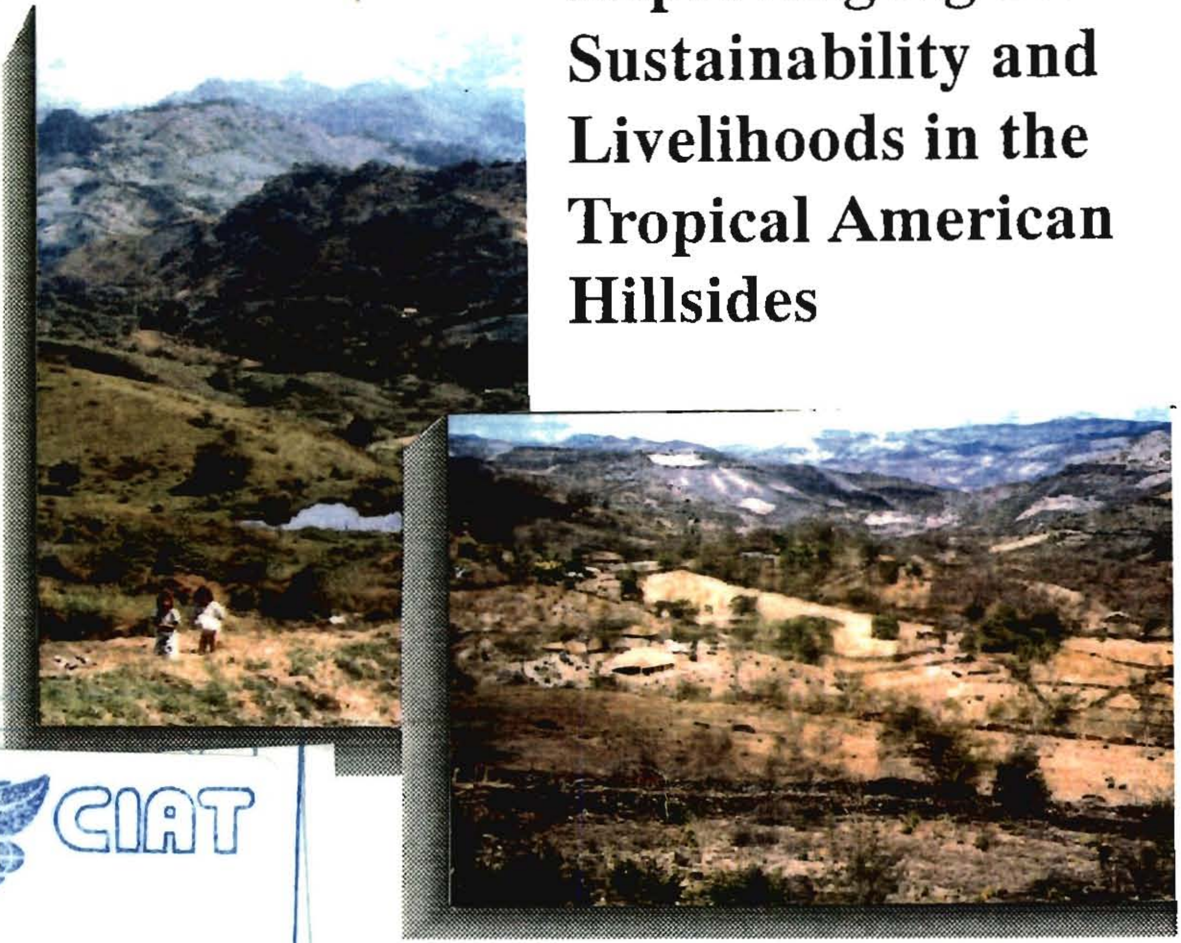
Improving Agricultural Sustainability and Livelihoods in the Tropical American Hillsides



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COLECCION HISTORICA

A Proposal for:

International Development Research Centre (IDRC)

Swiss Development Cooperation (SDC)

Executing Agency:

CIAT
Centro Internacional de Agricultura Tropical
Cali, Colombia

Collaborating Partners:

Centro Agronómico Tropical de Investigación y Enseñanza (CATIE)

Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT)

Instituto Interamericano de Cooperación para la Agricultura (IICA)

International Food Policy Research Institute (IFPRI)

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IMPROVING AGRICULTURAL SUSTAINABILITY AND LIVELIHOODS IN TROPICAL AMERICAN HILLSIDES

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17 NOV. 1999
CIAT
UNIDAD DE INFORMACION Y DOCUMENTACION

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Acronyms

CATIE	Centro Agronómico Tropical de Investigación y Enseñanza
CIAL	Comité de Investigación Agrícola Local (Agricultural Research Committee)
CIAT	Centro Internacional de Agricultura Tropical
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo
CIPASLA	Consorcio Interinstitutional para la Agricultura Sostenible en Laderas, Colombia
GO	Governmental Organization
GIS	Geographic Information Systems
IARC	International agricultural research center
IDRC	International Development Research Centre, Canada
IFPRI	International Food Policy Research Institute
IICA	Instituto Interamericano de Cooperación para la Agricultura
NARI	National agricultural research institute
NGO	NonGovernmental organization
NRM	Natural Resource Management
PD	Postdoctoral scientist
PRODAR	Programa de Desarrollo Agro-Industrial Rural
SDC	Swiss Development Cooperation
SS	Senior scientist
VS	Visiting scientist

Executive Summary

This proposal requests US$500,000 from SDC and US$408,000 from IDRC for the first two-year phase of a five-year project to improve the livelihood security of hillside farmers in Tropical America. The project aims to develop systems of land management which sustain and regenerate the natural resource base. A working model will be built of participatory research and development for sustainable agriculture in several sites located in Central America and in Colombia. A budget request for the second phase will be submitted in 1995.

The Problem

In the mid-altitude hillsides, where most of the poor farmers in tropical America reside, the depletion of soils and forests exceeds renewal rates. *Mining* the natural resource base gives farmers short-term subsistence without livelihood security and, as a result, a serious discrepancy exists between actual systems of land use and the ecologically sound systems appropriate for fragile soils on steep slopes.

Program Goal

To simultaneously improve the livelihood security for hillside farmers in tropical America and the sustainability of the natural resource base.

Project Objective

To develop sustainable systems of land use with a working model of community-based, participatory research and development that will improve the productivity of hillside agriculture in experimental sites in Central America and in the Andes.

Outputs

The principal project outputs include:

- information on, and methods to operationalize, *sustainability*
- technology
- institutional models
- tested strategies for commercialization and small-enterprise development
- policy guidelines
- strategic research results
- trained people

Activities

The working model of sustainable agricultural development for the hillsides will be designed to link four major activities:

- participatory technology testing, which feeds into strategic research on ecological processes to develop new systems of land use
- small-enterprise development to promote ecologically desirable land use
- institutional innovation to unite environmental monitoring and conservation with technical change in agriculture at the community level
- policy experimentation to inject local participation into policy formulation and implementation required for new systems of land use.

Beneficiaries

The long-term beneficiaries are resource-poor hillside families who, through adoption of improved systems of land use, will be able to maintain and improve food security, productivity of labor, and income generation without further land degradation.

The immediate beneficiaries are the farmers; the research and extension personnel of NARIs, public-sector agencies for natural resource management; NGOs; local government municipalities and producer organizations who participate in project activities and receive training.

Project Management

The executive agent for this project is CIAT who will be responsible to the donors for reporting the financial and technical progress of the project. Steering committees representing national and local institutions in each project location or watershed, will manage workplans and their respective budgets for subprojects that address some of the proposed activities.

International Collaboration

Sustainable agricultural development requires interinstitutional cooperation based on shared research agendas and complementary comparative advantages. National and local organizations involved in the project will be supported by a consortium of international organizations with the following expertise:

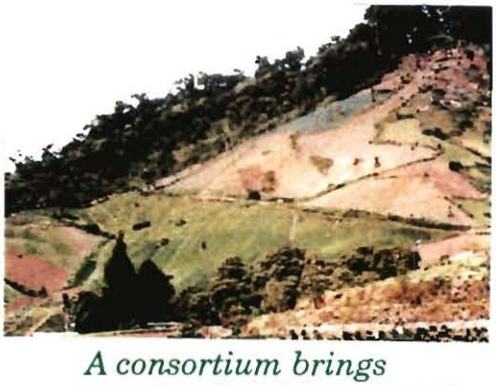
CIAT:	technology generation, farmer participatory research, GIS analysis
CATIE:	watershed management and agroforestry systems
CIMMYT:	resource-conserving maize-based systems
IICA:	institutional development
IFPRI:	policy analysis

1.0 Background, Rationale, and Expected Impact

1.1 Background to the Project

Hillside agriculture in tropical America today faces ever greater pressure for cost-effective, competitive production on a resource base, the inherent productive potential if which is declining sharply. This further undermines the capacity of the ecosystem to regenerate. In the mid-altitude hillsides, where most of the poor people employed in farming reside, the depletion of soils and forests exceeds renewal rates. In Central America alone, for example, over 60 percent of the hillsides is subject to severe, recent water erosion caused by agriculture. Soil erosion, sedimentation of dams, and deforestation are reaching critical levels. *Mining* the environment gives farmers short-term subsistence but without livelihood security, and creates a profound discrepancy between actual systems of land use and the ecologically sound systems appropriate for fragile soils on steep slopes.

Hillside farming is causing soil erosion and deforestation



A consortium brings together institutions with complementary expertise

To face this situation, CIAT initiated in 1991 the formation of an international consortium of institutions to work together on research and development for improving hillside agriculture in tropical America. The international consortium today includes CIAT, CIMMYT, CATIE, IFPRI, and IICA. The consortium brings together institutions with complementary expertise for regional interchange of site-based experiences, for sensitizing policy-makers, and for bringing agricultural and natural resource management institutions together in dialogue. The consortium partners began in 1991

a dialogue with universities, NARIs, natural resource management agencies, NGOs and development projects in the region on issues of hillside agriculture (CIAT/IICA, 1991).

Agroecozone characterization, already carried out for CIAT's strategic planning, was utilized by the consortium to select experimental areas for pilot projects in the Central American hillsides and one in the Andean region. The CIAT Hillsides Program was initiated with the recruitment of three scientists in mid-1992 and with the objective of generating agroecologically and economically viable component technologies for improved resource management in hillside agriculture.

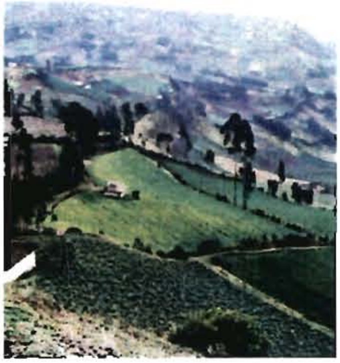
1.2 Rationale

The problems of hillside degradation are well-known: failure of centralized, bureaucratic services and governance to motivate rational resource management; the supply-driven generation of unsustainable technological innovation; the marginalization of impoverished resource-managers; and the dependence of local decision-making on national and international policies beyond local influence or control. In the hillsides, a vicious circle of poverty, reinforcing environmental degradation, is common wherever poor people depend on farming marginal land for their livelihood.

Although many projects have been implemented to promote soil conservation, reforestation, and watershed management in the hillsides over the past two decades, their impact has been modest compared with the magnitude of the problems (Kaimowitz, 1992). Very few documented cases exist of spontaneous adoption of conservation practices by hillside farmers (Laing & Ashby, 1992). The reasons for lack of impact are several.

Systematic research is lacking on ecological processes contributing to sustainability

First, despite today's wealth of initiatives in Latin America promoting sustainable agricultural practices, systematic, rigorous research is lacking on the ecological processes these practices aim to induce or sustain. A widespread, but fragmented process of trial and error is under way (Altieri, 1992), because (1) public-sector agricultural research focuses on productivity, and, until recently, ignored long-term development and conservation needs for agriculture; and (2) the more than 200 NGOs promoting sustainable practices in the region had weak research capability.



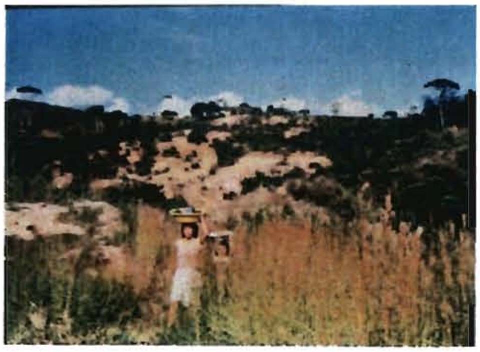
Satisfactory indicators are needed to measure sustainability or the tangible benefits of new techniques (Harrington, 1991). The actual extent and severity of land degradation is poorly documented, biological processes are not well understood, and the cause-effect relationships between resource degradation and productivity are scarcely researched (Stocking, 1989). Because of insufficient and unreliable data, successes are difficult to replicate and failures cannot be explained (Altieri, 1992). As a result, few well-researched principles exist upon which to base the design of appropriate systems of land use for the hillside agroecosystem.

Research on economically viable and ecologically sound technology is needed

Another reason for lack of impact is that many hillside conservation technologies involve delayed or minimal benefits and involve costs or production losses, such that resource-poor farmers have little incentive to adopt them. Research is needed to identify ecologically sound technology that uses resources more efficiently, to address this discrepancy between private costs and social benefits of conservation in hillside agriculture.

A few cases of successful, spontaneous adoption of conservation practices by hillside farmers do show ,however, that success is achieved when linkages are forged between conservation practices and significant opportunities for farmers to improve their livelihood. Examples include those cases where soil conservation practices permitted the introduction of higher value crops, or supported the integration of livestock, or generated additional income by being associated with value-added processes (Barbier, 1990; Barrow, 1991; Bocco, 1991; Nimios and Savage, 1991; White and Maldonado, 1991). A frequent cause of failed conservation practices is that these often conflict with strategies for livelihood security of the poor, which depend on basic environmental requirements for energy, food, water, forage, fuel, and shelter.

Linkages are needed between conservation practices and strategies for livelihood security of the poor



The reasons for lack of impact are not solely technological. It is difficult for individuals farming fragmented plots in steep-slope agriculture to capture the benefits of soil conservation or reforestation, because these require collective action. Local participation in the adaptation of conservation practices to meet farmers needs and objectives is an important element of success. However, such initiatives typically involve farmer participation in implementation, but fail to institutionalize participation in decision-making. Little is known about how to design organizational strategies to realize collective innovation for improved resource management that is sustainable, i.e., independent of external interventions.

Farmer participation must be institutionalized

The need for collective action and the discrepancy between private costs and social benefits mean that incentives for adoption often have to be employed, but in practice little is understood of how to design or implement appropriate incentives. Our knowledge of how policy instruments, such as prices or subsidies, affect the behavior of hillside farmers as resource managers, is sadly deficient. Institutional separation of technology generation for agriculture and the regulation of natural resource management is a major obstacle to the development of conservation

Little knowledge exists on how policy instruments affect the behavior of hillside farmers practices attractive to hillside farmers in Latin America. Production objectives are pursued by Ministries of Agriculture separately from conservation objectives implemented by other institutions, often resulting in contradictory incentive schemes for farmers (Southgate and Whitaker, 1992).

Decentralized, participatory, local management is needed

A unified approach is needed for the design of incentives, based on analyzing the production and conservation trade-offs embodied in production technologies. There is a dearth of proven organizational models on which to base recommendations for implementing of such incentive schemes at the local level. In Latin America, to promote rational land use, enforce regulation, and manage incentives efficiently, central planning is being replaced by decentralized participatory local management of natural resources. But environmental objectives are still divorced from technical innovation for agriculture.

Experimentation includes policy variables and institutional models

New strategies of technology generation, involving sustainable land management, are required for hillside agriculture so that livelihood requirements are met without mining the natural resource base. To date, agricultural research has relied on reductionist models, which left social variables out of the technology development process. Farming systems research attempted to address this deficiency by focusing on adaptive research to fit technology to existing socioeconomic constraints. Technology generation for sustainable agricultural development in the hillsides must be conducted within the framework of social and technical production-conservation trade-offs. This requires a new model that brings experimenting with organizational and policy variables into the design of technology.

1.3 Statement of the Research Problem

New systems of land use, based on integrated technological, organizational, and policy interventions, need to be developed for the hillsides.

The design of new systems will involve analysis of the social and technical trade-offs between production and conservation. Understanding these trade-offs will improve the capacity of researchers, policy-makers, and farmers to manage hillside agroecosystems so that livelihood requirements can be met without mining the natural resource base.

Field-based, action research is needed

Because hillside agroecosystems are a mosaic of diverse micro-edaphoclimatic regimes, user circumstances, and cultures, in any one area, the results will be location specific. The essential task is to develop a strategic understanding of **how** to intervene in a hillside agroecosystem to establish ecologically sound and economically viable systems.

Our knowledge of how to specify and operationalize key variables for this purpose is so imperfect that empirical estimation of relationships among variables needs to be derived from field-based, action research. A working experimental model of sustainable agricultural development for the hillsides must be built.

