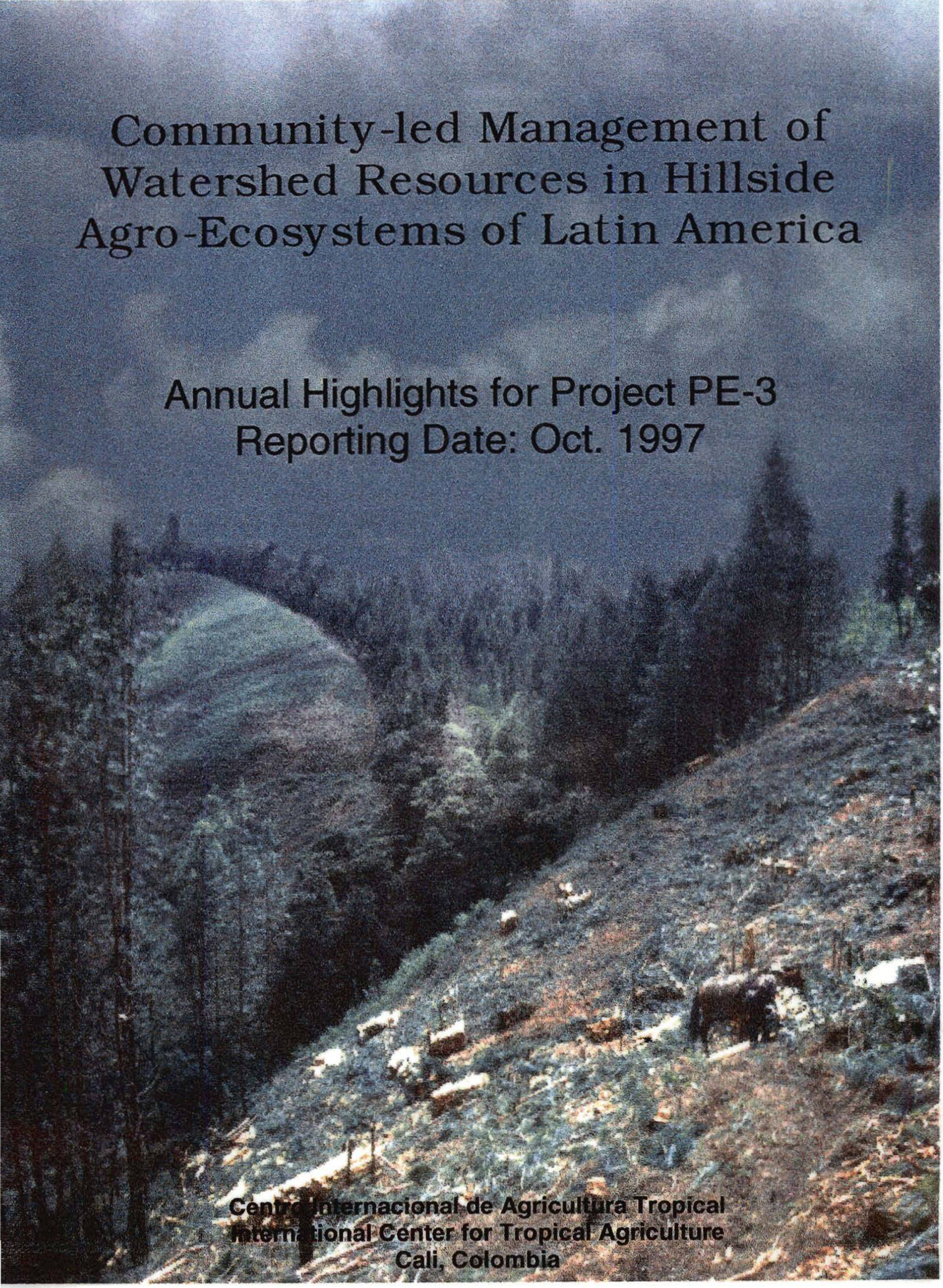

Community-led Management of Watershed Resources in Hillside Agro-Ecosystems of Latin America

Annual Highlights for Project PE-3
Reporting Date: Oct. 1997

Centro Internacional de Agricultura Tropical
International Center for Tropical Agriculture
Cali, Colombia

Donors:

- Eco-Regional Fund to Support Methodological Initiatives
- Inter-American Development Bank
- International Development Research Centre
- Tropical America Eco-Regional Program: a CGIAR Systemwide Initiative
- Royal Danish Ministry of Foreign Affairs (Danida)
- Swiss Agency for Development Cooperation

Collaborators:

IICA

CGIAR Centers:

- CIMMYT
- CIP
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- Bern (Switzerland)
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Governmental and Non-Governmental Organizations:

- DICTA
- INTA
- Ministerio de Estadística y Censo (Honduras)
- CONDESAN (consortium)
- CIPASLA (consortium)
- CLODEST (consortium)
- PASOLAC

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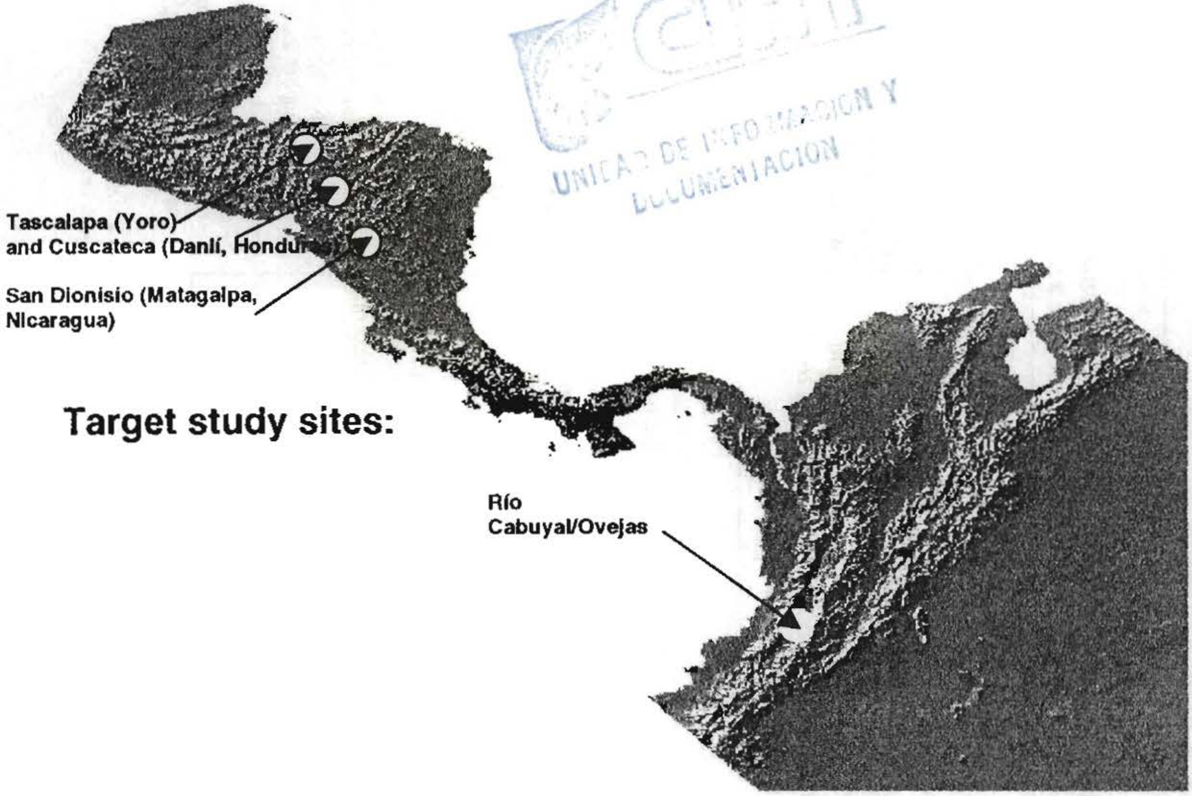
Project PE-3: Community-Led Management of Watershed Resources in Hillside Agro-Ecosystems of Latin America



Community Management of Watershed Resources in Hillside Agro-Eosystems of Latin America

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

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

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

Fig. 2. Project PE-3: Community-led Management of Watershed Resources in Hillside Agroecosystems of Latin America

Project objective

To develop generic databases, decision-support tools and social organizational models for planning research and development activities led by hillside community action groups

Outputs	**1. Procedures established for use of databases to target problems, priority areas, and beneficiary groups for intervention in watershed management.**	**2. Strategic techniques developed to strengthen capacity for location-specific diagnosis, monitoring, and impact assessment of environmental problems and interventions.**	**3. Generic interactive decision-support tools produced to strengthen stakeholders' capacity to evaluate location-specific innovations and to negotiate action plans.**	**4. Institutional capacity to use decision-support tools established for community-managed development of watershed resources.**
Activities	1.1 Revision, edition, consolidation, and georeferencing of data into user-friendly biophysical and socioeconomic databases, including for gender. 1.2 Development of a step-wise framework for increasing the precision and resolution of spatial data ("successive refinement"). 1.3 Characterization of key parameters ("indicators") of land use change at plot, farm, catchment, and watershed scales. 1.4 Development of strategic procedures for applied policy impact analysis for use by local interest groups, including women's groups.	2.1 Development of field techniques for local monitoring of soil and water indicators of susceptibility to change. 2.2 Development of natural resource evaluation techniques, both financial and nonfinancial. 2.3 Identification of internal system indicators and their calibration with external system health and sustainability indicators. 2.4 Incorporation of indigenous indicators into knowledge-based decision-support tools, and their consolidation with spatial (GIS) analysis. 2.5 Testing methods and tools for agroecosystem health planning and technology testing at a landscape scale with community leadership, including women.	3.1 Development of techniques for simplifying extensive database queries by "non-experts." 3.2 Benefit-sacrifice assessment for upstream and downstream stakeholders, e.g., erosion, pollution, and water demand trade-offs. 3.3 Simulation of potential impact of current and exploratory technologies within the context of political environments. 3.4 Development of knowledge-based models to complement "databased" process models for decision support. 3.5 Cost-benefit analysis of requirements for alternate decision-support tools.	4.1 Development of organizational principles and procedures for watershed user associations and institutional consortia. 4.2 Participatory research on organizational development and collective action. 4.3 Use of decision-support tools to develop preferred scenarios with stakeholder organizations, including women's groups. 4.4 Development of computer-assisted training materials for negotiating collective action plans and for managing "change", using decision-support tools and techniques. 4.5 Conduct training with research networks (e.g., ICASA and commodity and NRM networks). 4.6 Management of project reporting, documentation, and information exchange.

Establishing Procedures for Database Use *(Output 1)*

Database development *(Activity 1.1)*

That aspect least thoroughly understood rather than most thoroughly understood often dictates the efficacy of the process of planning development projects.

Two common "information pathologies" that can occur from lack of authoritative information are false analogies of ecosystem characteristics and overgeneralization. Characteristics refer to potential production, resilience, sustainability, *et cetera* and overgeneralization refers to lack of understanding of the nature and range of ecosystem variability.

During 1997, several tens of alpha-numeric and GIS databases were reviewed, edited, consolidated and georeferenced. Databases and coverages were exchanged and made available to numerous collaborators by means of our Web site and CD-ROM (*vide infra*).

Inventorying Resources *(Activity 1.2)*

A critical element of success in the process of setting achievable outputs for community action, not to mention measurable milestones, is an accurate inventory of available resources. Without a resource inventory, no baseline condition can be described, no trends defined, no progress measured and gaining commitment of key individuals and organizations will be problematic.

To date, census data and *ad hoc* household surveys have been primary mechanisms for inventorying the resource base. Citation of census data can be found in many publications including those of IARCs. We have been particularly interested in what census/survey data really measure. In technical terms, what system is being quantified and where does the system fit in the hierarchy of biophysical and socio-economic systems from farm to country scales?

As with most of the research activities carried out by Project PE-3, we are particularly interested in the cost and value of information (*viz*. "new Knowledge"). Costs are relatively fixed. The value of any new information will vary from need to need, permitting stakeholders to decide for themselves how best to formulate action plans.

During 1997, significant progress was made towards assessing the role of national agricultural census data of land use for inventorying the state of community-scale watershed systems. The studies depend upon quantifying relationships between data extracted from remote sensed images and data available from agricultural censuses. Very detailed work is most advanced for the Tascalapa watershed in Yoro, Honduras, but is being repeated for validation in the other three targeted watershed sites.

Data sets:

Two basic data sets were used in this study. Both derived from Landsat TM images with a basic resolution of 30m. Landsat TM images are arguably the most widely used throughout the world for large area land cover studies. During 1997 we will completed land cover analysis for 80% of Honduras. For in depth methodological studies multiple images of different dates were used to ensure maximum unobscured coverage. For example, three images were combined for a study of the Department of Yoro, which includes the Tascalapa study site.

The study area and municipality classifications had been ground-truthed with the aid of 1:20,000 scale aerial photography from April and September 1993. Field observations were made in March-May, 1997.

The Honduran Ministry of Statistics and Census supplied national Agricultural Census Data for 1993.

Method Summary:
A land map of the Tascalapa watershed, based upon field-validated air-photograph interpretation was used as a base-line reference for generating spectral signatures for ten land cover/land use classes. The TM classification for the watershed study area showed good agreement with the classification using high-resolution air photograph.

To compare land cover derived from TM imagery with agricultural census data, it was necessary to expand the area classified to cover the extent of the political boundaries of Departments or municipalities (Fig. 3). This is because published census data are only available for traditional political units. This severely limits its use, making it impossible to characterize non-traditional landscapes like community watersheds using currently available government census and statistical data.

For the methodological study, the original Landsat TM image was re-sampled to produce a range of pixel resolutions, i.e., 32m, 50m, 100m, 250m, 500m and 1km. Land cover classification estimates beginning with different resolutions were compared with census estimates (Table 1).

Finally, results of a classification for the Department of Yoro at a resolution of 100m were compared with published census data. The comparison included three degrees of detail, (a) agricultural land use/non-agricultural land use; the latter comprising settlement/bare land and sparse conifer range land, (b) cropland including bare fields/ pasture/ fallow/ forest and woodlots/ non-agricultural land, (c) ten land cover classes.