Some of the questions that such a working experimental model would permit research to answer are:

- What are the production-conservation trade-offs evident in the short-term, that result from the impact of a technology on vital ecological processes?

- Is the trade-off acceptable to farmers?
- Are long-term conservation goals jeopardized by the technology?
- How can critical thresholds, or minimal safe standards, be established in vital ecological processes to guide technology design?
- What are key parameters for designing technologies that achieve acceptable, if less-than-optimal resource conservation?

- What organizational mechanisms can be put in place to motivate farmers to take on added costs of desirable practices? How difficult or costly are such mechanisms to sustain?
- What policy instruments alter production-conservation trade offs for farmers?
- What new opportunities for innovative, ecologically sound technologies are created by a change in incentives to farmers?

The answers to these questions can be used to aid decision-makers who wish to replicate the project's model.

1.4 Anticipated Results

This project will develop a model of community-based, participatory R&D in well-defined experimental areas. The model will develop new systems of land use for the hillsides, based on integrating technological, organizational, and policy interventions. The project will identify principles for making the model self-sustaining; and for replicating it in similar ecological and institutional environments, through training.

The project will build a model for operationalizing key concepts of sustainability......

The project will generate new options for ecologically-sound land use acceptable to hillside farmers. It will provide new understanding of why some technical practices are more sustainable than others, and why some institutional arrangements or policy instruments are more supportive of ecologically sound resource management than others. Building the model will involve operationalizing key concepts of sustainability, both biophysical and socioeconomic, which will provide a unique framework for monitoring and evaluating the impact of this and other projects. These results are likely to have far-reaching influence on procedures for bringing together international, regional, and local institutions to improve resource management and develop sustainable agriculture.

...and develop methodologies for institutions to operationalize sustainability

Methods are an important product of this work, because agricultural sustainability is a moving target. In any locale, as new production opportunities develop, and as knowledge of how to manage natural resources sustainably improves, what is sustainable and how to achieve it will also change. "Learning how" or methodology to innovate in agriculture in a sustainable way is therefore an important product of the project. Methods produced by this project will help research institutions to operationalize sustainability for hillside agriculture and so further the understanding of how to develop synergistic agricultural technologies. Practical, "user-friendly" field methods will contribute to local capability (in grass-roots organizations and NGOs) to monitor and diagnose sustainability thresholds, using indigenous environmental indicators, and to respond to problems of resource degradation with suitable agricultural practices.

The sum total of this research and development will be improved livelihood for hillside people

The sum total of this research and development will be improved livelihood for hillside people, measured in terms of more stable, secure and diverse sources of food and income (farm and nonfarm); and improved labor productivity for men, women, and children. An important indicator of success in improving *sustainability* will be increased participation of local men, and especially, women in making decisions about technical, institutional and policy innovations in their communities to achieve this result. Integral to improved livelihood will be the use of sustainable farming practices. The result will be to stabilize and intensify agricultural production through ecologically sound, land use systems for the hillsides that will protect the soil, relieve pressure on forest resources, and increase biodiversity in ways acceptable to local people and manageable by local institutions.

1.5 Beneficiaries

The long-term beneficiaries are resource-poor hillside families, who, through adoption of improved systems of land use, will be able to maintain and improve food security, productivity of labor, and income-generation without further land degradation.

The *immediate* beneficiaries of the present project are:

(a) resource-poor hillside men, women, and children, who participate in the development of prototype land use systems allied to small rural agroindustrial enterprises; and the community-based organizations required to support sustainable agricultural development in the project's prototype sites.

(b) the research and extension personnel of NARIs; public-sector agencies for natural resource management, NGOs, local government municipalities, and producer organizations, who, through their participation in the project, receive training in methodologies for the development of improved systems of land use for the hillsides.

The *indirect* beneficiaries of the project are:

(a) Scientists, through either their participation in the strategic research studies conducted by the project or their access to the project's results.

(b) Decision-makers in agriculture or natural resource ministries who participate in seminars to discuss project results or receive published recommendations on the project's model for developing sustainable hillside agriculture.

(c) *Downstream beneficiaries* (i.e., urban and lowland farmers) of improved land use in the project's experimental watersheds.

2.0 Project Description

2.1 Program Goal, Project Objectives, and Outputs

The goal, objective, and activities related to the project outputs are graphically shown in Figure 1.

2.1.1 Program Goal

The program goal to which this project contributes is to *improve* livelihood security for hillside farmers in tropical America integrally with reduction in soil degradation and deforestation to improve the natural resource base.

2.1.2 Project Objectives

(a) General Objective

The general objective of this project is to build a working model of community-based, participatory research and development that will improve the productivity and sustainability of hillside agriculture in at least three experimental areas, through interinstitutional cooperation in testing technologies, institutional innovations, and policy interventions. The project will provide strategic principles, methods, and decision-making tools, and the appropriate training in their use, that will permit the model to be replicated.

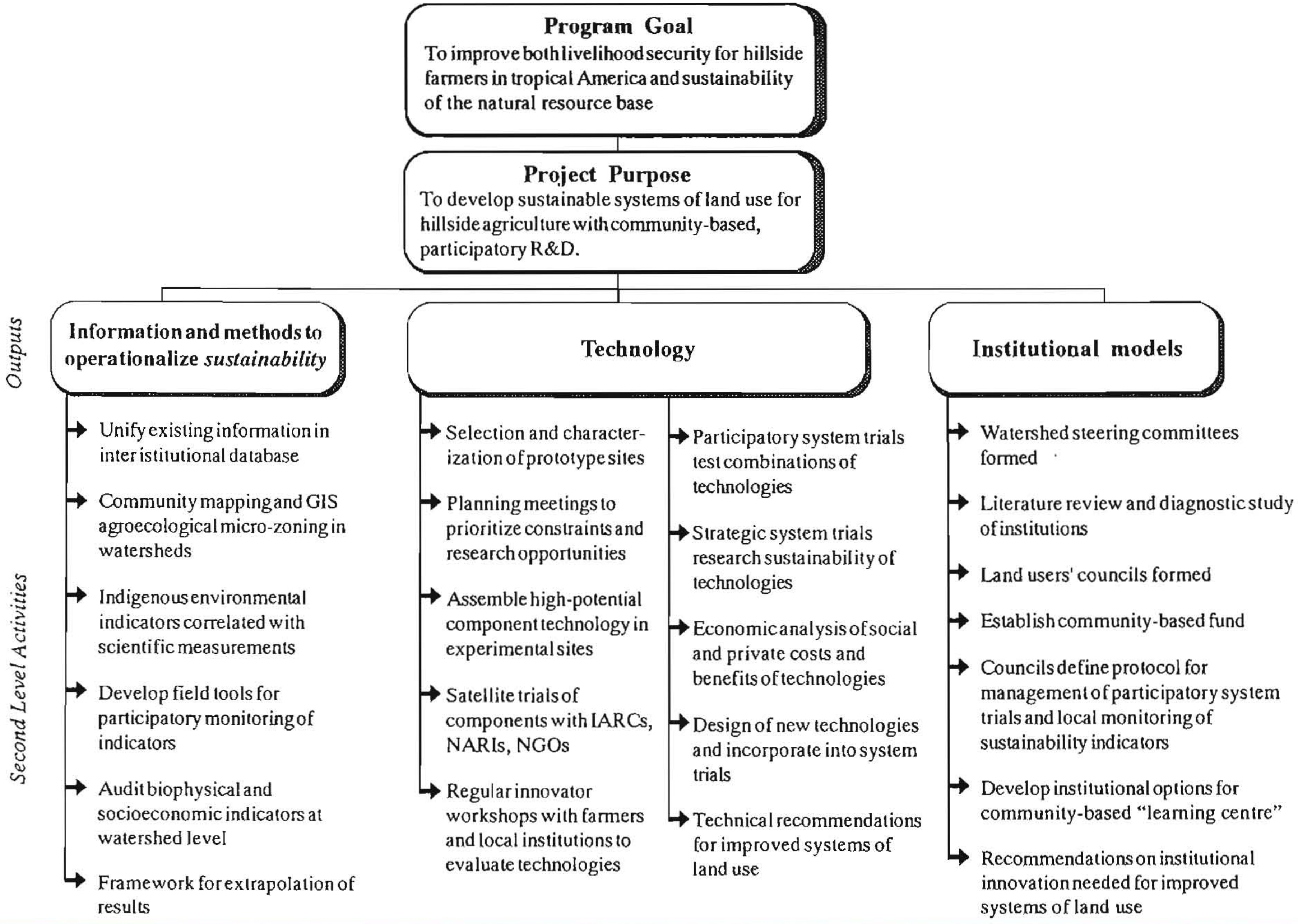


Figure 1. Work Breakdown Structure of Project Activities

Program Goal
To improve both livelihood security for hillside farmers in tropical America and sustainability of the natural resource base

Project Purpose
To develop sustainable systems of land use for hillside agriculture with community-based, participatory R&D.

Outputs

Second Level Activities

Information and methods to operationalize *sustainability*
- Unify existing information in interistitutional database
- Community mapping and GIS agroecological micro-zoning in watersheds
- Indigenous environmental indicators correlated with scientific measurements
- Develop field tools for participatory monitoring of indicators
- Audit biophysical and socioeconomic indicators at watershed level
- Framework for extrapolation of results

Technology
- Selection and characterization of prototype sites
- Planning meetings to prioritize constraints and research opportunities
- Assemble high-potential component technology in experimental sites
- Satellite trials of components with IARCs, NARIs, NGOs
- Regular innovator workshops with farmers and local institutions to evaluate technologies
- Participatory system trials test combinations of technologies
- Strategic system trials research sustainability of technologies
- Economic analysis of social and private costs and benefits of technologies
- Design of new technologies and incorporate into system trials
- Technical recommendations for improved systems of land use

Institutional models
- Watershed steering committees formed
- Literature review and diagnostic study of institutions
- Land users' councils formed
- Establish community-based fund
- Councils define protocol for management of participatory system trials and local monitoring of sustainability indicators
- Develop institutional options for community-based "learning centre"
- Recommendations on institutional innovation needed for improved systems of land use

Figure 1. Work Breakdown Structure of Project Activities (Cont'd)

Program Goal

To improve both livelihood security for hillside farmers in tropical America and sustainability of the natural resource base

Project Purpose

To develop sustainable systems of land use for hillside agriculture with community-based, participatory R&D.

Outputs

Second Level Activities

Commercialization, and small enterprise development

- Study markets for high-value products
- Prioritize high-potential products for satellite trials
- Identify existing processing technology
- Feasibility studies
- Seek private-sector support
- Set up pilot small enterprises and commercialization
- Proposals for new product development research
- Recommendations on rural agroindustrialization for improved systems of land use

Policy guidelines

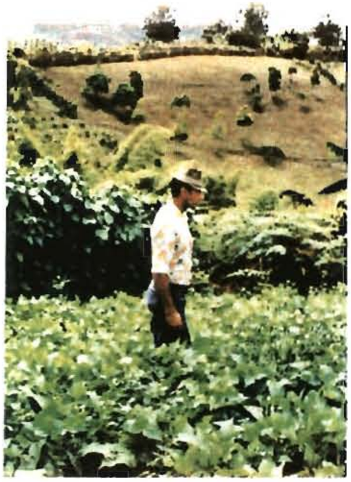
- Bibliographic review of micro-effects of macro-policy instruments
- Analyze actual policies in project areas
- Recommendations for small-enterprise development
- Economic valuation of resource degradation
- *Ex ante* economic analysis of technologies entering system trials
- Recommendations for pilot incentive schemes
- Monitor and evaluate pilot incentive schemes
- Recommendations for policy innovation
- Discussions with policy-makers and downstream (urban) beneficiaries

Strategic research

- Literature reviews and expert consultations to define general framework
- Planning of subprojects for strategic research studies
- Execution of subprojects and regular meetings on work in progress
- Development of a model that links results of different studies
- Publication and dissemination of results

Trained people

- Technical courses for skill formation of professionals in project areas
- Farmer training
- Awareness seminars for decision-makers



(b) Specific Objectives

The specific objectives addressed by the methodology are:

- To establish prototype systems of sustainable land use in experimental hillside areas through the incorporation of ecologically sound technologies acceptable to farmers.
- To implement innovative organizational arrangements for managing the prototype systems of sustainable land use.
- To establish pilot small enterprises and commercialization to promote a diversity of higher value crops, increased income, and sources of employment in the new systems of land use.
- To develop policy guidelines derived from tested pilot incentive schemes that were designed and implemented with local people to promote sustainable land use. These guidelines would form a basis for discussion with policy-makers.
- To improve local and scientific capabilities for monitoring environmental sustainability by developing a "tool kit" of methodologies and decision-making aids.
- To obtain new knowledge from strategic research studies for (a) designing multispecies systems and modelling biological processes that improve soil fertility in tropical acid soils, and (b) understanding farmers' decision-making about technology options for sustainable agriculture, and its implications for making private benefits compatible with social costs of improved resource management.

- To strengthen regional capacity to innovate in the development of sustainable land use systems for the hillsides, through the training of scientists, state and NGO extension professionals, and local leadership participating in the project, and through the dissemination of results.

2.1.3 Outputs

The principal project outputs include the following:

- information and methods to operationalize *sustainability*
- technology
- institutional models
- strategies for commercialization and small-enterprise development
- policy guidelines
- strategic research results
- trained people

2.2 Project Sites

The project will include a total of three areas or watersheds selected to represent different degrees of resource degradation in the hillsides. Up to three *prototype* locations will be identified in a given watershed or micro-catchment basin, which will also be studied as a whole.

The project proposes to include locations in watersheds or micro-catchment basins in the La Ceiba area on the Atlantic littoral of Honduras, an area of relatively low current degradation, but high fragility due to rapid deforestation; and in the Rio Ovejas area in Cauca, Colombia, where population density is higher and soil erosion is severe. A third site, representing a different degree of resource degradation, will be identified in Central America, and may be located in Nicaragua.

3.0 Methodology and Activities

Participatory research is emphasized

Prototype sites within watersheds will provide a framework for comparison

The project proposes to use a novel approach combining rigorous experimentation, survey methods, and participatory research for the design of new systems of land use which incorporate livelihood security for resource-poor hillside farmers.

The research design involves comparisons of changes over time in *prototype sites,* which are functional agroecological units or landscapes meaningful to local inhabitants. Prototype sites will be selected within watersheds to represent different degrees of resource degradation (principally soil erosion). The changes in environmental and socio-economic indicators used to measure *sustainability* obtained in each site will be compared to identify the effects of treatment variables on *sustainability*.

Treatment variables include:

- combinations of agricultural production and conservation technology components with farmer participation, and refined by controlled experimentation
- small-enterprise development associated with the new technology components
- pilot incentive schemes to promote the new system, with local management
- land users councils to organize collective regulation of resource management in the new system.

Although prototype sites will develop location-specific configurations of technology and associated small enterprises, as well as community organization, the focus of research is on general, strategic principles derived from comparisons among sites, and across watersheds, over time.

The research design involves *ex ante* and *ex post* measurements of the effect of treatment variables on key sustainability indicators (e.g., soil nutrient status, extent of soil cover, and diversity and stability of income sources) in prototype sites. Survey research and GIS will develop a framework for extrapolation of results, identifying agroecological units or landscapes comparable with the prototype sites where replication of results will be sought (in the next phase of the project). The usefulness of the watershed as a unit of analysis for operationalizing sustainability for the hillsides will be assessed. Although treatment effects are unlikely to be observed at the watershed level in this early phase of the work, a watershed-level "audit" of sustainability indicators will provide a framework for scaling up treatments to the watershed level later on.

Indicators of sustainability defined at the beginning of the project will probably be and should be reformed and enriched as the project progresses. Therefore, prototype sites will be continuously monitored, using participatory evaluation methods with local inhabitants and case study methodology for different scales of analysis (e.g., field plots, farm, micro-catchment) to provide interlocking biophysical and socioeconomic time-series data on these sites. Data analysis will focus on deriving principles for model specification and on empirical estimation of relationships among key variables to generate aids to decision-making.

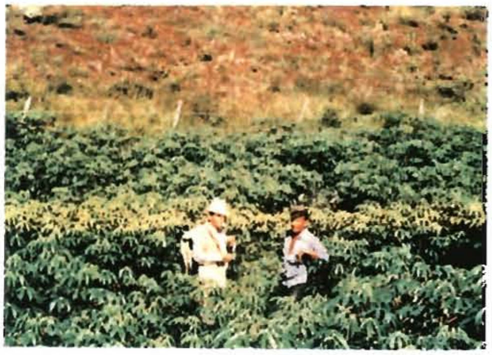
3.1 Operationalizing Key Indicators of Sustainable Agricultural Development

Indigenous environmental indicators of sustainability will be defined and revised

This activity involves establishing critical levels of biophysical and socioeconomic indicators of sustainability as a framework for monitoring and evaluating the impact of technology. To make this framework useful to local people, indigenous environmental indicators will be identified and calibrated with variables that can be scientifically measured. Simple field tools for monitoring indigenous environmental indicators (e.g., for measuring soil erosion) will be developed by the project. Indigenous environmental indicators will be correlated with variables of interest in experimental trials. The project will develop methods, using indigenous indicators, to aid decisions about when to introduce a particular practice that can be used by local people. Indigenous socio-economic welfare indicators will be included in the monitoring.