Results relating pixel resolution:
Estimates of "annual cultivation", although higher than census estimates, remain constant until 100m, and then increase in proportion between 250m and 1km pixel resolutions. Estimates for "perennial cultivation" remain more or less constant and then drop between 250m and 1 km. The estimate for "pasture" increases rapidly after a small decrease between 32m and 100m resolution. "Fallow" estimates change markedly with sudden decreases at 50m and again between 500m and 1 km. "Forest/woodlots" estimates fluctuate, decreasing at 100m and 500m resolutions. With the exception of "perennials" (CV=36), variation across pixel resolution within land cover class is small with coefficients of variation well below 10.

Contrary to expectations, there is no obvious relationship between estimates from remote imagery and figures derived from the census. This was expected in the case of "forest-cover", as farmers do not privately own much of the forested land, although small *woodlots* managed for wood products are common.

A second study compared estimates for three degrees of differentiation of land cover type derived from remote imagery and published census data for the Department of Yoro. Secondary data for the Department of Yoro indicated it would have a significantly different geomorphological and land cover profile than the two municipalities of Yoro and Sulaco. Given that decreasing pixel resolution resulted in only minor variation in estimates of major land cover classes, it was decided that land cover estimates would be carried out using a 100m pixel resolution.

Fig 3. Land cover classification map of the *municipios* of Yorito and Sulaco, Honduras. The Tascalapa watershed is partitioned by the political boundary.

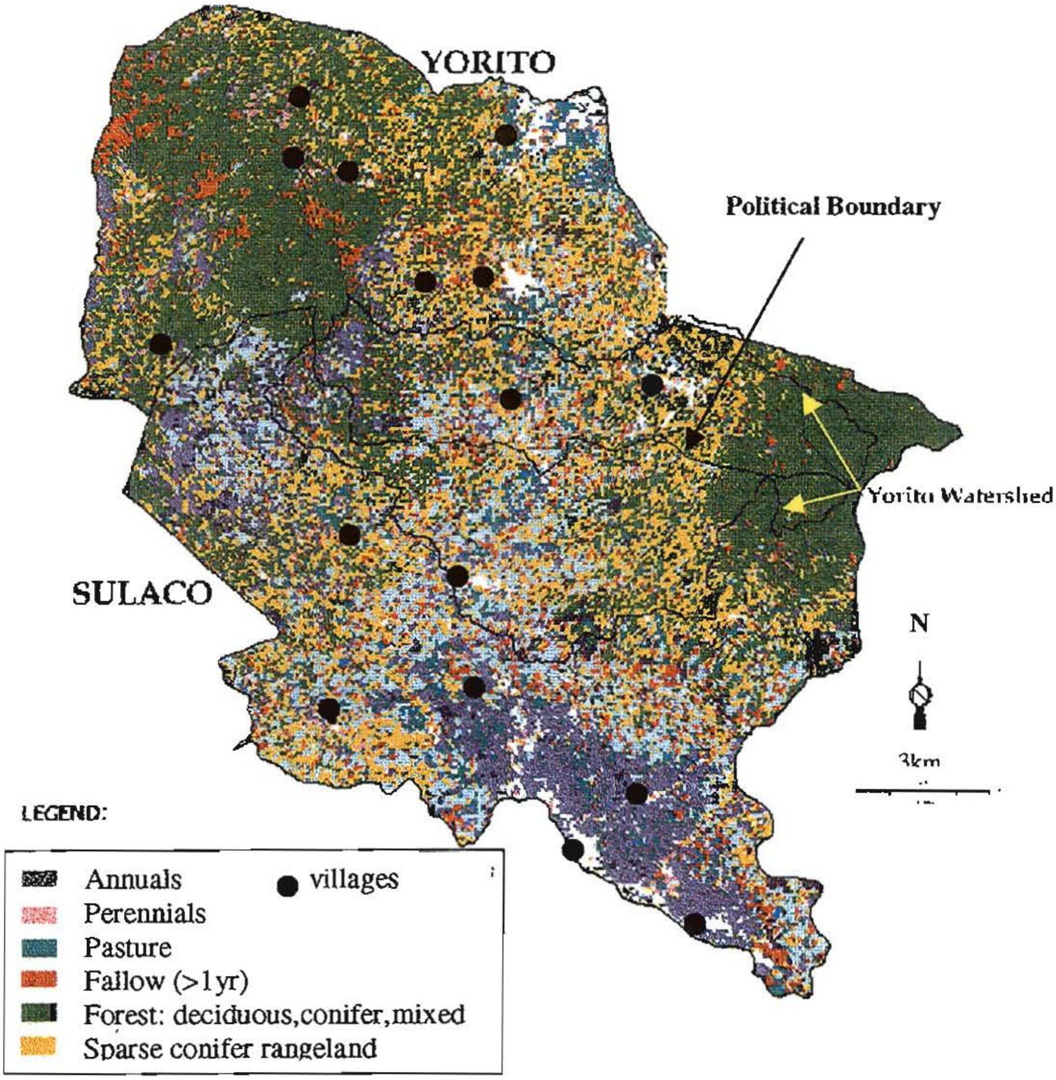


Table 1. Land cover characterization for Tascalapa watershed, Department of Yoro, Honduras, showing affect of pixel resolutions.

Land Cover	Agric. Census	TM Image 32m	TM Image 50m	TM Image 100m	TM Image 250m	TM Image 500m	TM Image 1 km
				ha			
Annuals	4,855	6,084	6,103	6,100	6,175	6,372	6,640
Perennials	2,455	481	471	473	456	393	113
Pasture	6,567	2,866	2,865	2,886	2,855	2,966	3;512
Fallow (>1yr)	2,074	3,251	3,527	3,251	3,617	3,493	2,939
Forest	954	13,766	13,219	13,752	13,510	12,743	13,393
Sparse conifer rangeland		8,843	8,876	8,851	8,843	9,251	9,537
TOTAL	16,905	35,291	35,061	35,555	35,456	35,218	36,134

Table 2. Comparisions of areas for three degrees of detail of land cover characterization for the Department of Yoro, Honduras. Landsat TM image was sampled at 100m².

	1993 Agricultural Census			Landsat TM (composite of 3 dates)		
Land cover class	3rd Degree	2nd Degree	1st Degree	3rd Degree	2nd Degree	1st Degree
	ha			ha		
Annual crops and fallow <1yr	**45,812**			**37,263**		
Burned landscape	*			**17,328**		
Perennial crops	**35,222**			**48,155**		
Total cropped and prepared land		81,034			102,746	
Pasture	**131,628**	131,628		**118,859**	118,859	
Old (bush) fallow >1yr	**38,159**	38,159		**119,972**	119,972	
Total agro-pastoral land			**250,821**			**341,158**
Deciduous forest and woodlots				**81,609**		
Mixed forest and woodlots				**84,965**		
Conifer forest and woodlots				**107,085**		
Sparse conifer rangeland				**62,322**		
Total silvo-range land	**18,560**	**18,560**	**18,560**		335,984	**335,984**
Infrastructure, bare and eroded land				61,357	61,357	61,357
Unclassified [1.]	501,759	501,759	501,759	37,219	37,219	37,219
TOTAL	771,140	771,140	771,140	776,141	776,141	776,141

1. For the Census, the class "Unclassified" was calculated as the difference between published figures for total area and the sum of Census classes. * : In the Census, the class "Burned landscape" is assumed to be included within one of the classes of "cropping".

The Department of Yoro has 771,700 ha according to published government data and 776,140 ha as calculated by analysis by remote imagery and geographical information systems (GIS); an insignificant discrepancy of 0.6%. This is a bit surprising as we have shown in previous studies that areas of hillside landforms can be seriously underestimated when calculated by GIS software packages, up to 20% in our studies of the Tascalapa watershed. This is due to the effect of slope, a factor not considered in the 776,140 ha estimate. Although it has not been verified, one suspects that the published data may not be derived from survey data but rather also calculated from a flat map representation.

Table 2 summarizes results. As mentioned above, the agricultural census does not pretend to provide a complete estimate of forest-cover. For technical reasons, a percentage of the forest/woodlot classified on the image represents perennial crops such as coffee and perhaps some banana and sugarcane. Excellent estimates of area in coffee are available from the Honduran Coffee Institute (IHCAFE). The Project is sharing data with this organization and together we are looking for ways to improve image classification using IHCAFE annual survey data.

At the intermediate level of detail, there appears to be a relationship between the cumulative figures for cropland and ploughed fields and the census total. The slight increase represented by the image estimation may be due, at least in part, to forest clearance during the time lapse between the 1993 census and the satellite image acquisition dated March 1995. The image classification resulted in equal areas of pasture and old (bush) fallow, whereas the census is 'strongly biased' toward pasture with fallow contributing less than a third of the area reported for pasture. This discrepancy may be partly due to the spectral confusion between "fallow more than a year old" and "pasture", particularly regarding the younger fallow, where bush and shrub regeneration is minimal. It may be useful to apply a probability factor-weighting to the *maximum likelihood* classification based upon the census ratio of 3.4:1 for pasture: fallow > 1 year, in order to improve estimates of these two image classes.

At the "third-degree" level, where ten land cover classes have been mapped, the Census figures have again been compared with the areas derived from the spectral classifier. It is interesting to note that the class "perennial cultivation" for the Department of Yoro was overestimated by 13,000 ha, but significantly underestimated for the municipalities of Yorito and Sulaco. This suggests that valley crops such as oil palm and plantain/ banana are easier to classify. Shade-grown crops such as coffee are much more difficult to detect using remote sensing methods.

By comparison, the census reported on no more than 35% of the total geographical area of the Department of Yoro. We are looking at other Departments of Honduras to determine the relation between census data and image classes. This research is not meant to raise questions about either census data or the usefulness of remote imagery. Clearly, census data characterize some sub-system in an agro-ecological hierarchy. The potential for using these data, gathered at great expense, to improve decision making remains to be seen and will be addressed in partial fulfillment of a PhD degree in collaboration with the University of Liecester.

Structure, function, change ***(Activity 1.3)***

As presented in the introduction and again in Fig 2, an output of the Project is the development of procedures using databases to target groups of stakeholders who will potentially benefit from investments in development. Although procedures and databases being developed can be used to target a wide range of rural stakeholders, the Project is itself interested in opportunities available to the least advantaged of the rural population. Our short-term focus is the nexus of poverty and availability of potential resources.

1997 saw completion, with collaboration by CIAT and CONDESAN (Consortium for Sustainable Development in the Andes), of an evaluation study commissioned by the International Fund for Agricultural Development (IFAD, a CIAT donor). The study resulted in recommendations for how IFAD-funded projects could more effectively address natural resource management and impoverishment issues in Central America, the Caribbean and the Andean hillside regions.

The study reviewed 32 projects implemented by IFAD between 1979 and 1994. Conclusions drawn from the IFAD review were incorporated into a study designed to test procedures identifying impoverished rural populations based upon researcher-selected "indicators", i.e., model parameters available in databases developed by the Project and collaborators (*viz.* Activity 1.1). Parameters were chosen based upon five principles believed to be critical elements of success for development projects interested in alleviating rural poverty while sustaining productivity of the resource base.

The five critical elements are:

- Proposed interventions should have a clear strategic conceptualization. For example, a focus on agriculture as a vehicle for capital accumulation. Only through a well-conceived strategic framework will results be replicable.

- Target populations of beneficiaries should be clearly defined. In principle, criteria of exclusion can be applied. (*vide infra*)

- Proposed technological interventions should be evaluated rigorously, especially for risk. Simple economic partial budget analysis is often not enough.

- Serious attempts should be made at developing project partners, including both public and private sector. The trade-off for maintaining bilateral identification with a project is high transaction costs.

- Thorough project monitoring, evaluation and reporting is necessary if a body of knowledge, based on past collective experiences, is to be developed. Otherwise, each project becomes an *ad hoc* exercise.

Targeting beneficiaries in Honduras.
In a test of methods, the 1993 Agricultural Census supplied by the Honduran Institute of Statistics and Census (INEC), and re-aggregated to the geographic scale of village (*aldea*) was screened according to a pattern of "successive refinement" using criteria for inclusion-exclusion (Table 3).

The 5 criteria used were:

1. Villages with more than 30% of landowners having less than 4 head of livestock.
2. Villages with more than 50% of landowners having less than 6.4 ha of land.
3. Villages with more than 60% of landowners having less than 1.2 ha of annual crops.
4. Villages with more than 50% of landowners more than 40 years old. This criterion supposes that the poorer and older landowners have less time, and therefore less opportunity, to accumulate capital.
5. Villages with less than 20% of landowners preparing land using a tractor.

Table 3. Results of screening the database of the 1993 Agricultural Census for Honduras with the objective of identifying villages presumed to offer the greatest opportunity for development projects focusing on the alleviation of poverty.

Parameter Considered	No. of villages	No. of landowners
Criterion 1	**2,583**	**245,053**
Criteria 1,2	**1,398**	**133,680**
Criteria 1,2,3	**102**	**10,390**
Criteria 1,2,3,4	**78**	**7,136**
Criteria 1,2,3,4,5	**32**	**4,336**

Based on the screening of the databases, three classes of villages were defined. Relatively *affluent villages* where projects targeting poverty will likely have limited impact on absolute numbers of poor. These villages are characterized by households with more than 4 head of livestock, more than 1.3 ha of annual crops and land preparation by tractor.

Critical villages, where direct aid may be needed, but there is little opportunity for cost-effective technological intervention to reduce poverty. These villages are characterized by a large percent of households with less than 1 head of livestock, less than 1 ha of annual crop, land preparation with hand labor, no hired labor, no irrigation and headed by members more than 40 years old.

Opportunistic villages are believed to have the best opportunities, based on agriculture, for growing out of poverty. They represent the remaining villages.