The development of sustainability indicators will involve an "audit" of the status of key biophysical and socioeconomic resources at different points of time for prototype sites and for the experimental watersheds. Social surveys, soil sampling, and other measurements in the audit will be geo-referenced to permit the development of a framework for extrapolation of the project's results by GIS. Results will be analyzed to determine major degradation problems (e.g., land use related to soil erosion), their socioeconomic correlates, and changes over time in prototype sites and the watershed as a whole.

3.2 Technology Generation



Technology generation by this project involves the progressive transformation of a prototype site to evolve a new system of land use. Farmers will participate in locating experimental components in a mosaic across the landscape. Activities include selection and characterization of prototype sites, interinstitutional planning meetings coordinated by the watershed committees to identify research opportunities, and the assembly of a "menu" of high-potential technologies for the prototype site.

Three types of trials will be conducted:

- Satellite trials, to evaluate high-potential indigenous and improved technologies with respect to productivity, effect on sustainability (e.g., run-off and nutrient leaching), and acceptability to farmers.
- Participatory system trials, in which farmers combine traditional components with new components selected by them from satellite trials.
- Strategic system trials, in which farmers' systems are compared with researcher-designed systems in controlled experiments to assess long-term impact on indicators of sustainability.

Innovator workshops will be conducted regularly with farmers to familiarize them with components in satellite trials, to involve them in participatory evaluations of satellite trials, and to encourage them to help develop a community work plan for participatory experimentation with the components that farmers select from the satellite trials.

High-potential technologies will be tested in three types of trials

Participatory trials will be monitored by local people and researchers with respect to indigenous environmental indicators. Social scientists will monitor participatory trials to obtain insights into farmer decision-making.

This information will be used to generate new technology components. Results will provide technical recommendations for new land use systems, for use by research, extension, and farmers.

3.3 Institutional Innovation to Facilitate Sustainable Resource Management

This activity involves building a community-based capacity for participation in research and development, which unites technology generation, production, and resource conservation at the local level. Institutional innovations in the prototype sites will provide new knowledge of how institutional arrangements affect farmers' decision-making, and will generate new parameters for technology design.

A land users' council will bring together diverse interest groups for the trials

At the local level, the project envisages bringing together diverse interest groups—producers, women, woodcutters, landlords, tenants, into a land users' council in each prototype site, for organizing local participation in the innovators workshops. Each council will manage a community fund (with external fiscal control) to partially support workshop costs and participatory trial costs, local monitoring of environmental indicators, and farmer-to-farmer field visits to evaluate trials.

The council will provide a forum for discussion of production-conservation trade-offs and of the implications for collective action and local regulation of resource management. The councils will be represented in the watershed steering committees, which will coordinate the institutional support, (mainly NGO and local government) required by the councils. Research will monitor this process and develop recommendations on institutional options for the project, such as setting up community "learning centers" where local involvement in technological innovation and resource management might be put on a permanent footing.

3.4 Commercialization, Value-added Processes and Small Enterprise Development

Ecologically sound land management practices will be stimulated by links to comercialization and small-enterprise development

This activity involves creating incentives for use of ecologically sound management practices by linking these to commercialization of the product or to value-added processing. A study of market opportunity will be carried out to identify the potential for this. The feasibility of pilot-testing one or two products in each watershed will be assessed. Based on the results, pilot small enterprises and test marketing will be initiated. Examples are artisanal extraction of high-value essences from herbal plants that can be used as contour barriers for soil conservation; feed for small livestock, using leguminous trees and farm by-products; or processing of fruits or milk products in an integrated production-marketing approach.

Strong links will be promoted between pilot small enterprises and technologies for inclusion in the project's system trials. Activities will be led by watershed steering committees which may subcontract with NGOs and state organizations experienced in small enterprise development. Methodological input and training will be provided to these organizations from CIAT's Utilization Section. Links with PRODAR (a regional rural agroindustralization network supported by IICA) have been initiated.

Research will monitor farmer decision-making and participatory evaluations of technology by farmers involved in small-enterprise development. Results will feed into the technology generation activities, through interinstitutional planning meetings and the innovators' workshops, and into policy guidelines (Section 3.5).

3.5 Policy Guidelines

This activity involves an analysis of actual policies operating in the experimental watersheds and an economic valuation of present resource degradation in these watersheds. This information will be used to predict gaps between private and social costs and benefits likely to be associated with the project's high-potential technologies. The predictions will be compared with farmer evaluations of the technology. Based on the results of this comparison, recommendations for the design of local pilot incentive schemes will be presented to the watershed steering committees and the councils, which will do further planning.

Pilot incentive schemes will combine mechanisms such as farmers' solidarity groups to enforce compliance, credit instruments, or other locally identified incentives. Subprojects with appropriate NGOs, state agencies, or local government will be set up to finance and manage pilot incentive schemes when necessary. The project will inject seed money into the schemes to strengthen local decision-making and management of these and, when appropriate, to enable the councils to contract services for administering incentive schemes.

Recommendations for policy guidelines will be discussed with decision-makers

Research will monitor pilot incentive schemes to assess their impact on technology choice and resource management by farmers, and to provide technology generation with policy-related parameters for technology design. Recommendations for policy guidelines will be discussed with decision-makers and downstream beneficiaries of improved management in the experimental watersheds, to develop private or public sector financial support for scaling up successful pilot schemes.

3.6 Strategic Research Studies

Strategic research will emphasize comparisons across prototype sites in order to derive general principles

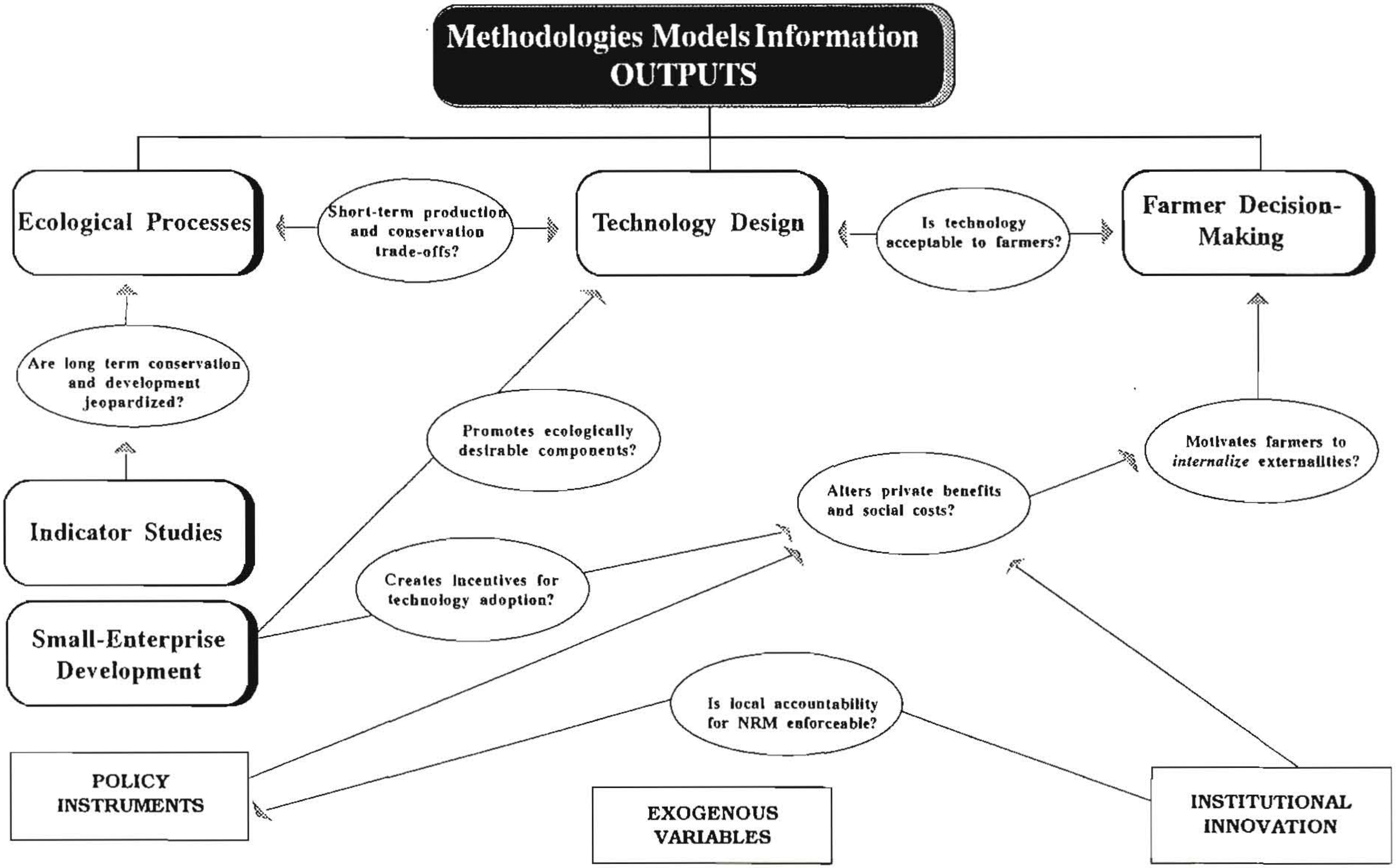
The overall objective of these studies is to derive principles from the experience of building a working model of sustainable hillside agriculture in the prototype sites. These principles will contribute to the model's replication elsewhere. From research-in-action in field sites, the project aims to develop an integrated understanding of critical interactions among key ecological, technological, socioeconomic, and policy-related variables that will guide future decision-making in the design of land use options for the hillside agroecosystem. A conceptual framework linking strategic research studies and showing key questions to be addressed is illustrated in Figure 2. Strategic research studies will emphasize comparisons across prototype sites.

Strategic studies will require literature reviews, expert consultations to refine a framework, information from watershed planning meetings, and innovators' workshops for detailed planning in the form of subprojects. The following types of studies are envisaged:

Figure 2

Land Use Options for Sustainable Hillside Agriculture

Conceptual framework of linkages among project activities and strategic research questions


Methodologies Models Information
OUTPUTS
Ecological Processes
Short-term production and conservation trade-offs?
Technology Design
Is technology acceptable to farmers?
Farmer Decision-Making
Are long term conservation and development jeopardized?
Promotes ecologically desirable components?
Motivates farmers to *internalize* externalities?
Alters private benefits and social costs?
Indicator Studies
Creates incentives for technology adoption?
Small-Enterprise Development
Is local accountability for NRM enforceable?
POLICY INSTRUMENTS
EXOGENOUS VARIABLES
INSTITUTIONAL INNOVATION

- Multidisciplinary analysis of sustainability indicators, to estimate strategic coefficients for threshold levels and minimal safe standards in key resources, and their relationship to indigenous environmental indicators.

- Changes in the dynamics of nutrient cycling and plant growth resulting from various technological components in multispecies systems on acid tropical soils.

- Modelling bio-resource flows at different scales or levels of analysis (e.g., field plot, farm, micro-catchment area).

- Discrepancies between private benefits and social costs of alternative systems of land use, and their implications for *ex ante* assessment of the impact of new technology.

- Organizational principles for institutionalizing participatory decision-making in technology change and resource management at the local level.

- Farmer decision-making about land use and technology choice; and the links between policy, technology, and resource management expressed in farmer's behavior.

Travel funds are requested for researchers from the different institutions contributing to these studies to meet in sites on a regular basis. Results will be published, and reported in seminars for decision-makers.

Detailed description of the major project activities appears in Appendix 1.

4.0 Training and Information Dissemination

Seminars with decision-makers

Three seminars will be conducted in each country, with decision-makers at regional and national levels, to disseminate awareness of the project's results and to stimulate discussion of the implications of the results for national policy.

Doctoral dissertations

Doctoral dissertations will provide training in the projects model for sustainable agricultural development and will document experiences in the form of case studies or contribute to methodology development or modelling.

Training courses

On-site training by the project will involve short courses in skill formation for technical professionals in specific areas to be identified through work plans for subprojects. On-the-job training for these professionals will be a permanent feature of project activities.

Farmer training

Farmer training in the prototype experimental sites will be carried out by appropriate institutions' subprojects in each experimental watershed. This activity is likely to include training farmers in small-scale experimentation, monitoring local resource degradation, leadership, and management and accounting for small enterprise development.

Publications

Results of the project will be published in the form of scientific papers, booklets and articles designed to reach extensionists and NGO project staff or farmers, and leaflets or case studies describing the approach and its results for policy-makers and others who may wish to replicate the model.

5.0 Executing Agency

CIAT's Mission

CIAT was established in 1967. Its mission is to "contribute to the alleviation of hunger and poverty in tropical developing countries by applying science to the generation of technology that will lead to lasting improvements in agricultural output while preserving the natural resource base". CIAT pursues this mission through two interrelated approaches: research on germplasm development and research on resource management.

CIAT is increasingly emphasizing strategic research that covers a wide agroecological zone while assisting national and regional research partners to assume major responsibilities for applied and adaptive research that are more location specific.

Germplasm Development Division

CIAT has a global responsibility for germplasm research on cassava, field beans and tropical forage species in acid soils. It has a regional responsibility for research on rice in Latin America and the Caribbean.

Resource Management Research Division

The Resource Management Research new division focuses on research that will improve the management of resources available for agriculture in tropical America, such that gains in food outputs and other commodities are compatible with the long-term preservation and enhancement of the resource base.

The division's work is integrated by three agroecological and one land use research programs . The agroecosystem programs focus on disturbed **forest margins** in the humid tropics, mid-altitude tropical **hillsides** and lowland acid-soil **savannas**.

CIAT works collaboratively with other institutions in providing an interdisciplinary approach to the multi dimensional problem of agricultural sustainability.

6.0 Collaborating Agencies

6.1 Comparative Advantage of Consortium Partners

CIAT

- Soil nutrient dynamics
- Farmer decision-making and participatory research
- Methodology for small-enterprise development
- Geographic information systems and agroecological studies

CATIE

- Agroforestry systems
- Watershed management

CIMMYT

- Maize-based cropping systems

IICA

- Institutional mechanisms and development

IFPRI

- Policy analysis

6.2 Names and Addresses of Institutions Involved in the Project

- Centro Internacional de Agricultura Tropical (CIAT)
  A.A. 6713
  Cali, Colombia

- Centro Agronómico Tropical de Investigación y Enseñanza (CATIE)
  Turrialba
  Costa Rica

- Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT)
  Apartado Postal 6-641
  06600 Mexico, D.F.

- Instituto Interamericano de Cooperación para la Agricultura (IICA)
  Apartado 55-2200
  Coronado
  Costa Rica

- International Food Policy Research Institute (IFPRI)
  1200 17TH Street
  N.W. Washington, D.C.
  United States of America

7.0 Personnel (CVs included in Appendix 6)

Personnel to be involved activities in the project sites:

INSTITUTIONS	ROLE	TIME COMMITMENT
CIAT		
Hillside Program		
Dr. Jacqueline A. Ashby	SS Social Science Program Leader	50%
Dr. Raúl Moreno	SS Production Systems Project leader, Central America	100%
Dr. Ron Knapp	SS Cropping Systems/Soils Project leader, Colombia	100%
NN CIAT core	PD Economist	100%
NN Project Scientist	SS Soils/production Systems, Central America	100%
NN Project Scientist	SS Economist, Central America	100%
Land Use Program		
Dr. Sally Humphries	VS Social Scientist	100%
Dr. Peter Jones	SS Land Use Analyst	15%
Dr. William Bell	SS GIS Specialist	30%
NN	SS Resource Economist	10%
Tropical Forages Program		
Dr. Carlos Lascano	SS Germplasm Improvement/ Animal Nutrition	10%
Bean Program		
Dr. Douglas Beck	SS Germplasm Improvement/ Plant Nutrition	25%
Cassava Program		
Dr. Carlos Iglesias	SS Germplasm Improvement	10%
Dr. Karl Müller-Sämann	PD Erosion Management	15%

Personnel to be involved in activities at the project sites (cont'd):

INSTITUTIONS	ROLE	TIME COMMITMENT
CIMMYT		
Dr. G. Sain	SS Economist	5%
Dr. J. Bolaños	SS Maize Agronomist	10%
CATIE		
Dr. D. Kass	SS Soil Scientist Coordinator, Sustainable Agriculture Program	10%
Dr. J. Faustino	SS Soil and Water Conservation Specialist	10%
IFPRI		
Dr. Sara Scherr	SS Natural Resource Economist	25%
P. Bonnard	DC Natural Resource Economist	100%
IICA		
Dr. David Kaimowitz	SS Economist/Specialist in Technology Transfer	25%

SS = Senior Scientist

VS = Visiting Scientist

PD = Postdoctoral Scientist

DC = Doctoral Candidate

NN = To be recruited

8.0 Project Administration

8.1 Organization of the Project

The organization for participatory decision-making, technical reporting, and financial management of this project is shown in Figure 3.