Existing production systems and the influence of development strategies.
A study describing current production systems within community watersheds and how they relate to past development efforts was carried out in five target study sites. These sites were the Tascalapa Watershed in Yoro, Honduras, the Río Calico Watershed in Matagalpa, Nicaragua, the Río Cabuyal/ Ovejas Watershed in Cauca, Colombia, and two CONDESAN sites, Río El Angel, Ecuador, and La Encanada, Peru.

The study concluded that in spite of some variation in specific years, overall land use has not changed dramatically in the last 15 years. Productivity has improved somewhat, but crops and rotations are similar to what existed in the 1980s in spite of countless efforts by development projects.

Fundamental reasons for lack of growth and development, particularly around watershed communities characterized by poverty, are believed to relate to five issues. In the short-term, inhabitants of the watersheds were not able to capture value from possible external system effects. For example, the Tascalapa River is a resource for multiple users downstream. However, the sale of energy and low cost for potable water (US$0.01/$m^3$ in rural aqueducts) produce little income and even less incentives for changing resource management in this, and similar, hillside watersheds.

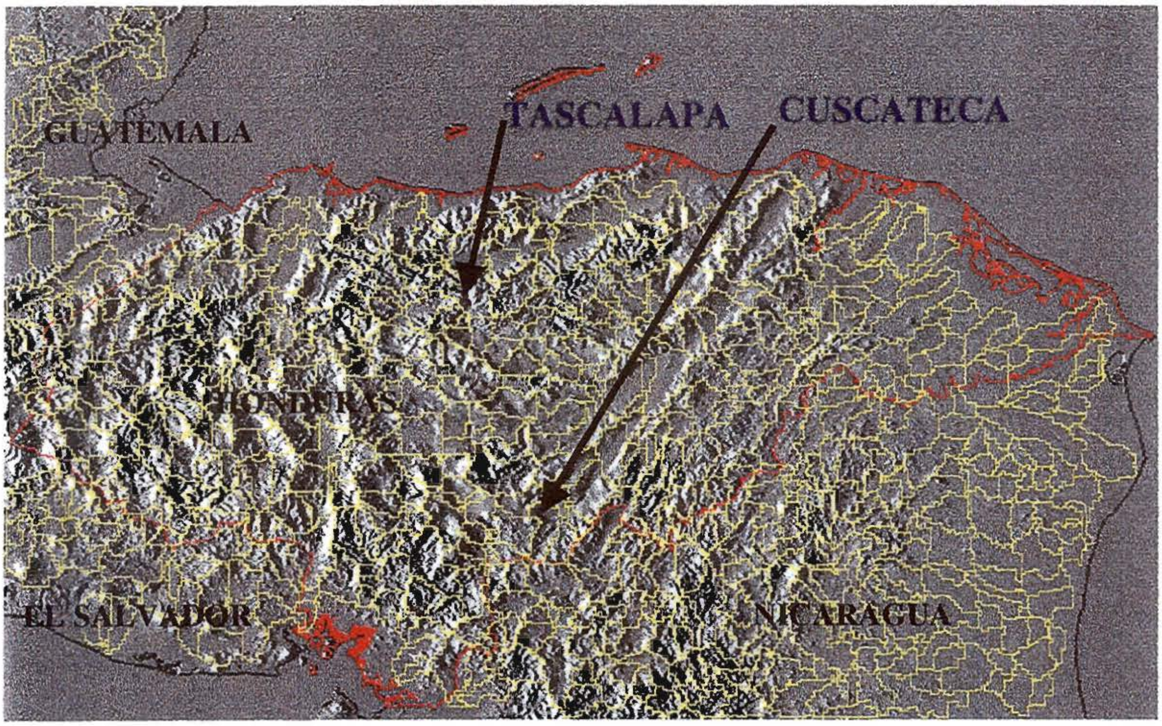
Small farmers lose out in competition with medium and large landowners. Principle activities in the five study sites are production of maize, bean, potato and pasture. With the exception of milk and meat, the products are characterized by inelastic demand and high price variability. In four of the five countries in the study, maize, bean and potato are cultivated by large as well as small producers. According to the 1993 Agricultural Census of Honduras, there are 35,210 households producing drybean of which 17,068 own less than 1.2 ha. During times of high prices, supply elasticities result in large landowners increasing hectares seeded and capturing large parts of the benefits.

Similar results were predicted for the Río Cabuyal, Colombia site. A study designed to assess how different cropping patterns affect the probability of financial failure showed that seeding 10% more area in a typical maize-bean-bean-cassava rotation significantly reduced the risk of farm failure. (Hansen et al, 1997). Such an option would seem to be more realistic for larger landowners.

The trade-off in terms of opportunity for growth and development in hillside agro-ecosystems is that increasing area in production is tantamount to increasing deforestation (see the cover photograph from Río Cabuyal). Our studies show that reforestation, from an individuals perspective, is not a sound decision based on financial analysis. Perennial orchards and well-managed pasture for livestock should result in much higher financial rewards. However, these activities require minimum infrastructure to be viable mechanisms for growth.

Other evidence from the Yoro region comes from a self-analysis by an SDC-funded Integrated Rural Development Project. In spite of the yield potential of maize and bean varieties and concomitant expected income generation, no appreciable increase in system diversification nor increase in farm size, an indicator of capital growth, have been realized. For the majority of producers today, the potential for capital accumulation remains very low, US$100 to US$150/year/household. Given land prices in the range of US$250 to US$400/ha in the most marginal areas, meaningful increases in land holdings is highly unlikely.

Figure 4. Population of community-scale watersheds defined using a regional digital terrain model. Watersheds are organized as nested hierarchies and, therefore, this representation is only one of many possibilities. This step, however, is critical for assessing the relevance of general knowledge for site-specific planning and for extending site-generated knowledge to other communities



Expanding targets
A cross-cutting theme of Project PE-3 is the belief that key steps in the screening, diagnosing, planning and execution of alternative paths for development of marginalized rural communities can be generalized and applied across a universe of landscapes. Not all landscapes, however, are equally useful and effective for conceptualizing problems and solutions.

It is well known that some technologies are easily divisible, meaning they can be adopted as effectively by individual farm households as by larger groups of individuals. Improved crop varieties are a classic case in point. Some needs and opportunities for development, however, require a critical mass to be effective. Rural agro-industry development, non-point source pollution solutions and management of common pool resources, e.g., water, are examples of the later.

Fig. 4 is one of many possible unique perspectives of Honduras (as well as parts of El Salvador and Nicaragua). The capacity to view Honduras from a perspective other than the traditional farm or political boundary of a *municipio* may be just what is needed to give rural stakeholders an improved sense of community and will to pursue solutions collectively.

The capacity to interactively define landscape units is one result of development of digital Terrain models (DTMs). In addition to the large-area example in Fig. 4, during 1997 the Project will complete high resolution DTMs for all the target study sites, permitting high resolution process level studies of landscape structure, function and change.

As pointed out in the previous section, the capacity to characterize watersheds is a result of "mining" and reprocessing data, e.g., government census data, to levels of aggregation previously unavailable to international and government organizations not to mention NGOs and community action groups. One can appreciate the value of this when one considers that "watersheds" are nested hierarchical landscape units. Consequently there is significant latitude when apportioning communities to watersheds. The issue is best resolved by stakeholders, with the obvious advantage of optimizing a sense of community and concomitant sense of commitment to action plans.