The International Consortium Steering Committee

An international consortium provides the mechanism for collaboration with other international institutions

A consortium of international, regional, and national institutions has been formed for research on the hillside agroecosystem in tropical America. The consortium unites CIAT, CIMMYT, and IFPRI from among the IARCs with IICA and CATIE. Discussions with NGOs interested in participating are being pursued with, for example, World Neighbors in Central America, and the Carvajal Foundation in Colombia. A consortium steering committee has met regularly since 1991, and it is proposed that donors send their representative or representatives to join this steering committee.

The international consortium steering committee provides a mechanism for *horizontal* or regional networking of international organizations at site-based projects, such as this one. The committee would also help synthesize results among site-specific projects, and their communication.

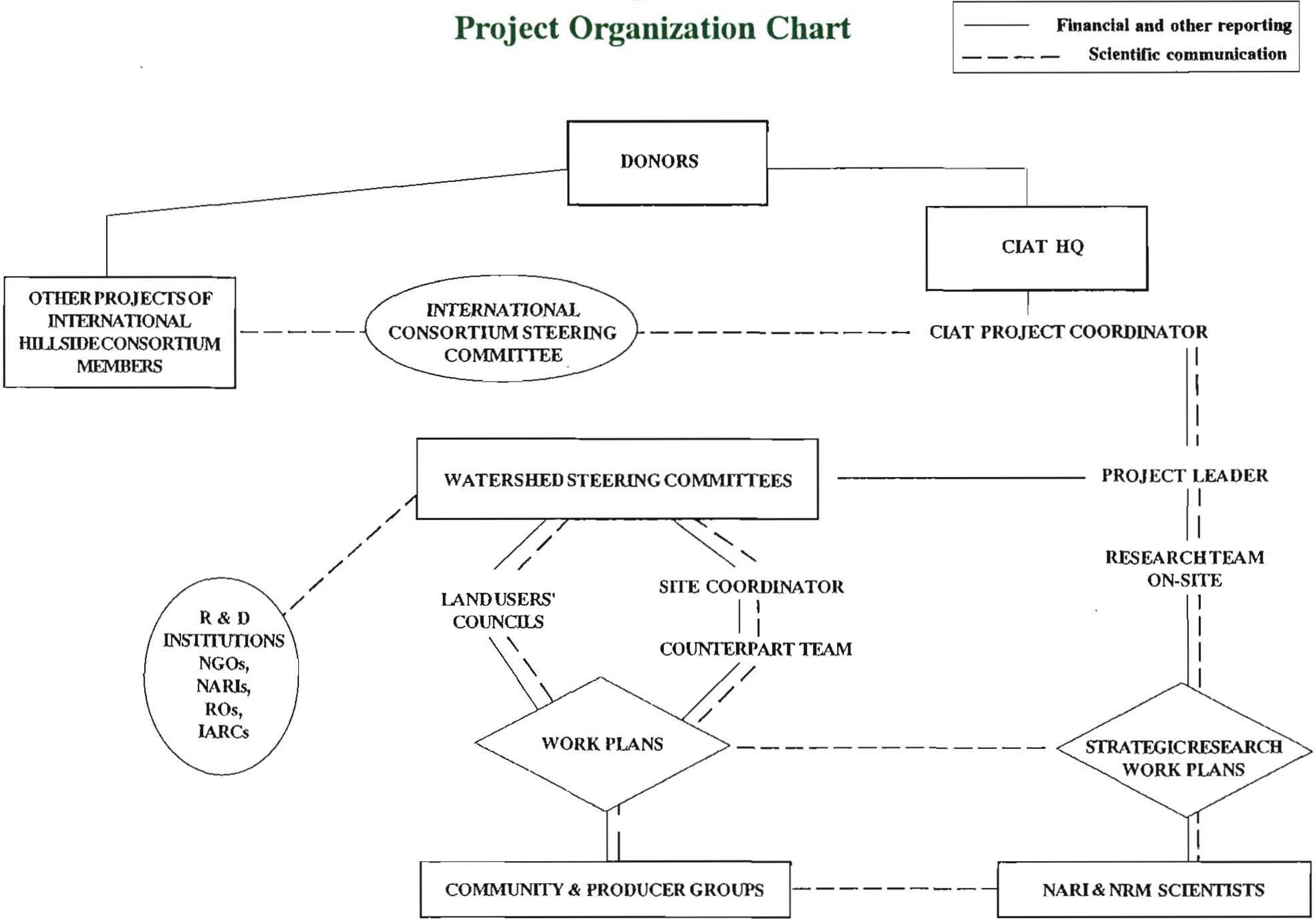
Project Management

The executive agent for this project is CIAT

The executive agent for this project is CIAT, who will be responsible to the donors for reporting the financial and technical progress of the project.

Figure 3

Project Organization Chart


Financial and other reporting
Scientific communication
DONORS
CIAT HQ
OTHER PROJECTS OF INTERNATIONAL HILLSIDE CONSORTIUM MEMBERS
INTERNATIONAL CONSORTIUM STEERING COMMITTEE
CIAT PROJECT COORDINATOR
WATERSHED STEERING COMMITTEES
PROJECT LEADER
RESEARCH TEAM ON-SITE
LAND USERS' COUNCILS
SITE COORDINATOR
COUNTERPART TEAM
R & D INSTITUTIONS NGOs, NARIs, ROs, IARCs
WORK PLANS
STRATEGIC RESEARCH WORK PLANS
COMMUNITY & PRODUCER GROUPS
NARI & NRM SCIENTISTS

CIAT will also be responsible for coordinating any project evaluations with the donors.

The project coordinator will be Dr. Jacqueline A. Ashby, social scientist and program leader in the CIAT Hillside Program based at CIAT, Palmira.

The project leader for Central America will be Dr. Raúl Moreno, multispecies production systems specialist in the CIAT Hillside Program team. Dr. Moreno will oversee project activities carried out by the site coordinator and by Hillside Program scientists based on-site, and will lead research on prototype systems of land use. He will be based at IICA in Costa Rica, to facilitate interinstitutional collaboration of project activities in Central America in this first phase of the project. The project leader for Colombia will be Dr. Ron Knapp, soils and cropping system specialist of the CIAT Hillside Program and based in Colombia.

The project leaders will provide the necessary liaison with regional and international research institutes who participate in work plans developed with site-based teams and watershed steering committees. They will also ensure appropriate input from CIAT research programs and support units into these work plans. The project coordinator will ensure that collaborative strategic research studies are coordinated among scientists of IARCs, regional institutes and NARIs, and that necessary progress reports are prepared with project leaders.

8.2 Roles and Responsibilities of Institutional Research Partners

Each institutional partner has a comparative advantage that will be used in subprojects and identified in the annual *planning meetings* coordinated by the respective watershed steering committee. Although individual institutions are responsible for the preparation of their own work plans for a subproject, these are reviewed and approved by the site specific watershed steering committee.

The detailed roles and responsibilities for each research partner are specified in Appendix 3.

8.3 Organization in Project Study Areas

In each of the three areas defined as a watershed and proposed for this project, an interinstitutional watershed steering committee will coordinate the operational planning and execution of project activities. It will regularly monitor and evaluate of the subprojects that will be undertaken by participant institutions. State and NGO agencies in the watershed, and local community-based organizations, including the proposed land users council, will be represented.

Steering committees in each project location or watershed will manage subprojects and their respective budgets.

The watershed steering committee will function like a board of directors. It will not implement subprojects it solicits or approves. The executive arm of the steering committee will be the site coordinator and counterpart support staff. Within each prototype site, a council of local inhabitants is proposed to organize local participation in planning, monitoring and evaluation of project work plans, and in executing appropriate activities.

8.4 Implementation Schedule

The implementation schedule is based on the major project activities described in the Work Breakdown Structure outlined in Figure 1.

The project has a five-year duration. Two areas, one in Honduras and one in Colombia, will be included in the first year. In the second year, a third study area will become operative. The first year activities include initiating GIS analysis, survey work, community mapping and the study of indigenous environmental indicators. Related strategic research for indicator studies will begin. The watershed steering committees will be formed, annual planning meetings conducted to identify subprojects, and work plans developed by the institutions involved in the first-year's activities. An institutional diagnosis will be conducted on how best to organize their cooperation and local participation. Prototype sites will be identified, satellite trials initiated with high potential technology, and, where suitable, participatory evaluations of technology conducted with farmers.

Market studies will be conducted in the first year, to identify product development opportunities for the hillsides. Actual policies affecting land use, production, and markets in the study sites will be analyzed. National seminars to bring the project to the attention of decision-makers and policy-makers in the country where a study area is located, are proposed for the first year.

The preliminary estimates for the commencement, duration and termination of each major project activity is shown in Appendix 4. These will be revised on an annual basis.

8.5 Reporting

The CIAT project coordinator is responsible for preparing an annual progress report for submission to donors. A progress report of the project will be provided in December of each calendar year to coincide with CIAT reporting. CIAT Headquarters in Colombia will provide a financial statement, for each 12 months of expenditure, starting on the date of project initiation.

8.6 Formative Evaluation

Watershed steering committees and land users' councils will define a small number of performance indicators which they will monitor during the project.

Examples of performance indicators are:

- Increased use by watershed organizations of environmental and socioeconomic sustainability indicators to plan and evaluate programs and projects.
- Use by farmers of field tools for monitoring indigenous environmental indicators to make decisions about land use.
- Increased experimentation by farmers with ecologically desirable technologies in the prototype sites.

- Improved understanding of trade-offs between production and conservation objectives, both individual and social.
- Increased integration of participatory methods into natural resource management institutions.
- Increase in local inhabitants' awareness of the environmental risks inherent in different farming practices.
- Community initiative in convening land users' councils to discuss collective social action or other types of concerns relevant to land use decisions.
- At least one financially viable small enterprise in each of the six prototype sites (if feasibility studies recommended), using raw materials that promote ecologically sound practices.
- Improved understanding of how to design incentives for farmers to adopt conservation-practices among local and national policy - makers.
- Improved ability of researchers to assess and predict environmental effects of proposed technological changes on the experimental watershed sites; and to extrapolate from this understanding.

9.0 Budget

Budget Notes (PHASE 1: 1993-1995)

See tables.

This grant request is for phase 1 (October 1993-December 1995) of a 5-year project. A request for support for phase 2 (January 1996-July 1998) will be submitted in 1995.

A. COLOMBIA

1. CIAT

1.1 Personnel: research support staff.

In years 1 to 3, support is requested for an associate who will conduct research and provide training on farmer participatory system trials and innovator workshops. In years 2 and 3, support for 18 months is requested for an assistant sociologist to monitor and evaluate community funds, to assess their impact on farmer decision-making about land use, and to write a report on the results.

1.2 Operations: supplies and services.

Years 1 to 3 include supplies and services for field work, including gasoline. In each year, approximately 1-month consultancy on market studies and methodology for product development research for small-enterprise development; and approximately 4-months consultancy on economic studies for valuing natural resources and any necessary legal or fiscal assistance, for input to management of community funds.

1.3 Equipment

Support to purchase 1 motorcycle for local travel in field sites. Two vehicles will be leased from CIAT throughout phase 1 to support field research conducted by the project in conjunction with CIPASLA.

2. Support to Local Organizations

2.1 **CIPASLA** (Consorcio Interinstitucional para la Agricultura Sostenible en Laderas).

CIPASLA is a group of local institutions in the Río Ovejas watershed, north Cauca, Colombia. Ten institutions have each formally assigned staff members to work with CIPASLA: CIAT; CVC (the Cauca Valley Corporation); DRI (Desarrollo Rural Integrado, GO); and CETEC (NGO) are members of the executive committee. HIMAT (small-scale irrigation, GO); CORPOTUNIA (NGO of the Carvajal Foundation); FIDAR (NGO formed by FUNDAEC); RENORDE (national network of watershed management agencies); CRC (agroforestry, GO) and UMATA (Unidad Municipal para Asistencia Técnica Agrícola) of Río Ovejas are members of both the consortium's board of directors and executive committee.

CIAT will provide fiscal administration of the grant requested for CIPASLA. CIPASLA funds will be distributed as small grants to member institutions on the following basis:

(a) Approximately 6 subprojects annually will be considered by CIPASLA for funding through this grant request; proposals with budgets for cofinancing through this grant will be submitted to the executive committee (Comité Coordinador) twice each year.

(b) The executive committee will send projects to technical consultants for review, and screen projects on this basis and for consistency with the overall project's objectives. It will submit screened projects for approval by the CIPASLA board of directors ("Grupo de Apoyo" of the ten-member institutions, plus representative of the steering committee "Grupo de Usuarios" made up of community organizations). Projects will be approved and evaluated on a yearly basis.

The grant request includes support for a coordinator for the consortium to be appointed in 1993 to coordinate subprojects with the consortium members and 2 Ingeniero Agrónomo assistant equivalent salaries for the NGOs. Without this support, NGO participation cannot be assured. Travel and per diems for this personnel and NGO field staff involved in the project through CIPASLA is requested. Partial support for up to 6 CIPASLA subprojects annually is requested. Training for farmer assistants in the 21 communities which will work with CIPASLA is requested.

2.2 DRI support to CIPASLA

DRI is in the process of making a grant to CIPASLA for environmental problem diagnosis, monitoring and evaluation; training of technical staff; and supplies and services for agricultural technology transfer projects. (DRI is the Colombian government program, Integrated Rural Development).

2.3 Community Funds

CIAT will provide fiscal administration of the grant requested for community funds. Community funds will be managed by the "Grupo de Usuarios" or land users' council, which consists of seven representatives elected by local community organizations in the micro-catchment area where CIPASLA is concentrating its activities. The "Grupo de Usuarios" has a representative on the CIPASLA board.

Approximately US$3,000 annually of community funds will be earmarked by the project for participatory research: funds partially cover costs of large-scale system trials projected to include up to 30 households or 300 ha, and which will include animals, and will be managed by groups of farmers organized into Local Agricultural Research Committees. The funds will also cover farmer participation in innovator workshops, farmer-to-farmer training; and community-based monitoring of system trials. Seed money for a pilot incentive scheme is included in the community funds: experimental rotating credit will be provided initially to approximately 6 groups of 5 households in adjacent blocks of land to promote adoption of conservation practices in critical areas of the watershed. Incentives and regulation of repayment of experimental credit will be defined with the "Grupo de Usuarios" in consultation with the Local

Agricultural Research Committees, with supervision by the CIPASLA coordinator. The "Grupo de Usuarios" may contract services from NGOs for these purposes. One responsibility of the "Grupo de Usuarios" will be to define mechanisms for (1) incorporating recommendations from the participatory system trials into the pilot incentive scheme, and (2) enabling additional groups to participate in the scheme so that adoption of environmentally sound land use acceptable to farmers can be extended beyond the experimental areas.

2.4 Indirect Costs

Indirect costs include all costs not easily calculated such as administration, financial and infrastructural support. Indirect costs are calculated as a percentage of the total budget, excluding capital and cost.

B. CENTRAL AMERICA

Table 1 shows the level of support requested from SDC (Switzerland) for the Central American portion of this project. The IDRC grant request is as follows:

1. Community Funds

In Central America, two case-study sites, one in Honduras and one in Nicaragua, will be chosen in 1993 as sites for participatory research by the CIAT Hillside Program. CIAT is currently working with a local NGO in La Ceiba, Honduras, to obtain funding from within the region for this purpose. The grant request to IDRC represents seed money to start this research in Central American sites. To permit further testing of the methodology for identifying experimental incentives to promote conservation practices, US$10,000 is included in this grant request for the Central American portion of this project. These funds will be used for establishing up to 8 Local Agricultural Research Committees in communities in the CIAT case study site in Honduras and in Nicaragua, which will draw on the results obtained in the Colombia case study. The eight Local Agricultural Research Committees in each site will jointly manage a community fund to draw on the recommendations resulting from participatory system trials, and to define locally appropriate incentives that will promote farmer experimentation with these recommendations.

2. Market Studies for Product Development

Support is included in the budget item "Supplies and Services" for a consultant study to identify potential markets for existing or new species of plants which prove promising for introduction into new cropping systems being evaluated for sustainable productivity by CIAT' Hillside Program, in two case study sites in Honduras and Nicaragua.

3. CIAT Contribution

CIAT will provide the equivalent of two senior scientists and their support staff required for collaborative research with local organizations in the CIPASLA consortium. Such provision will include travel, supplies and services, and computer equipment for field data collection involving CIAT and CIPASLA personnel, and their transportation. The CIAT farmer participation project will conduct training on participatory research methods for CIPASLA and Local Agricultural Research Committees in the 21 communities involved in the project in 1993 and 1994. CIAT has also provided funds for diagnostic social surveys, data collection for GIS analysis, soil sampling, and hydrology data collection being carried out with CIPASLA institutions in 1993; and for two planning workshops with CIPASLA. CIAT will provide similar support in 1995 for monitoring and evaluation studies to assess progress in phase 1. CIAT will seek additional support jointly with CIPASLA for a national policy seminar to disseminate the project's results from phase 1.

Table 1

CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL – CIAT
SDC – IMPROVING AGRICULTURAL SUSTAINABILITY AND LIVELIHOODS IN CENTRAL AMERICAN HILLSIDES
GRANT REQUEST (FIVE YEARS)
IN (US$,000)

INE ITEM	OCT/93 TO SEPT/94	OCT/94 TO SEPT/95	OCT/95 TO SEPT/96	OCT/96 TO SEPT/97	OCT/97 TO SEPT/98	TOTAL
. PERSONNEL						
Senior scientists (2)	200.0	210.0	220.0	232.0	243.0	1,105.0
Research fellow (sociologist)	–	–	57.0	60.0	63.0	180.0
Support staff	112.0	117.6	123.5	130.0	136.0	619.1
Total personnel	**312.0**	**327.6**	**400.5**	**422.0**	**442.0**	**1,904.1**
. TRAVEL	**30.0**	**31.5**	**33.1**	**34.7**	**36.5**	**165.8**
. OPERATIONS						
Supplies and services	50.0	52.5	55.1	57.9	60.8	276.3
External evaluation	–	5.0	–	–	5.3	10.3
Total operations	**50.0**	**57.5**	**55.1**	**57.9**	**66.1**	**286.6**
. TRAINING AND INFORMATION EXCHANGE						
Training and publications	30.0	31.5	20.0	21.0	22.1	124.6
National policy seminars	–	5.0	5.0	–	5.0	15.0
Total training and information exchange	**30.0**	**36.5**	**25.0**	**21.0**	**27.1**	**139.6**
. SUPPORT TO OTHER ORGANIZATIONS						
In depth – site subprojects :						
Honduras	20.0	21.0	22.1	23.2	24.2	110.5
Nicaragua	20.0	21.0	22.1	23.2	24.2	110.5
Institutional diagnosis	6.0	–	–	–	–	6.0
Total support to other institutions	**46.0**	**42.0**	**44.2**	**46.4**	**48.4**	**227.0**
. DIRECT COSTS						
Vehicles leasing (5)	22.5	23.6	24.8	26.1	27.4	124.4
Total direct costs	**22.5**	**23.6**	**24.8**	**26.1**	**27.4**	**124.4**
. INDIRECT COSTS	105.5	104.1	116.7	121.6	129.5	577.5
. EQUIPMENT						
Small equipment	37.0	2.0	1.0	–	–	40.0
Total equipment	**37.0**	**2.0**	**1.0**	–	–	**40.0**
Grand total	633.0	624.8	700.4	729.7	776.9	3,464.9

Abraham E. Espino
Financial Controller

HLCAMEX
17-Aug-93
PROPOSED

Table 2 : Summary, October 1993 – December 1995

CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL – CIAT
GRANT REQUEST TO IDRC FOR SPECIAL SUBPROJECT : IMPROVING AGRICULTURAL SUSTAINABILITY AND LIVELIHOODS IN TROPICAL AMERICAN HILLSIDES – (PHASE I)
IN (US$,000)

PERIOD	CIAT	DRI	IDRC	TOTAL
1 OCTOBER TO 31 DECEMBER 1993	150.46	45.00	54.64	250.10
1 JANUARY TO 31 DECEMBER 1994	418.94	–	162.04	580.98
1 JANUARY TO 31 DECEMBER 1995	468.91	–	181.58	650.49
GRAND TOTAL	1,038.31	45.00	398.26	1,481.57

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Table 3 : Phase I, Budget Summary

CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL – CIAT
GRANT REQUEST TO IDRC FOR SPECIAL PROJECT :
IMPROVING AGRICULTURAL SUSTAINABILITY AND LIVELIHOODS IN
TROPICAL AMERICAN HILLSIDES – (PHASE I)
IN (US$,000)

COLOMBIA

	1 October/93 – 31 Dec/95			GRAND
LINE ITEM	CIAT	DRI	IDRC	TOTAL
PERSONNEL				
Senior scientists (2)	480.30	–	–	480.30
Support staff	144.83	–	94.10	238.93
TOTAL PERSONNEL	**625.13**	–	**94.10**	**719.23**
OPERATIONS				
National travel	36.00	–	–	36.00
Supplies and services	115.32	–	54.90	170.22
TOTAL OPERATIONS	**151.32**	–	**54.90**	**206.22**
EQUIPMENT				
Small equipment	12.00	–	2.00	14.00
Vehicle leasing (2)	37.19	–	20.93	58.12
Computing	5.00	–	–	5.00
TOTAL EQUIPMENT	**54.19**	–	**22.93**	**77.12**
TRAINING AND INFORMATION EXCHANGE				
Training and publications	6.15	–	–	6.15
TOTAL TRAINING AND INFORMATION EXCHANGE	**6.15**	–	–	**6.15**
SUPPORT TO LOCAL ORGANIZATIONS				
CIPASLA : Personnel	–	–	80.00	80.00
CIPASLA : Travel and per diems	–	–	11.50	11.50
CIPASLA : Subprojects	–	10.00	34.40	44.40
CIPASLA : Training	–	10.00	4.10	14.10
CIPASLA : Diagnosis, monitoring, evaluation	40.00	25.00	–	65.00
Community funds	–	–	50.50	50.50
TOTAL SUPPORT TO LOCAL ORGANIZATIONS	**40.00**	**45.00**	**180.50**	**265.50**
INDIRECT COSTS	161.52	–	45.82	207.34
GRAND TOTAL	1,038.31	45.00	398.25	1,481.57

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Table 4 : Phase I, 1993

CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL – CIAT
GRANT REQUEST TO IDRC FOR SPECIAL PROJECT :
IMPROVING AGRICULTURAL SUSTAINABILITY AND LIVELIHOODS IN TROPICAL AMERICAN HILLSIDES – (PHASE I)
IN (US$,000)

COLOMBIA

	1 October – 31 December 1993			GRAND
LINE ITEM	CIAT	DRI	IDRC	TOTAL
PERSONNEL				
Senior scientists (2)	49.80	–	–	49.80
Support staff	15.75	–	5.20	20.95
TOTAL PERSONNEL	**65.55**	–	**5.20**	**70.75**
OPERATIONS				
National travel	3.75	–	–	3.75
Supplies and services	12.00	–	3.20	15.20
TOTAL OPERATIONS	**15.75**	–	**3.20**	**18.95**
EQUIPMENT				
Small equipment	12.00	–	2.00	14.00
Vehicle leasing (2)	8.10	–	1.50	9.60
Computing	5.00	–	–	5.00
TOTAL EQUIPMENT	**25.10**	–	**3.50**	**28.60**
TRAINING AND INFORMATION EXCHANGE				
Training and publications	3.00	–	–	3.00
TOTAL TRAINING AND INFORMATION EXCHANGE	**3.00**	–	–	**3.00**
SUPPORT TO LOCAL ORGANIZATIONS				
CIPASLA : Personnel	–	–	2.60	2.60
CIPASLA : Travel and perdiems	–	–	0.75	0.75
CIPASLA : Subprojects	–	10.00	2.60	12.60
CIPASLA : Training	–	10.00	–	10.00
CIPASLA : Diagnosis, monitoring, evaluation	20.00	25.00	–	45.00
Community funds	–	–	30.50	30.50
TOTAL SUPPORT TO LOCAL ORGANIZATIONS	**20.00**	**45.00**	**36.45**	**101.45**
INDIRECT COSTS	21.06	–	6.29	27.35
GRAND TOTAL	150.46	45.00	54.64	250.10

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Table 5 : Phase I, 1994

CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL – CIAT
GRANT REQUEST TO IDRC FOR SPECIAL PROJECT : IMPROVING AGRICULTURAL SUSTAINABILITY AND LIVELIHOODS IN TROPICAL AMERICAN HILLSIDES – (PHASE I)
IN (US$,000)

COLOMBIA

	1 Jan – 31 Dec/94		GRAND
LINE ITEM	CIAT	IDRC	TOTAL
PERSONNEL			
Senior scientists (2)	210.00	–	210.00
Support staff	58.00	38.50	96.50
TOTAL PERSONNEL	**268.00**	**38.50**	**306.50**
OPERATIONS			
National travel	15.75	–	15.75
Supplies and services	50.40	25.20	75.60
TOTAL OPERATIONS	**66.15**	**25.20**	**91.35**
EQUIPMENT			
Small equipment	–	–	–
Vehicle leasing (2)	14.18	9.45	23.63
Computing	–	–	–
TOTAL EQUIPMENT	**14.18**	**9.45**	**23.63**
TRAINING AND INFORMATION EXCHANGE			
Training and publications	3.15	–	3.15
TOTAL TRAINING AND INFORMATION EXCHANGE	**3.15**	–	**3.15**
SUPPORT TO LOCAL ORGANIZATIONS			
CIPASLA : Personnel	–	38.00	38.00
CIPASLA : Travel and per diems	–	5.25	5.25
CIPASLA : Subprojects	–	15.00	15.00
CIPASLA : Training	–	2.00	2.00
CIPASLA : Diagnosis, monitoring, evaluation	–	–	–
Community funds	–	10.00	10.00
TOTAL SUPPORT TO LOCAL ORGANIZATIONS	–	**70.25**	**70.25**
INDIRECT COSTS	67.46	18.64	86.10
GRAND TOTAL	**418.94**	**162.04**	**580.98**

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Table 6 – Phase I, 1995

CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL – CIAT
GRANT REQUEST TO IDRC FOR SPECIAL PROJECT :
IMPROVING AGRICULTURAL SUSTAINABILITY AND LIVELIHOODS IN TROPICAL AMERICAN HILLSIDES – (PHASE I)
IN (US$,000)

COLOMBIA

	1 Jan – 31 Dec/95		GRAND
LINE ITEM	CIAT	IDRC	TOTAL
PERSONNEL			
Senior scientists (2)	220.50	–	220.50
Support staff	71.08	50.41	121.50
TOTAL PERSONNEL	**291.58**	**50.41**	**342.00**
OPERATIONS			
National travel	16.50	–	16.50
Supplies and services	52.92	26.50	79.42
TOTAL OPERATIONS	**69.42**	**26.50**	**95.92**
EQUIPMENT			
Small equipment	–	–	–
Vehicle leasing (2)	14.91	9.98	24.89
Computing	–	–	–
TOTAL EQUIPMENT	**14.91**	**9.98**	**24.89**
TRAINING AND INFORMATION EXCHANGE			
Training and publications	–	–	–
TOTAL TRAINING AND INFORMATION EXCHANGE	–	–	–
SUPPORT TO LOCAL ORGANIZATIONS			
CIPASLA : Personnel	–	39.40	39.40
CIPASLA : Travel and per diems	–	5.50	5.50
CIPASLA : Subprojects	–	16.80	16.80
CIPASLA : Training	–	2.10	2.10
CIPASLA : Diagnosis, monitoring, evaluation	20.00	–	20.00
Community funds	–	10.00	10.00
TOTAL SUPPORT TO LOCAL ORGANIZATIONS	**20.00**	**73.80**	**93.80**
INDIRECT COSTS	73.00	20.89	93.89
GRAND TOTAL	**468.91**	**181.58**	**650.49**

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Appendix 1

Methodology and Activities

1.0 Operationalizing key indicators of sustainable agricultural development

Building a working model of sustainable agricultural development involves operationalizing and validating some key concepts of *sustainability*. The development of a methodological framework for this purpose will be an ongoing activity of the project. The project will begin with studies to establish critical levels of biophysical and socioeconomic indicators of sustainability, and the impact of technological interventions on these indicators will be monitored and evaluated throughout the project.

An important output will be to institutionalize, through methodologies developed as a result of this work, the continued use of this framework at the community level, to be readily accessible to local people and institutions.

Therefore, this activity involves developing methodologies for calibrating indigenous environmental indicators with variables that can be scientifically measured.

1.1 Community and field-level indicators

Participatory mapping

In the project's first year, community mapping will be conducted with local people in each watershed to build a local inventory of the natural resource base and the existing pattern of land use. These participatory maps will help to ground-truth mapping carried out by GIS at CIAT. The result will be the micro-zoning of experimental areas or watersheds, related to local peoples' perception of the natural environment and their actual patterns of land use.

Indigenous environmental indicators

Participatory mapping is the first step in understanding indigenous environmental indicators. The next step will be to identify folk taxonomies, particularly that of soil management, and decisions about crop choice, rotations, use of fallows, and deforestation. Folk indicators of resource degradation and regeneration will be derived. Agronomists and soil scientists will measure soil properties, indicators of biodiversity, and other variables, which can be associated with locally used environmental indicators. Correlations between folk indicators and scientific variables will be analyzed.

Folk indicators for local monitoring

Gaps in local taxonomies will be identified. The scientific research will aim to enrich the local portfolio of indicators with the development of simple field measurement tools (for example, of soil erosion). Regular monitoring tours of experimental areas, involving local farmers, extensionists, and researchers, will be conducted to collect information, using these field measurement tools, to validate the methodology.

Development of decision-making aids

Further studies will aim to identify whether folk indicators or simple field tools can be tagged to critical levels of certain indicators, for example of soil acidification. Monitoring of indicators in experimental trials testing new technologies will aim to develop straight forward decision-making aids that can be used to determine when, for example, a change in rotation or introduction of a green manure is advisable. Tools for field measurement and decision-making aids derived from the indicator studies will be utilized in participatory evaluations of technology with farmers.

1.2 Watershed-level Indicators

Audit of natural resources in the watershed

The development of sustainability indicators will also involve the definition of watershed characteristics required for monitoring sustainability at the system level. Of particular importance will be the identification of key indicators from nutrient, water, and energy balance studies to develop the framework for an "audit" of the status of key biophysical resources at different points in time in the watershed. Research will investigate multicollinearity among biophysical characteristics in order to establish indices of sustainability useful for monitoring and evaluating the impact of the project.

Development of a farm typology for analysis of social equity

Socioeconomic indicators of sustainability will be defined and measured in close collaboration with the study of biophysical parameters. The results of micro-zoning from community-mapping and GIS will be used to design a sample frame to administer a socioeconomic survey of the experimental areas or watersheds. The survey will provide data on social characteristics hypothesized to be important correlates of resource degradation. For example, involvement in off-farm employment, especially by men, and the female-headed household are hypothesized to correlate with resource degradation on hillside farms. The survey will be designed to identify regenerative resource management practices and the social correlates of these. A key variable will be farmer experimentation, which is an indicator of "capacity for response" in the system. Local innovators, and the features of the local production systems they experiment with, will be characterized, to identify points of intervention for technology generation by the project. A farm typology will be developed to provide a framework for analyzing social equity impacts of the project. From the relationships established between farm types, land use, resource degradation and farmer-led innovation, key socioeconomic indicators of sustainability will be derived to be used in monitoring the project's impact in its experimental sites.

Interface of socioeconomic and biophysical indicators

Measurement of biophysical indicators will be designed to take into account important socioeconomic variables that determine land use. For example, in Honduras, the successive use of areas first begins with colonization of forests, followed by secondary fallows for cropping by small farmers, and then by pasture establishment by landowners. Such a succession of use will provide an important framework for pseudo-time series soil sampling. In the Colombian site, for example, soil erosion and nutrient status on land worked permanently by owners may be compared with land frequently or continuously rented out. Soil nutrient balance and other resource levels will be analyzed in relation to social equity variables. Results will be fed into economic and policy analyses.

GIS and extrapolation

The watershed-level indicator studies will require, at first, data collection based on scientific sampling designs to permit aggregate analysis and identification of major trends in the indicators being studied. Socioeconomic surveys, biophysical measurements, and participatory mapping will be geo-referenced for GIS analysis. A framework for extrapolation will be developed and validated by GIS, to provide simple, least-cost approaches for future indicator studies.

2.0 Technology generation for the establishment of prototype systems of sustainable land use

Principles of prototype systems of land use

The overall objective of this activity is to develop prototype systems of sustainable land use in experimental sites within each watershed. By developing technologies which protect and regenerate the natural resource base, these prototype systems seek to increase livelihood security for small farmers by diversifying and improving year-round food availability and income generation from steep-slope agriculture. A prototype system will maximize technology "blending", that is the combination of ecologically sound local practices with introduced technologies. Design of prototype systems involves the progressive transformation of an experimental site, with farmers participating to locate experimental components in a mosaic across the landscape, to evolve a new system of land use.