With a capacity to analyze spatial data, research results from Project PE-3 and others can be efficiently and effectively targeted and extended for maximum benefits.

Land use change and trade-offs

The Project believes changing land use can improve the well-being of people living in hillside communities. Much of our efforts to date have focused on inventorying resources including time-series landscape changes calculated from historical remote sensed images. The objective is to identify most appropriate development paths.

All our analyses to date are pointing to *size of operation* as the overriding factor influencing choices in land use. Individually, the smallest hillside landowners seem unable to breakout of the cycle of annual cropping. The unanswered question is whether some form of "critical mass action" can break the cycle. An obvious example that comes to mind is cooperatives supported by rural enterprise development.

In summary, it should be made clear that the Project believes the most effective analyses will come from modeling stakeholders...not landscapes. What will be the strategy for this? We envision stakeholders "modeling" themselves; incorporating their own valuations, including their own definitions of spatial limits, in negotiations involving trading benefits accruing from resource management.

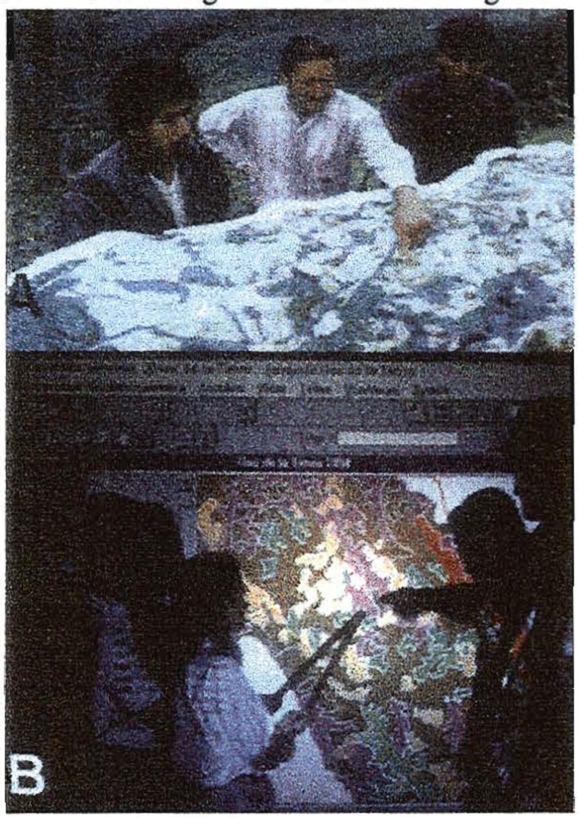


Fig 5. Two examples of inventorying resources using powerful tools for stimulating group discussions and creating a sense of community responsibility for management of watershed resources. Fig 5a shows a relief model of the watershed inspired by the local consortium and constricted with enormous community involvement. Fig 5b illustrates a complementary and more analytical approach using interactive GIS and simulation.

Developing Techniques for Local Diagnosis (*Output 2*)

Farmers judging soil quality *(Activity 2.1)*

Based upon our experiences with inter-institutional community consortia (see Program annual report for 1994-1995 and Ravnborg and Ashby, 1996), six functions have been identified as essential for effective resource management by local-level watershed organizations. One of these is the process of local monitoring by local stakeholders. Experience in the Colombian study site, Río Cabuyal, showed that providing information about the "state of resources" is itself an important part of negotiating compromises to resolve conflicts of interests and gaining commitment.

1997 saw the completion of a soil quality score card (SQS) that was built "from the ground up", using locally determined indicators of soil quality. The SQS was developed for the Cuscateca watershed (Danli, Honduras) with the assistance of a Swiss visiting professor of soil science. The work in Honduras complements thesis work that was carried out in the Colombian study site by a Dutch thesis student.(de Kool, 1996)

A key aspect of this work is the development of a glossary of local taxonomy. Future work will focus on generalizing the results, linking local perceptions of soil quality with the body of "scientific knowledge" embodied in soil choropleth maps, e.g., SOTER, and creating procedures for designing sampling frames for purposefully characterizing landscape units for risk of degradation.

Linking local and regional perceptions of well-being and poverty *(Activity 2.3)*

Methodological obstacles have prevented local perceptions of poverty from providing a basis for traditional poverty assessments by development organizations. First among these is the location-specific nature of peoples' perceptions which is claimed to make it difficult to compare and contrast assessments across locations and scales of analysis.

During 1997, methods developed in the Colombian study site were implemented at a regional scale in Honduras.

The methodology involves a number of steps. First is to select sampling sites across a region with the explicit purpose of future interpolation of results. This strategy seeks maximum sample variation rather than average "representativeness".

Based upon data available in georeferenced databases from Activity 1.1, villages across Honduras were categorized according to predefined classes of altitude, accessibility, basic services, ethnicity, gender composition and estimates of population density. The six factors and classes give rise to a possible 2,430 categories. However, in Honduras, only 394 of these categories are actually present.

Given availability of resources and existence of target study sites, it was decided to conduct interviews in the Departments encompassing the study sites. This reduced potential sampling to 193 categories represented by 662 villages. A sample of 90 communities, 30 from each Department, was drawn from this population. Although the 90 communities comprise 2% of the total in Honduras, they comprise 20% of existing categories, i.e., variation, and closely follow the frequency distributions of the national population.

The second step is interviewing local stakeholders to develop the well-being rankings (see annual report 1994-1995) for details). A total of 316 informants participated in the study. A partial description of informants is presented in Table 4. A process of grouping households into average well-being categories follows this step.

The process of generalizing local results involves a degree of subjectivity. Preferably, two or more researchers review the entire list of descriptions of well-being identified by informants and "translate" the descriptions to indicators. For the Honduran study, more than 300 descriptions were translated into almost 400 indicators. Only about 100, however, were used by more than 5% of informants. Table 5 highlights a few examples of indicators extracted from descriptions.

Table 4: Characteristics of informants.

Age (yr)	Gender (%)	Occupation (%)
=<25: 9%	**Male: 51**	**Farmer 26**
26-45: 57%	**Female: 49**	**Day-laborer 15**
>45: 45%		**Housewife 32**
		Business 15
		Craft 6
		Professional 7

Table 5. Some frequently used well-being indicators by well-being level

Description	Percent of *aldeas* where used	Number of times used to describe: highest level of well-being	middle level of well-being	lowest level of well-being
Day laborers	97	1	38	217
Farmers	53	47	51	4
Don't day labor	34	22	17	3
Farmers and day laborers	26	0	18	12
Merchants	69	87	39	7
Middlemen of agricultural products	36	40	6	2
Own Land	93	164	78	7
Don't own land	78	3	12	108
Have little own land	54	1	61	11
Some rent land	36	1	11	32
Share cropping	33	0	12	31
Own cattle	86	203	19	1
Don't own cattle	32	1	25	9
Lack resources to cultivate their land	25	0	7	22
Buy little inputs with difficulty	20	1	5	18
Have difficulties in getting sufficient food	63	0	5	72
Don't have difficulties in getting food	43	31	23	3
Need to buy grains	52	1	16	63
Harvest for home consumption	56	24	54	12
Have excess for sale	55	57	32	4
Don't own houses	53	0	5	73
Own good houses	56	75	15	0
Have houses of poor quality	43	0	10	49
Contract day laborers	56	57	12	0

Source: Well-being rankings conducted in Atlántida, Yoro and El Paraíso departments, Honduras, 1997.