The overall strategy involves developing of multispecies systems which reduce production costs, decrease need for external inputs, improve efficiency in use of needed inputs, and generate improved linkages between livestock and crop production. Prototype systems will involve spatial and temporal arrangements of components such as soil conservation and fertility management practices, new crop varieties and intercrops, forage legumes and grasses, multipurpose tree species and agroforestry practices that exploit ecological compatibility among soils, and plants and animals. Smoothing out seasonal labor bottlenecks to achieve higher year-round labor productivity and employment, especially with respect to allocation of women's labor will be an important feature of prototype systems.

The design of prototype systems is integrally linked to the development of employment and income-generating opportunities through small enterprises based on product commercialization and value-added processes (Section 3.4); and to the institutionalization of a community-based capacity to manage technological innovation and to monitor key environmental indicators to prevent further resource degradation (Section 3.3).

Selection of prototype sites

The micro-zoning will provide an initial framework for identifying sites within each area or watershed, where the development of prototype systems of land use will be initiated. Up to three such experimental or prototype sites will be identified in each area. Sites will be selected to represent different degrees of variation on a range of conditions, such as access to markets, population density, soil degradation, and deforestation. Each prototype site will be a meaningful agroecological micro-zone as perceived by local inhabitants, and will represent a "cluster" of farms situated in the overall sampling framework used in the indicator studies. Results can therefore be extrapolated to other similar clusters in the watershed both by GIS and by local inhabitants, using indigenous environmental indicators.

Characterization of sites

The characterization of prototype sites will be dynamic and will be continually improved upon throughout the project with respect to: (a) key biophysical indicators (such as soil nutrient status, sedimentation in run-off, and plant and insect species). (b) socioeconomic indicators such as land tenure, farm size, family composition, intra-household labor allocation on and off-farm, and farmer experimentation; (c) local perceptions of the environment; (d) local perceptions of the main problems of livelihood security; and (e) institutional resources.

Planning meetings to the prioritize constraints

A technical meeting of researchers, extensionists, and community members will be coordinated by the respective watershed steering committee to prioritize constraints and research opportunities in the experimental area and to define interinstitutional work plans. This meeting will be held on a regular annual basis to exchange research results from experiments carried out by different institutions and to develop a common agenda for work plans. The meeting will include international consortium scientists as well as local technical experts.

Identify market opportunities

The results of a study of market opportunity for new products or value-added processes (Section 3) will be used to screen technologies for potential inclusion in experimental trials.

Assemble a menu of high potential in technologies

A preliminary set or "menu" of high potential technologies will thus be identified.

Collaboration with IARC commodity programs, regional institutes such as CATIE, networks such as PROFRIJOL and RIEPT, national programs and NGOs will be key to assembling the menu of high-potential components in each site. The "menu" of high-potential technologies will be continuously enriched throughout the project as new components are identified.

Satellite component trials

High-potential technologies will enter testing in satellite trials. These trials will be off-station and located in appropriate agroecological niches in each experimental site. Satellite trials will be researcher-managed or farmer-managed, depending on the objectives of each trial. Satellite trials of components will be facilitated by the project personnel, but interpretation of the results on site-specific adaptation of individual components will be carried out primarily through work plans developed in annual planning meetings by institutions sponsoring the component in question. For example, maize-based cropping systems will be analyzed by CIMMYT, and nurseries and trials of species for agroforestry will be analyzed by CATIE. Practices and plant species, which local farmers identify as promising, will have place in the "menu" and satellite trials will be a location for live conservation of local germplasm. Satellite experimentation with regenerative farming practices recommended by local farmers will be handled through the innovator's workshop council and community fund (Section 3). The annual planning meeting will be an important mechanism for bringing the results of satellite trials together in one place at one time.

Innovator workshops with farmers

As satellite component trials are set up, the project will conduct innovator workshops with farmers at each prototype with site. The purpose of these regular workshops will be: (a) to conduct participatory evaluations of satellite trials and to share information about unfamiliar components with farmers; (b) to analyze the community inventory of local land use and natural resources in the light of participants' evaluations of high-potential component technologies; and (c) to develop a community work plan for experimenting with some combinations of component technologies.

The participatory experimental plan

The experimental plan developed in the innovator workshop will define where in the prototype site (or cluster of farms) to locate farmer-led, participatory testing of combinations of components of interest to farmers. For example, the location of farmers' trials of their preferred tree species in agroforestry practices or improved fallows will be discussed. The area of farmer trials, the criteria for evaluation (including the folk indicators) to be used, the time scale for farmer experimentation, the methods of data collection and the protocol for farmer management of participatory trials will be defined in these workshops. Innovator workshops will be a forum for reporting and exchanging results of participatory evaluations among farmers and technical staff.

The participatory system trials

One result of the innovator workshops will be therefore, the progressive inclusion, over time, of technologies, which look promising to farmers, in a mosaic across the prototype site and into a farmer-designed, farmer-managed, trial land use system. The prototype site will be monitored by farmers and researchers to assess the impact of the introduced technologies on biophysical and socioeconomic indicators. Participatory system trials will require innovative statistical designs, and research will utilize stochastic methods to audit sustainability indicators.

Analysis of participatory system trials

Participatory system trials will also be monitored by social scientists to obtain insights into farmer decision-making and the adoption path farmers are likely to choose with respect to alternative technologies. The relative acceptability of different options to farmers will be assessed. Adjustments to technologies made by farmers will be observed, as these technologies are incorporated into the existing system of land use by the group of farmers. For example, the requisite adjustments in interfarm or intra-household labor use will be assessed. Farmers will intuitively assess trade-offs, and make decisions accordingly as they manage the experimental components within a system. Participatory evaluations with the innovators' workshops will help make farmers' assessment of trade-offs explicit to researchers.

Strategic system trials

A second result of the innovator workshops will be to generate hypotheses to be tested in controlled experiments or strategic system trials. The study of system-level interactions among combinations of components drawn from participatory trials will be emphasized. These experiments will be designed by researchers to test hypotheses about causal relationships not readily observable or measurable in the participatory system experiments. For example, an important objective of the strategic system experiments will be to permit study of the efficiency of nutrient use in combinations of components chosen by farmers for the participatory system trials, but under controlled conditions over several years. These experiments, some of which will be long term, will be used to assess the impact of introduced technologies in relation to key biophysical sustainability indicators.

Technology generation

Information from satellite, participatory, and system trials will be used for technology generation. Technology generation will focus on plant-soil relationships, in particularly integrated soil-fertility management involving the evaluation of innovative combinations of components such as rotations, soil erosion control, green manures, improved fallows, experimental organic or chemical fertilizers, and agroforestry practices. Although the applications identified for each experimental area will be site specific, this research seeks to identify basic principles for the design of sustainable systems: for example, to understand principles for combining shallow-rooted and deep-rooted plants to obtain efficient use of nutrients in steep-slope agriculture.

The methodology for developing of prototype systems of sustainable land use for hillside agriculture in the experimental sites requires a dynamic, iterative exchange of information among satellite component trials; farmer participation in evaluation of technologies; system trials designed and managed by farmers; and controlled experimentation. Managing this process will require institutional innovation, discussed in the next section.

3.0 Institutional innovation to facilitate sustainable resource management

Building a model of sustainable agricultural development involves institutionalizing a community-based capacity for participation in the process of research and development for more productive agriculture without further resource degradation. This is likely to provide researchers with new parameters for technology design. The project aims to build prototype institutional arrangements at the community level and at the watershed level, which will be linked to regional, national, and international institutions for this purpose.

Site coordinators

Site Coordinators will oversee the implementation of work plans developed in the annual technical meetings and innovator workshops.

Watershed steering committee

In each area or watershed, an interinstitutional watershed-level steering committee will be formed with representation from local community organizations, NGOs, and state committee agencies involved in research, extension, development, and natural resource management in the watershed. The watershed-level committee will oversee operational planning, and the site coordinator's coordination of the various institutions in project activities.

Land users' councils

In the three prototype experimental sites proposed for each watershed, a community-level council will be created by the project with local representation to help organize the innovators' workshops. Involvement of NGOs, producer organizations, and local leadership in the innovators' workshops will be promoted to develop interinstitutional support for the design of a more permanent, institutionalized forum at the local level.

The precise organizational format for this forum will be developed on the basis of local, site-specific organizations already in existence in each site. For example, in the north Cauca site, 30 farmers' Local Agricultural Research Committees sponsored by NGOs, village government bodies, and farmer associations each have a representative in a regional group, the "Grupo Ecológico." This group organizes field trips, meetings and field trials on sustainable agricultural practices and disseminates these to the member committees. In La Ceiba, community groups, womens' groups, and producer and woodcutter associations have been contacted during preliminary field work there. The innovators' workshop council will provide a forum for bringing these different types of social groups together for the purpose of improving resource management.

Design of land users' councils

A literature review of experience in community-level organization for resource management will be conducted. As part of the detailed characterization of the three prototype experimental sites in each watershed, a diagnostic study of institutions in these sites will be carried out. This study will provide recommendations, in consultation with local institutions, on how best to organize the participation of different groups in the innovators' workshop council. An organization chart will be developed to link councils with other local organizations and with the watershed steering committee, so that regular information sharing and consultation among these bodies is institutionalized.

The community council fund

Community-based institutional innovation cannot depend entirely on voluntaryism: participation costs local people time and energy. Therefore, the project proposes to design, with NGOs and local institutions, an experimental community-based fund with local decision-making but external fiscal control. Experiences of local NGOs with this type of fund will be drawn upon, and contributions in cash and kind to the fund by all participants will be sought. Mechanisms will be developed to make the fund self-sustaining over time.

Purpose of the community council fund

The community-based fund would be managed through the innovators' workshop council for purposes including partial support for workshop costs; a financial protocol for managing participatory system trials, including costs of experimental inputs not locally available; or compensation for experimental risks deemed locally unacceptable. CIAT's experience with farmer participation research shows that the creation of community-based funds with appropriate fiscal control is an important mechanism for creating responsibility in participatory trials, and local ownership of the resultant technological recommendations. Other purposes of the community-based fund would be partial support for local monitoring of environmental sustainability indicators; support for farmer-to-farmer field visits for evaluation of technologies; local germplasm conservation through satellite trials. NGO support for training the council members in the requisite management skills will be an important feature of the community-based fund, and is discussed in detail in the section on training.

Activities of the community council

Activities of the innovators' workshop council will include therefore, organizing the workshops for farmer evaluations of high-potential technologies and for design of participatory system trials; managing the protocol for participatory system trials; and organizing local participation in monitoring environmental sustainability indicators. Another important function of the council will be as a forum for local participation in the analysis of the implied costs and benefits to different individuals or groups of the technologies being tested in the participatory system trials. The council will be a forum for discussing collective social arrangements that may be needed to support the use of certain technologies. If, for example, tenants are unwilling to maintain soil conservation measures such as contour barriers, the implications of such practices for rental agreements may be threshed out in the council. Another example, is the desirability of testing agroforestry practices in certain parts of a prototype site, of potential benefit to downstream-water users, but implying additional costs to farmers testing the practices. Such farmers will help the workshop identify viable adjustments in the technology to make it more acceptable to the individual; but at the same time, collective social arrangements may be defined through the workshop to accommodate different interests. The council will bring the criteria of different actors to the workshop agenda, to ensure that they are taken into account when the acceptability of technology is evaluated.

Identification of options for the future

Social science research on the institutional innovation outlined above will be an important activity of the project. At mid-point in the project, this research will provide recommendations on how to put the institutional innovations tested in the first half of the project on a permanent footing. The feasibility will be assessed of setting up a "learning center" or centers, at the community level, where local involvement in resource management regulation and technological innovation for agriculture might be formally united. Research will also provide evidence on how new institutional arrangements create new parameters for technology design.

4.0 Commercialization, value-added processes and small - enterprise development

The purpose of this activity is to create incentives for the adoption of ecologically sound management practices by linking these practices to commercialization of products or value-added processes, additional income generation and employment. A close relationship will be maintained between the introduction of technological components into the project's satellite and system trials, the economic evaluation of these, and the development of opportunities for commercialization through small enterprises.

Commercialization, product and process development, and creation of small enterprises will be carried out in close collaboration with PRODAR, REDAR, and the CIAT Cassava Utilization Section, which will provide methodological backup. Participation of producer organizations, NGOs and state agencies will be integral to this activity.

Study markets for high-value product opportunities

A study will be carried out to identify market opportunities and available processing technology for products of high potential for the design of prototype systems of sustainable land management in the project areas. Priority in the projects satellite and system trials will be given to plants, including trees, with potential for commercialization or transformation using known processing technology. Examples are the extraction of high-value essences from herbal plants to promote their use in highly efficient live barriers for soil conservation; cheese production linked to use of forage legumes grasses or trees which can be included in improved fallows and rotations or agroforestry; feed for small livestock; artisanal seed production. The project will prioritize product development with the potential to enhance diversity, the recycling of bioresources and the integration of crop-livestock enterprises in the prototype systems.

Feasibility studies

The feasibility of pilot testing one or two products in each watershed will be assessed. Results will be discussed in the site technical meetings and innovators' workshops, with the involvement of local producers, NGOs, and state agencies experienced in the development of small enterprises. Opportunities for the involvement of private-sector institutions in supporting the pilot enterprises and the commercialization of their product will be sought by the project. Based on the results of feasibility studies, pilot small enterprises, and test marketing will be initiated.

Strong links will be promoted through the innovators' workshop between producers' evaluation of technologies for inclusion in the participatory system trials and monitoring the pilot small enterprises. Research will analyze the relationship between farmers' criteria for the inclusion of sustainable farming practices in the participatory system trials, the way in which these are managed by farmers, and the raw material requirements of the pilot enterprises, to ensure integration of production, processing and marketing. If opportunities for product development are identified that require further research on technology development for processing, the project will work together with the appropriate institutions to formulate proposals and obtain further funding for this purpose.

5.0 Policy Guidelines

The objective of this activity is to develop policy guidelines for discussion with decision-makers and "downstream" (urban) beneficiaries of improved natural resource management in the experimental watersheds. The overall strategy is to introduce policy variables, identified from policy research, into the experimentation at prototype sites with the implementation of pilot incentive schemes designed with local participation.

Pilot incentive schemes will address the situation in prototype system sites where the private benefits of practices which have well-identified social benefits (e.g. reduced run-off and sediment load) are too minimal or too delayed to compensate farmers for the costs of implementing them.

Policy analysis

A literature review of case experiences will be conducted to identify the effects of policy variables (e.g. prices, land tenure, forest development, rural industrialization, and trade policies) on hillside resource management, to identify general guidelines for the design of pilot incentive schemes. Actual policies operating in the project's experimental areas will be analyzed and a framework will be developed for identifying “policy domains” in the experimental areas, in collaboration with GIS, so that potential policy interventions can be prioritized for the design of pilot incentive schemes. Results will be taken into account in feasibility studies for the development of small enterprises in prototype sites; and in the prioritization of components for satellite and system trials conducted by the project.

Economic analysis

Economic valuation of resource degradation in the experimental watersheds will be carried out, using data from the indicator studies. This information will be used in *ex-ante* economic evaluation of technologies entering satellite and system trials, to predict likely gaps between private and social costs and benefits associated with technologies that are desirable for improved resource management in the watershed.

Design of pilot incentive schemes

Information from the policy analysis, economic studies, and farmers' participatory evaluations of the technlogies will be combined to provide recommendations for the design of local pilot incentive schemes. Recommendations will be reviewed by institutions in the steering committees and in the councils. A key objective of this review will be to identify, in each site, the role of local institutions, particularly the innovators' workshop council and the community fund, in relation to the role of external regulatory agencies in managing components of a local pilot incentive scheme.

Pilot incentive schemes will combine mechanisms such as solidarity groups, in which farmers' enforce among themselves communally defined norms for soil erosion control or forest management, for example; credit instruments tied to ecologically desirable practices, or other locally identified incentives.

Management and financing of pilot incentive schemes

The project will establish collaborative arrangements with NGOs and state agencies, as appropriate in the experimental watersheds, for the financing and management of pilot incentive schemes which will be coordinated with community organizations.

Management of some components of the pilot schemes by the innovators' council and community fund will be an important feature of the experimental design. Community-based management will integrate decision-making about technological innovation, collective social controls, and incentive mechanisms at the local level. Where necessary, the project will inject seed *money* for initiating pilot incentive schemes. Priority will be given to the use of project funds to facilitate local decision-making and management of incentive mechanisms. Discussions with policy-makers of the recommendations obtained from evaluation of the pilot incentive schemes will aim to attract outside financial support for scaling up, and continuating of the pilot schemes.

Monitoring of pilot incentive schemes

Policy research will monitor and evaluate the implementation of pilot incentive schemes. Information from micro-zoning and socioeconomic surveys will be used to select a small number of case study households for in-depth assessment and long-term monitoring, to permit analysis of the relationship between policy variables, farm-level resource use, and technology choice. Case study households will be drawn from prototype experimental sites, and from other comparable communities outside the pilot incentive scheme, to permit assessment of the impact of the pilot incentives on farmer decision-making.

Participatory evaluation of management

The project will implement regular participatory evaluations of the management of a pilot incentive scheme with institutions and farmers taking part, to identify difficulties and unanticipated outcomes, as well as solutions to these which evolve as the scheme is implemented.

Recommendations to policy-makers

Information from policy research and evaluation of the pilot incentive schemes will be used to develop recommendations for policy innovation, to be discussed with policy-makers and "downstream" beneficiaries of improved resource management in the watersheds, and for publication and dissemination.

Appendix 2

CIAT Scientific Research Responsibilities

CIAT Hillside Program

Dr. Raúl Moreno, Hillside Program production systems specialist, based in Central America, will provide scientific leadership in strategic research for technology generation, and will work closely with the soil scientist staff also based on-site, recruited by the project and based on-site in Central America for the purpose. Dr. Moreno will provide technical support to the counter-part teams in Central America and national program scientists working in these sites.

Dr. Ron Knapp, soils and cropping systems specialist of the CIAT Hillside Program based in Colombia, will provide scientific leadership for the biophysical and socioeconomic research to operationalize sustainability. Dr. Knapp will coordinate indicator studies with the CIAT Land Use, and Germplasm Development programs, IFPRI, IICA, CATIE, CIMMYT and other institutions. Dr. Knapp will provide technical support to the counterpart team in Colombia and to national program scientists working on site.

Dr. Jacqueline Ashby, Hillside Program social scientist, will provide scientific leadership in relation to research on institutional models and the participatory research for technology generation.

The CIAT Hillside program will provide methodology and training from its farmer *participation project* to site coordinators, their assistants, national and local institutes collaborating in the participatory system trials, and innovator workshops.

The CIAT Hillside Program economists (one to be recruited by the project) will have the important role of integrating within each site, results for indicator studies, economic valuation of resource degradation, and *ex ante* and *ex post* evaluation of technology, and modelling implications for land use and farmer decision-making in technology choice. Scientific leadership will be provided by the Hillside Program economist based in Honduras for economic research with other institutions.

Other CIAT Programs and Units

Land Use

The CIAT Land Use Program will outpost a Rockefeller Foundation-sponsored visiting scientist as a member of the site-based team in Honduras. This sociologist, Dr. Sally Humphries, will lead on-site research related to institutional innovation and the studies of indigenous environmental indicators and farmer decision-making, working closely with Dr. Ron Knapp (Hillsides) and Dr. Scherr (IFPRI) in Central America. Dr. Peter Jones and Dr. William Bell of the CIAT Land Use Program will work with Dr. Ron Knapp (Hillsides) on indicator studies, being primarily responsible for the hillside interinstitutional database and GIS mapping.

CIAT Germplasm Improvement Programs

The Tropical Forages, Bean and Cassava Programs will work together with the Hillside Program through the work plans drawn up in annual planning meetings of the watershed steering committees. The project will draw on the relevant experience of program scientists for the objectives and activities of each work plan. Commodity program scientists will participate in annual planning meetings on-site as needed for the satellite trials, and will be primarily responsible for interpreting data and reporting results from satellite trials. They will work closely with counterpart assistants assigned to satellite trials by the watershed steering committees.

CIAT Cassava Utilization

The CIAT cassava utilization section has broadened its mandate to include value-added products and processes relevant to hillside and forest ecosystems. The section will provide scientific leadership, methodology and training to local and national organizations supporting pilot small enterprises and test marketing of products in addition to cassava. Products and processing technology will be identified by national program counterparts, consultants, and doctoral thesis students.

Appendix 3

A. Input by Other Regional and International Institutes

Introduction

Input by other regional and international institutes is divided into (1) site-based activities which are the concern of this project, and (2) networking and dissemination of results by the consortium members.

CIMMYT

1. Site-based project activities

CIMMYT will contribute to the project in Central America through its strategic research for the development of productivity-increasing, resource conserving technology for hillside maize cultivation systems, focusing on reduced tillage and cover crop technologies as appropriate to the project sites. The nature of this input will be identified through the development of work plans for site-based research in Central America. CIMMYT core-funded regional scientists would help plan work "on the ground", carried out by the counterpart teams and project staff based on-site, and help interpret results relevant to maize. On-site field research assistance and travel would be provided by the project.

2. Networking and Dissemination

CIMMYT helped establish a regional network of socioeconomists and members of the network will be able to become familiar with this project's results. The CIMMYT Economics program is developing methods and a diagnostic framework for resource conservation technologies for several sites in Mexico and Central America, and hopes to interact with this project's sites. For this purpose, the CIMMYT Economics Program is exploring ways to communicate with policy-makers and has initiated a joint activity, for which this project's results may be used with INCAE in San Jose, Costa Rica.

IICA

1. Site-based project activities

(a) **Policy seminars:** CIAT will subcontract IICA to coordinate the proposed seminars for decision-makers in national and local agencies, and for policy makers in the country where the sites are based. The seminars will discuss the project's experience, and the implications of the model for environmental planning and institutional reform.

(b) **Training courses:** CIAT will be subcontract IICA to conduct training courses related to policy issues. The events will be short courses targeted at technical personnel. The exact content of the training program will be developed based on a diagnosis of training needs. The program is expected to interact closely with an IICA training project involving Radio Netherlands, and concerning communications for agricultural sustainability. That project will both provide educational materials for the training events and serve as a vehicle for disseminating the conclusions which emerge from project events. Other training materials will be drawn from an IICA-GTZ project, which is helping IICA to develop a conceptual framework, methodologies, and instruments related to agricultural sustainability.

(c) CIAT will subcontract IICA to provide technical assistance for a diagnosis of the institutions operating in the selected watershed, to help improve their cooperation in the research and development activities.

2. Networking and dissemination

The Consortium aims to establish ongoing dialogue among governmental, nongovernmental, and international agencies, and local communities concerned with environmental planning in hillside areas in Central America. This project's site-based results would be utilized in regional seminars coordinated by IICA for this purpose, for which funding in addition to this project is being sought.

IFPRI

1. Site-based research

IFPRI's Environmental Production Technology Division will participate in site-based project activities as follows:

(a) contribute to indicator studies to operationalize sustainability with (i) field research on historical changes in land use and resource quality in the Honduras and Colombian sites, which will define "policy domains" in watershed sites and assist extrapolation of results (ii) methodological input to modelling effects of technology change on land use (iii) participation in survey research.

(b) provide scientific leadership in research on *policy guidelines for the hillsides*, and the intensive case study of farmers' decisions about existing resource management practices, their effects on environment and production, and how these are affected by policy variables.

(c) evaluation of pilot incentive schemes to derive guidelines for policy innovation. On-site field research assistance and travel would be provided by the project to participating IFPRI scientists.

2. Networking and dissemination

IFPRI will contribute to discussion and dissemination of project results with international workshops for a network of policy researchers working on hillside resource policy issues. Workshops will encourage and support replication and testing of this project's model in new sites. Funding for the network activities is independent of this project.

CATIE

CATIE's main contribution to the project in Central America will be in the areas of (a) watershed management and use of geographic information systems, to "audit" sustainability in prototype locations and at the watershed level, (b) agroforestry systems, and (c) nutrient cycling and run-off studies. The nature of this input will be identified through the development of work plans for the site-based research in Central America. CATIE scientists would work closely with Dr. Raúl Moreno (Hillsides) and help plan work "on the ground" carried out by counterpart teams and project staff based on-site, and help interpret results relevant to CATIE. On-site field research assistance and travel would be provided to CATIE scientists for work with the project.

PRODAR

The project's collaboration with PRODAR, an international network that supports rural agroindustrialization, will be managed by IICA and CIAT's cassava utilization section. PRODAR will provide information from its databases on products and processes of high potential identified by the project, and on organizations with experience in working with these products in Latin America. PRODAR will also supply links to other key players such as NGOs working in the field with rural agroindustrialization, university and food technology institutes. PRODAR may also assist in the development of proposals to take products or processes tested in this project beyond the pilot stage.

B. Input by National and Local Institutions

Central America

The following institutions have shown interest in cooperating with the proposed site in La Ceiba: Secretaría de Recursos Naturales Honduras, the Centro Universitario Regional del Litoral Atlántico (CURLA), Zamorano University, and World Neighbors. Local government (Municipios) and producer organizations in the area have demonstrated firm interest in the project to Dr. Sally Hymphries. Institutions like these would participate in the watershed steering committee to be formed in the Honduras site in 1993.

Site selection and identification of institutional partners in a second watershed in Central America will be carried out in the first year of the project.

Colombia

CIPASLA (Consorcio Interinstitucional para la Agricultura Sostenible en Laderas) is a group of local institutions in the Río Ovejas watershed, north Cauca, Colombia. Ten institutions have each formally assigned staff members to work with CIPASLA: CIAT; CVC (the Cauca Valley Corporation); DRI (Desarrollo Rural Integrado, GO); and CETEC (NGO) are members of the executive committee. HIMAT (small-scale irrigation, GO); CORPOTUNIA (NGO of the Carvajal Foundation); FIDAR (NGO formed by FUNDAEC); RENORDE (national network of watershed management agencies); CRC (agroforestry, GO) and UMATA (Unidad Municipal para Asistencia Técnica Agrícola) of Río Ovejas are members of both the consortium's board of directors and executive committee.

This committee began monthly meetings in December 1992, with a small operating budget formed from contributions by the participating organizations. The watershed committee began data collection to create an interinstitutional database for indicator studies, and has selected micro-zones for prototype sites.

Organization in Project Study Areas

Study areas proposed for this project are in the La Ceiba area on the Atlantic littoral of Honduras and the Río Ovejas watershed in Cauca Department, Colombia. A third study area will be selected in the first year of the project in Nicaragua.

1. Watershed steering committee

In each study area proposed for this project and defined as a watershed, an interinstitutional watershed steering committee will oversee the operational planning and execution of project activities, and the regular monitoring and evaluation of the work plans that will be undertaken by participant institutions. State and NGO agencies in the watershed and local community-based organizations will be represented. Land users' councils will be formed of local inhabitants in prototype sites and will be represented on the watershed steering committee.

The purpose of the watershed steering committee is to unify planning of natural resource management, agricultural production, rural enterprise development, and policy at the local level within a functional agroecological unit known as the watershed, or its micro-catchment basins. This institutional model is hypothesized by the project to be a necessary ingredient of sustainable agricultural development in the hillsides and will be refined.

Work plans

Watershed steering committees will convene regular planning meetings at which all institutions participating in the project will present work plans for group discussion, using the participatory planning by objectives methodology and the logical framework. The steering committee will define performance indicators for monitoring and evaluation, which will be included in work plans. The steering committee meetings will regularly report the results of evaluation.

Budget

Watershed steering committees will manage a budget for support to local organizations participating in the project. Fiscal control and reporting to donors of these funds will be done by CIAT. The steering committees will approve budgets for proposed work plans to carry out certain project activities by organizations in the watershed on an annual basis. Site coordinators will prepare financial reports in collaboration with a project administrative assistant (accountant) and project leaders.

Composition of counterpart team

The watershed steering committee will function like a board of directors. It will not implement work plans it solicits or approves. The executive arm of the steering committee will be the site coordinator and counterpart support staff. Site coordinators will be locally hired.

Some organizations (mainly GO) will be in a position to assign existing staff to work plans for which the steering committee will cover the operational costs; others (NGO) will require salaries to be wholly or partially funded to execute work plans.

In order to maintain coordination and accountability, all counterpart staff hired, directly or seconded, to carry out approved work plans with project funds will report to the site coordinator with respect to work plan activities.

In principle, the counterpart team will consist of a multidisciplinary team of local professionals qualified in the following areas:

- watershed management/agronomy
- agronomy and/or agroforestry
- small-enterprise development (marketing specialist)
- institutional development/community organization (social scientist)
- policy analysis (economist)

2. Land users' councils

Up to three prototype sites will be selected as representative of a micro-region within a watershed. Prototype sites will be meaningful agroecological units to local inhabitants, and will include a cluster of communities and households within a sampling framework designed for monitoring purposes with GS for the entire watershed. Within each prototype site, a council of local inhabitants will be formed to organize local participation in planning, monitoring, and evaluation of project work plans, and in executing appropriate activities.

The counterpart team specialist in institutional development and community organization will support land users' councils.

The exact functions of land users' councils and their relationship to watershed steering committees will be designed in the proposed diagnostic study of institutions.

The proposed functions of land users' councils are:

- represent community interests on the watershed steering committees
- organize innovators' workshops for farmer participation in technology evaluation
- organize local monitoring of environmental sustainability indicators
- monitor farmer involvement in carrying out the community work plan for participatory system trials, including the financial protocol
- support farmer-to-farmer training
- define and monitor collective social arrangements needed to support the use of certain technologies
- review recommendations for small-enterprise development
- review recommendations for pilot incentive schemes and define a role for the councils in these
- manage incentive-mechanisms in pilot schemes where appropriate, or contract this management from NGOs through the community fund
- manage the community fund for these purposes.

Appendix 4

References

1. Altierl, M. 1992. "Where the rhetoric of sustainability ends, agroecology begins: Grass roots field work in Latin America." Ceres No. 134 (Vol. 24, No. 2) March-April.

2. Barbier, E. 1990. "The farm level economics of soil conservation: The uplands of Java"; Land Economics #66(2):199-211.

3. Barrow, E.G.C. 1991. "Evaluating the effectiveness of participatory agroforestry extension programs in a pastoral system, based on existing traditional values". Agroforestry Systems 14:1-21.

4. Blaikie, P. and H. Brookfield. 1989. Land Degradation and Society. New York: Methuen.

5. Bocco, G. 1991. "Traditional knowledge for soil conservation in Mexico." Journal of Soil and Water Conservation #46(5):346-348.

6. CIAT/IICA, 1991. Agricultura Sostenible en Las Laderas Centroamericanas: Oportunidades de colaboración interinstitucional. San José, Costa Rica: Coronado, C.R.

7. Harrington, L. W. 1992. "Measuring Sustainability." Journal for Farming Systems Research-Extension. Vol.3 No.1: 1-20

8. Kaimowitz, D. 1992. "La experiencia de Centro América y la República Dominicana con proyectos de inversión que buscan sostenibilidad en las laderas." Documento para el Seminario sobre Agricultura Sostenible en América Latina del *BID e IICA*. Washington, D.C. 9-10 Septiembre.

9. Laing, D.L. and J.A. Ashby. 1992. "Adoption of Natural Resource Management Practices by Resource-poor Farmers." M. A. In Robisch (ed.). Forthcoming. Acceptance of Soil and Water Conservation Strategies and Technologies DITSL, Witzenhansen

10. Nimios, T. and R.F. Savage. 1991. "Successful Conservation in the Equatorial Highlands." Journal of Soil and Water Conservation 46(5):341-343.

11. Stocking, M. 1989. "Measuring Land Degradation." In Blaikie and Brookfield. pp.49-64.

12. Southgate, D. and M. Whitaker. 1992. "Promoting resource degradation in Latin America: Tropical deforestation, soil erosion, and coastal ecosystem disturbance in Ecuador." Economic Development and Cultural Change 788-807.

13. White, S. and F. Maldonado. 1991. "The use and conservation of natural resources in the Andes of South Ecuador." Mountain Research and Development 11(1):37-55.

Appendix 5

CIAT Project Experience

Donor: W. K. Kellogg Foundation

Location: Department of Cauca, Colombia, South America

Status: Ongoing

Duration:

phase 1 1987-1990
phase 2 1990-1994

Total value:

phase 1 US$490,000
phase 2 US$853,000

Goal: This project aims to develop methodologies for institutionalizing community-based capacity for adaptive technology testing, through farmer participation.

Objectives: To establish 70 committees of farmers (CIALs) conducting adaptive technology testing, using participatory methods, and evaluate their viability in three different institutional settings.

To institutionalize demand-pull from the rural community on the formal research system, through the CIALs.

Outputs: A tested methdology and training materials for establishing farmer committees for community-based technology testing, using participatory research methods.

Increased adoption of more diverse technologies selected and screened for local conditions by farmers.

Description of activities: This project is being conducted in the Río Ovejas watershed, in Cauca, Colombia, in collaboration with producer organizations, NGOs, local government, national agricultural research and extension services (ICA), and the watershed management agency (CVC).

	The project has established 30 farmer committees (CIALs), which carry out on-farm technology testing in cooperatives, NGO-run informal groups, and rural communities. A regular training program is conducted by an NGO for professionals to establish CIALs and provide training to farmers. Established CIALs gradually take over the planning, implementation and evaluation of on-farm trials, as visits from professionals diminish over time.
	Several CIALs established small business enterprises for artisanal seed production of varieties they selected. The CIALs formed a regional group for testing soil conservation technology and for evaluating tree species. The CIALs organize and partially finance a biannual meeting to exchange results of their experiences with each other. A training package of 12 handbooks is available. The performance of CIALs is regularly monitored on a number of indicators to provide data on effectiveness, impact and cost of the methodology.
CIAT's role:	CIAT is responsible for developing the methodology and training materials, training trainers, and validating the methodology. CIAT manages the project.
Evaluation:	Biannual participatory evaluation of progress is carried out with farmers and professionals participating in the project.
CIAT personnel involved:	Dr. Jacqueline Ashby
Partners:	The Carvajal Foundation, Cali, Colombia Corporación Autónoma Regional del Cauca (CVC) Instituto Colombiano Agropecuario (ICA) CORMAC, ECONORCA (producer organizations)

Appendix 6-A

CIAT C.V.