It is apparent that there is strong redundancy among informants for certain descriptors/indicators. The question is, are there strong exceptions to the general application of specific indicators, i.e., where a specific indicator is blatantly inappropriate. Canonical correlation analysis was used to test robustness and appropriateness of potential generalization of individual indicators.

Only through a process of ordination can a population of communities be prioritized and targeted for assistance. Systematic, representative sampling using a survey instrument containing quantifiable parameters/indicators develops such community profiles. This is currently being done for four regions, the entire department of Yoro and three watershed study sites in Honduras.

Local knowledge-based decisions
(Activity 2.4)

Poor farmers are often assumed to be caught in a vicious cycle in their natural resource management. Due to lack of economic resources and their need to satisfy immediate needs for survival, poor farmers are assumed to offset concerns with long-term sustainability. This means that already degraded natural resources are degraded even more, which in turn aggravates their poverty in a continuing cycle.

Analysis of data obtained from a survey undertaken in Río Cabuyal, Colombia, allows examination of this "vicious cycle". The survey used a pictorial questionnaire that was developed to link information about bio-physical conditions of a plot, its actual land management, and – most importantly – the farmer's reasons for choosing the actual land management. The survey includes information from 198 households resulting in about 532 plots. The sample was stratified according to household well-being, based on information obtained through the methodology for developing poverty profiles derived from local perceptions of well-being which we described earlier. This enables us to compare land use strategies of the poorest, the less poor and the least poor households.

One of the land use types encountered in the survey is *fallow*, a critical "land use" normally associated with land "regeneration" processes. According to "the vicious cycle hypothesis", land scarcity would cause poor farmers to be less likely to have land in fallow than not-so-poor farmers. Our results show that this is *not* the case in Río Cabuyal.

While being significantly less likely to have land in pasture or forest, the poorest households, i.e. households being classified as having the lowest level of well-being, were found to be just as likely to have land in fallow (and under crops) as households enjoying highest or middle levels of well-being. Around 60% of all households in Río Cabuyal have land in fallow. Neither in terms of the proportion of their total area in fallow as compared with other land uses were any significant differences found between the poorest and the not-so-poor and least poor households. All categories allocate about 20% of their land to fallow.

A second supposition, following from "the vicious cycle hypothesis" is that poorest farmers would tend to leave their land fallow for shorter time than not-so-poor farmers. This conventional wisdom was not supported by our analysis either. The average fallow period was found to be close to 7 years with no significant differences between the three well-being groups. Eliminating longer-term fallow did not change the picture. Overall, for 102 out of the 224 plots for which previous fallow periods were reported, the fallow period had lasted 2 years or less. Forty-six percent of the least poor households reported to have plots for which the previous fallow period had lasted 2 years or less as compared with 49% of the less poor and 42% of the poorest households.

Normally, fallow is thought of as a means to regenerate soil fertility. As mentioned, our survey inquired into farmers' *reasons* for choosing a specific land use type, in this case fallow. Prior to the survey, eleven reasons for leaving a plot fallow had been identified with the input of farmers. In the survey, these reasons were ranked as *important*, *not so important*, or *not important*. Surprisingly, our survey found that seen from a farmer perspective, regenerating soil fertility is not the dominant reason for leaving a plot fallow. Reasons related to restoring soil fertility only ranked third and fourth as compared to reasons related to lack of economic resources which ranked first and second.

Whereas no difference was found in the actual practice of fallow rotation, differences were found with respect to the reasons that make respectively poor and not-so-poor farmers decide to leave a plot fallow. Based on a homogeneity analysis and a subsequent cluster analysis on the variables related to the rank of reasons for fallow, the plots reported in fallow were grouped into four clusters. As shown in table X, the least poor households are significantly more likely to leave their plot fallow exclusively for it to regain soil fertility than households having less poor and poorest households (37% as compared to 13% and 9%). On the other hand, 53% of the poorest household leave their land fallow exclusively due to lack of economic resources as compared to 43% of the less poor and 28% of the least poor households.

One implication of this analysis is that research aimed to improve fallow might not be very successful among the poorest farmers for whom fallow is not part of a carefully planned soil fertility management strategy but rather a response to unpredictable – although frequent – lack of resources. In more general terms, the analysis demonstrates the need to question and validate the existence of a "vicious cycle relationship" between poverty and natural resource management.

Table 6. Reasons for leaving plots fallow (clusters) by level of well-being

	Plots owned by:			
Reasons for leaving plots fallow	**least poor households (n=43)**	**less poor households (n=40)**	**poorest households (n=34)**	**All plots in fallow (N=117)**
	% plots per well-being level			
Prefer cultivating other plots	7	13	9	9
Restore soil fertility	37	13	9	21
Restore soil fertility and lack of economic resources	28	33	29	30
Lack of economic resources	28	43	53	40
Pearson chi-square test: *p=.039*				

Decision Support for Location-specific *Ex-ante Analysis (Output 3)*

Assessing a Liquid Asset *(Activity 3.3)*

During 1997, Project PE-3, together with the International Irrigation Management Institute (IIMI), conducted a study of prevailing and potential water use practices in the Río Cabuyal watershed.

Needs for this study arouse during a formal "participatory planning-by-objective" workshop (PPO) held in March 1993 during which stakeholders expressed a desire for irrigation facilities. It was further motivated by a subsequent analysis that simulated the "financial sustainability" of different cropping and management scenarios for a specific, representative farm in the watershed. Results of that analysis indicated supplemental irrigation of tomato, a representative, high-value commercial crop entering the area, significantly reduced risk of financial failure compared to a traditional base scenario of cassava, bean and maize (Hansen, et al, 1997; Annual report 1994-1995).

The overall objective of the water study was to identify ways to improve the effective and sustainable use of water resources. On the basis of this analysis, scenarios for future water use, e.g., irrigation, were explored, taking into account existing and potential water conflicts within as well as between different water users' groups.

Although the targeted 3,200 ha Río Cabuyal watershed is not gauged, it is "embedded" within the larger Río Ovejas watershed which is. Hydrologic and climate data were interpolated to the sub-watershed. The rainfall-runoff relation of the watershed of the main river (Río Ovejas) was established by analyzing the hydrograph and rainfall patterns. This relation was used to estimate river flows in the watershed of the tributary river (Río Cabuyal). This method proved to be very suitable in this case, as physical conditions determining the rainfall-runoff relation, i.e., precipitation pattern, slopes, soils and vegetation, as determined from GIS analysis, are similar at both watershed scales.

The minimum flow during 1996 at the mouth of the Río Cabuyal during the dry months was determined from field measurements to be 260 l/s, or 22,464 m^3 per day. The quantity of water actually used by inhabitants living in the area totals 2,156 m^3 per day (i.e. 10% of the total) of which some 16% is for domestic purposes, 79% for irrigation and 5% for industrial uses. In spite of this apparent abundance of water, downstream users of the main drinking water system are suffering from water shortage apparently because upstream inhabitants use potable water for irrigation. Conflicts among users of different drinking-water systems have not been reported.