Centro Internacional de Agricultura Tropical

Jacqueline Anne Ashby

Citizenship:	USA/United Kingdom
Country of Residency:	Colombia
Position in Project:	Rural Development Sociologist
Education:	Ph.D., Development Sociology, Cornell University Ithaca, New York, 1980. Diploma of Education, Cambridge Institute of Education, University of Cambridge England, 1971. B.A. Honours, History, University of York England, 1969.
International Project Design and Management Experience:	**Hillside AgroEcosystem Program Leader, CIAT** 1992 to present Directed several special projects. **Senior Scientist, CIAT** 1987-1992 Director of the Special Project "Farmer Participation in Technology Design and Transfer", supported by the W.K. Kellogg Foundation: research for development of participatory methodology of technology evaluation; training and training materials development. **Senior Staff Sociologist** 1981-1987 International Fertilizer Development Center (IFDC): farming systems team member, adoption studies and gender issues. Directed special project on participatory research. 1980-1981 Rockefeller Foundation International Postdoctoral Fellow IFDC/CIAT Colombia: research of farmer decision-making in soil conservation (special project).

Research Associate, 1975-1978
Tribhuvan University and APROSC, Kathmandau, Nepal.

Areas of Specialization:

Environment, technology, and social organization. Participatory community development. Women in agricultural development. Farming systems research and extension.

Languages:

English	- Fluent
Spanish	- Fluent
French	- basic
Nepali	- basic

Publications:
(Author of 27 journal articles and book chapters, a representative sample of which appear here)

"Adopters and Adapters: The Participation of Farmers in On-Farm Reserach". J.A. Ashby in Planned Change in Farming Systems R. Tripp (ed). Wiley Sayce,1991.

"Targeting New Technology at Consumer Food Preferences in Developing Countries" W. Janssen, J.A. Ashby, M. Carlier and J. Castaño, Food Quality and Preference, 1992.

"Small Farmers' Participation in the Design of Technologies" in Altieri, M. and S. Hecht (eds.) Agro-Ecology and Small Farm Development, Boca Raton, FLA, CRC Press, 1990:245-256.

"Farmer Participation in Technology Development: Work with Crop Varieties". Jacqueline A. Ashby, Carlos A. Quirós and Yolanda M. Rivera. In Robert Chambers, Arnold Pacey and Lori Ann Thrupp (ed.) Farmer First. Farmer Innovation and Agricultural Reserach, Intermediate Technology Publications, Southampton Row, London, 1989. pp. 115-122.

"Agricultural Ecologies in the Mid-hills of Nepal". Jacqueline A. Ashby and Douglas H. Pachico. In Comparative Farming Systems. (ed). (Stephen B. Brush and Turner II, B.L.), Guildford Publications Inc., New York. 1988: 195-222.

"Methodology for the Participation of Small Farmers in the Design of On-Farm Trials". Jacqueline A. Ashby. Agricultural Administration, March/April 1986.

Appendix 6-B

CIAT C.V.

Centro Internacional de Agricultura Tropical

Raúl Alberto Moreno Martínez

Citizenship:	Chilean
Country of Residency:	Costa Rica
Position in Project:	Systems Agronomist IICA/CIAT Office in Costa Rica
Education:	Diploma (Dev. Studies) (U.K.), 1991 University of East Anglia
	Ph.D., 1971 North Dakota State University (USA)
	M.Sc., 1968 International Institute of Agriculture, Costa Rica
	B.Sc., 1966 Universidad Católica, Chile
International Project Design and Management Experience:	Systems Agronomist. Hillsides Program CIAT, 1992
	Production Systems Agronomist. Cassava Program CIAT, 1984-1991
	Cropping Systems Agronomist. Crop Production Dep. CATIE, 1974-1984
	Professor. The Graduate School. Chapingo. Mexico, 1973
	Visiting Professor. Universidad Autónoma. Santo Domingo, 1972

Present area of focus:	Research on development of more sustainable land management systems for hillsides in tropical America
Languages:	Spanish - Native English - Fluent French - Conversational

Appendix 6-C

CIAT C.V.

Centro Internacional de Agricultura Tropical

Edwin Bronson (Ron) Knapp

Position in Project:	Soil scientist, cropping systems specialist
Citzenship:	USA
Country of Residency:	Colombia
Education:	Ph.D., Soil Biochemistry/physics, Washington State U., Pullman WA. April 1980 M.S., Soil Biochemistry, Washington State U., Pullman, WA. December 1978 B.A., Economics, Dartmouth College, Hanover, N.H. June 1965
Languages:	English -Native Spanish -Conversational
International Research Experience:	**Centro Internacional de Agricultura Tropical, (CIAT)** Research on the sustainability of agricultural systems in Hillside Agro-ecosystems focusing on defining relationships for productivity - degradation, market cost - soil equilibrium Nov. 1992 to present **Centro Internacional de Mejoramiento de Maíz y Trigo,** (CIMMYT), Cali-Colombia Developed detailed crop management, climate and soil databases and maize dot density distribution maps; developed stochastic yield gap analyses using OFR results, crop modelling and GIS analysis; carried out geostatistical spatial analyses to improve selection in abiotic stress breeding nurseries affected by pronounced variability over short distances; studied sustainability mechanisms related to

fertility and soil acidification resulting from maize cultivation in one acid soil savanna ecosystem.
Jan. 1987 - Nov. 1992

Centro Internacional de Mejoramiento de Maíz y Trigo,
(CIMMYT), Texcoco (El Batan), Mexico
Designed, managed and taught a seven month field oriented, in-service production training course for university graduate agronomists from LDCs. Supervised graduate students and organized short term, in-country courses. Consulted for the World Bank.
Oct. 1980 - Jan. 1987

Professional Memberships:

- American Society of Agronomy
- Crop Science Society of America

Publications

Journals:

Knapp,E.B.,L.F.Elliot,and G.S.Campbell.(1983).Microbial Respiration and Growth During the Decomposition of Wheat Straw. Soil Biol.Biochem.15,No.3,319-323.

Knapp, E.B.,L.F.Elliot, and G.S.Campbell.(1983). Carbon, Nitrogen and Microbial Biomass Interactions During the Decomposition of Wheat Straw: A Mechanistic Simulation Model. Soil Biol. Biochem.15,No.4,455-461.

Published Proceedings:

Knapp,Ron [E.B.] and Compton Paul.(1985). Establecimiento de Normas: Un Paso Crucial en el Arte de Fijar Prioridades de Investgacíon y Produccíon. In: El Sorgo en Sistemas de Produccíon en America Latina. ICRISAT-INTSORMIL, p199-205.

Osmanzi,M.,S.Rajaram, and E.B.Knapp.(1987). Breeding for Moisture-stressed Areas. In: Drought Tolerance in Winter Cereals. ed. J.P.Stivastava, E.Porceddu, E.Alcevedo, and S.Varma. 1987 ICARDA. John Wiley & Sons Ltd.

Knapp,E.B. and A. Violic.(1989). Manejo de Experimentos en Fincas Bajo el Sistema de Labranza de Consevación. In: XI Seminario. Labranza de Conservación en Maíz. Ed. H.Barreto, R.Raab, A.Tasistro y A.D. Violic. IICA-BID-PROCIANDINO.1989. Quito,Ecu. PROCIANDINO. 195p.

Knapp,E.B., O.Urdinola M., O.Carmen C., and A. Ramírez V.(1990) Diagnosticando Prioridades de Investgación y Extensión: Un Estudio de Casos en la Zona de Ladera, Valle del Cauca, Colombia. In: Memorias XIII Reunión de Maiceros Zona Andina. Chiclayo, Peru. 25-30 Sept. 1988. INIPA, Lima Peru. p180-194.

Knapp,E.B., S.Pandey, and H.Ceballos.(1990). El Programa Regional Suramericano de Maíz del CIMMYT 1989-1990. In: Memorias XIV Reunión de Maiceros de la Zona Andina. Maracay, Venezuela. 17-21 Sept.1990.

Knapp,E.B.(1990). La Formulación de Recomendaciónes a Patir de Datos Agronómicos o: Datos son Datos, Información es Poder. In: VII Curso Corto. Sistemas de Producción: Investigación en Campos de Productores (Caso Maiz). IICA-BID-PROCIANDINO.1990. Quito,Ecu. PROCIANDINO.191p.

Knapp,E.B., S.Pandey, and H.Ceballos.(1992). The Use of Spatial Analysis in Nutrient Stress Maize Breeding. In: International Symposium on Environmental Stress: Maize in Perspective. Belo Horizonte,MG,Brazil. 8-13 March 1992. EMBRAPA-CIMMYT. In press.

Knapp,E.B.(1992). Uso de Modelos de Simulación en el Diagnostico de Riesgos y la Formulación de Dominios de Recomendación. In: Memorias XXXVIII Reunión PCCMCA. Managua, Nicaragua. 23-27 March 1992. PCCMCA, Managua, Nicaragua.

In Press:

Knapp,E.B., H.Ceballos, and S.Pandey.(1992). Uso del Análisis Espacial en Viveros de Mejoramiento de Maiz en Condiciones de Estrés por Nutriementos. In: Memorias XXXVIII Reunión PCCMCA. Managua, Nicaragua. 23-27 March 1992. PCCMCA, Managua, Nicaragua.

Published Abstracts:

Knapp,E.B., and H.H.Cheng.(1979). Inorganic nitrogen status in the Soil in Lysimeters Simulating No-Tillage Wheat. Agronomy Abstracts 1979.p.158.

Knapp,E.B., L.F.Elliott, and G.S.Campbell.(1980) The Interrelations of Carbon, Nitrogen and Microbial Biomass During the Initial Decomposition of Wheat Straw. Pacific Division Am. Assoc. for the Advancement of Sci. Abstracts. 1980. [This paper was awarded as the best paper presented at the 61st annual AAAS Pacific Division meetings.]

Tasistro, A.S., A. Violic, and E.B. Knapp. (1983). Weed Control Practices in Maiz (Zea mays L.) and wheat (Triticum aestivum L.) in Mexico. In: Weed Sci. Soc. of Amer. Abstracts. 1983.

Other Publications:

Knapp, E.B. "Diagnosing Factors Limiting Productivity in Wheat Production". Twenty competency-based tutorial instructional modules.

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File C. SDC

Copies for: ~~GAN FI RR RH~~

Appendix 7

Partners Confirmation Letters

DIREKTION FUER ENTWICKLUNGSZUSAMMENARBEIT & HUMANITAERE HILFE (DEH)
DIRECTION DE LA COOPERATION AU DEVELOPPEMENT ET DE L'AIDE HUMANITAIRE (DDA)
SWISS DEVELOPMENT COOPERATION (SDC)
DIREZIONE DELLA COOPERAZIONE ALLO SVILUPPO E DELL'AIUTO UMANITARIO (DSA)
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No. of pages incl. cover page:3

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Ref: t.311 Zentralamerika 14 Datum/date: 5/7/93
st ve2>fax/ciat/laderas

an/à/to: CIAT, Cali, Colombia, Att.: Dr. Jaqueline Ashby Fax:57-23-647243

Betrifft/Concerne/Regarding: CENTRAL AMERICAN HILLSIDES PROJECT (CAHP)

As announced in our fax of May 21, 1993 we are now in a position to give CIAT a reply on the above proposal. SDC has now formally decided to consider the proposal and to continue negotiations with CIAT which should lead to a memorandum of agreement between the two parties. SDC's financial commitment however has to be **limited to a maximum amount of US$ 500'000 annually**; this restriction is due to cuts affecting our regional budgets. Besides, several important questions have been raised in our internal discussions on which we would like to elaborate:

1. SDC's financing of CAHP would come from regional (and not agricultural research) funds while CIAT apparently considers CAHP as part of its core activities; this might lead to different appreciations on the role of CAHP and the degree of SDC's participation in the project preparation and execution: SDC's participation in the project preparation and execution should be in proportion to its financial contribution to CAHP.

2. Based on our experience from Central American networks, the budget allocations for operations, communication and support to other organizations seem too low in relation to the personnel cost. The question also came up whether the posting of three international staff to three different locations (Costa Rica, Honduras, Nicaragua) was really justified and would not entail high costs (financial and others) in terms of communications, infrastructure, logistics etc. In the light of SDC's financial limitations, possibilities of slimming down and streamlining CAHP may have to be explored.

3. Despite many interinstitutional contacts in the preparation phase of the project the question remains whether the envisaged mechanisms of institutional participation will allow NARS, NGO's etc. to actively determine the course of the CAHP, finally leading to their "ownership" of the project results. This question is essential for the success of the project and should be addressed during the preparatory August workshop.

4. Collaborating institutions should become real partners and not mere transmission bells facilitating the contacts between CIAT and the field. We understand however the need to utilize in comparative, multi-site studies the same methodology at various sites. A delicate balance will have to be struck between these two requisites.

5. In a similar way a balance will have to be found between research on technical and agronomical issues, mainly related to soil-science where many questions remain unanswered, and research on socio-economic and policy issues which is particularly important in the centralamerican context. A priorization for different areas will be necessary. It will also be essential to avoid duplication with work done by other actors, in this regard the Consortium and the workshop in August should be very helpful.

SDC is aware of the long term perspective such a project involves. A first financial commitment would however be limited to two years, taking into consideration the many open questions and the innovative character of the project. It is evident that after two years an assessment of research-*results* will hardly be possible. What should however be analized in depth between CIAT and SDC at that point are questions regarding research-*priorities, methodologies* and *interinstitutional collaborations*. For this purpose reference indicators should be defined at the outset of the project.

With a view to finalize our internal commitment procedures, we give a high importance to the workshop scheduled for end of August. We would suggest to have it on 27 and 28 of August in Managua. It should be made sure that a balanced set of relevant institutions is represented by knowledgable and interested people. SDC together with its regional office, Intercooperation and Pasolac would probably be represented by four to five people. Based on a proposal with programme, participants and budget, SDC could consider to finance the meeting and to sponsor a moderator. Kindly send us a proposal a.s.a.p.

As an annex we send you the covering page of a World Bank report which is of great interest in the context of CAHP. We suggest that CIAT get a copy of the document from the Bank. CIAT may also consider to invite the main author, Dr. Ernst Lutz, to the August workshop (ENVPR, Tel.: 4731043, Fax: 4770968).

Please note that our officer in charge of this project (Felix von Sury) will be back to the office only on July 23. In his absence Willi Graf is acting as contact person (Tel. 613331).

LATIN-AMERICA SECTION
The Head

A. Schläpfer

cc: - ODEHON, CORMAN (p. Kurier)
- SCL/SUP, EZ/GW, VS

- Date of meeting
- Expectation
- Intert. level commitment
- final project document.
- final budget - date.
h. l time

IDRC CRDI CANADA

International Development Research Centre
Centre de recherches pour le développement international

[illegible]

TO/A: Jacqueline Ashby	
DESTINATION: CIAT, Hillsides Porgramme	
CITY/VILLE: Cali	COUNTRY/PAYS: Colombia
NO. FAX NO.: 57-23-647243	NUMBER/PAGE/NOMBRE: 1
FROM/DE: Ronnie Vernooy	DIVISION: ENR / ERN
DATE: June 24, 1993	FILE NO./NO. DOSSIER: 93-0008

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MESSAGE

ear Jacqueline

hanks for sending us the details on the budget of the request to IDRC. I have a few questions:

Re: Central America, we did not receive the Appendix 1 to the budget notes concerning the Central merican part. Is the US$ 10,000 (for 1994) and seed money (for 1993) included in the Colombian part ? If ot, please send me the details: how much is the seed money; is there an overhead on the Central American udget ?

The total request as stated right now is US $ 446,290 or about CAD $ 550,000. As I told you on the phone, e have about CAD $ 500,000 programmed for this project. There is maybe some room for manoeuvre, but AD $ 60,000 is too much, and if the Central American still has to be included, this figure will even be gher, I guess. Could you please have a look at this ?

It would be useful to have an indication of the amount SDC will contribute to the project.

Where in Nicaragua will the research be carried out ? Could you give a brief description of the case study te (this has to be included in the Project Summary that goes to the Board, and will help us to plan other oposal for research in Nicaragua).

We will have some more time to prepare the final complete budget as the project will have to be ready in ugust (for projects over CAD $ 500,000 there procedure is different).

egards, Ronnie.

CIAT has in-house facilities for the production of high-quality training materials and video programs for scientific and extension agricultural activities.

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