Potential off-site impacts on a hydropower plant downstream from increased water use by ***sub***-watershed inhabitants will be negligible in terms of water availability. Based on development plans, the hydropower plant would tap the Río Ovejas which has a minimum flow of 10 m^3/s. The tributary Río Cabuyal carries 0.26 m^3/s in the dry season. Consequently, during the dry months only 2.5% of the water flow in the main river originates in the sub-watershed.

The strategic value of this study is development and testing of simple procedures for addressing water-budgeting conflicts in rural community watersheds. Fieldwork focusing on measurement techniques is being continued as part of MSc thesis work in collaboration with King's College of London and development of modeling tools as part of a PhD thesis with the University of Florida.

Capacity Building, information exchange, project relations and documentation *(Output 4)*

CD-ROMs and WEB Sites *(Activity 4.4)*
It is clear from the Project's objective, information exchange is a critical element governing Project impact. During 1997, the Project produced *beta* versions of CD-ROMs of GIS coverages for Honduras and Nicaragua. In addition, the user can "point and click" on an *interface* button and call up a "gray-literature" bibliography, specific for the region, of references addressing natural resource research themes (Fig. 6). The bibliography was begun by the Project and subsequently greatly expanded as a consequence of special-funding managed by CIAT's Library Unit. Both CD-ROMs have been distributed to collaborators for testing in the respective countries.

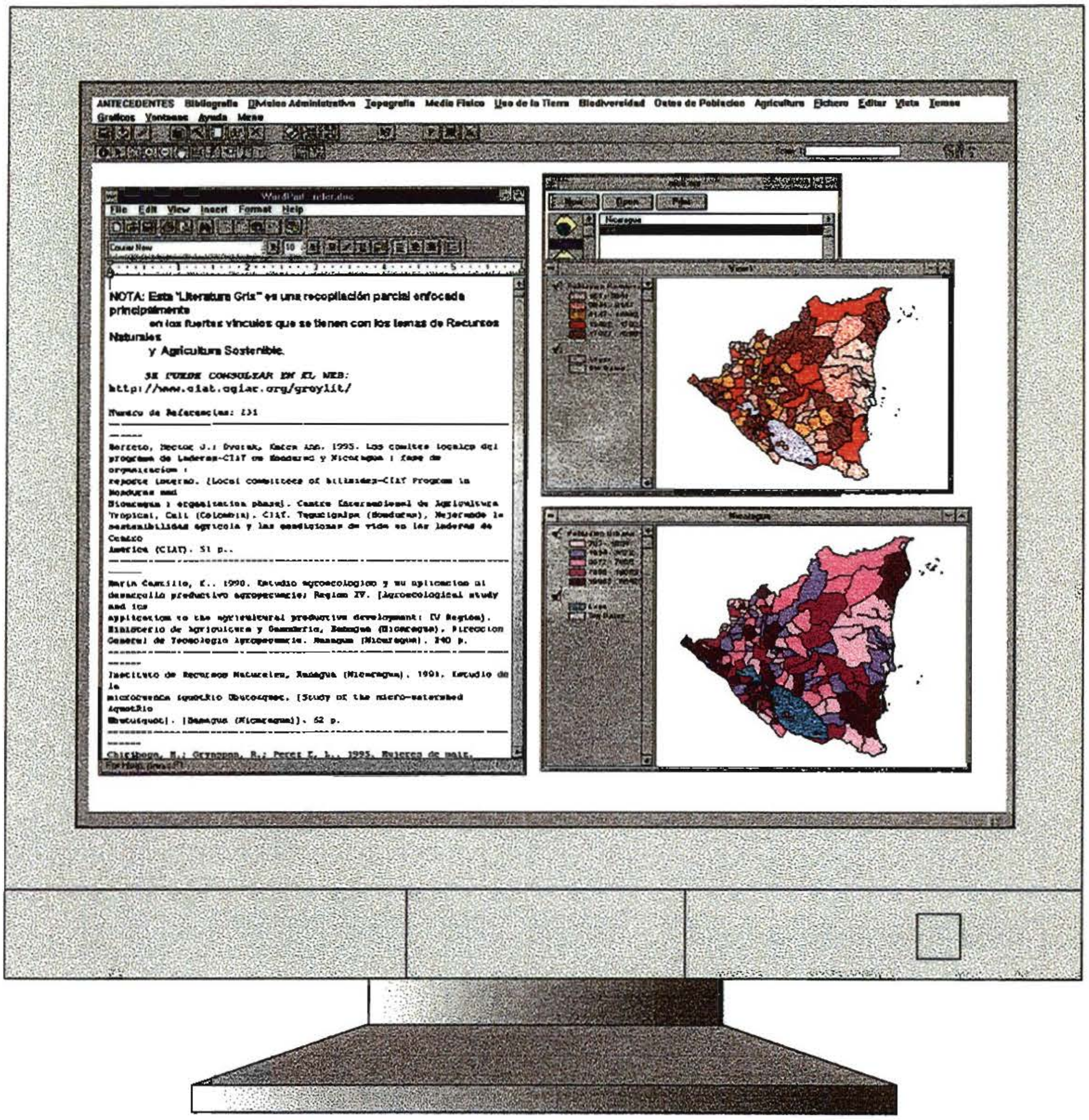
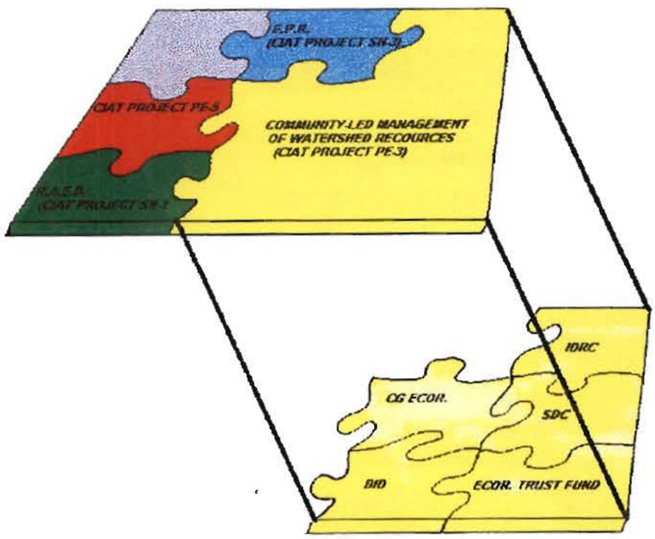


Figure 6. CD-ROM offers a user-friendly "point and click" environment. Shown in this figure are coverages of Nicaragua for gender distribution, urban population and a bibliographic search.

In addition to the CD-ROMs, a Spanish language WEB site was constructed and is on-line (**www.intertel.hn/org/ciathill**). This was a milestone identified in a participatory planning workshop of the Project steering committee held in November 1996. In addition to the Central American WEB site, the Project also reports and documents its progress via the CIAT WEB site (**www.ciat.cgiar.org**).

Figure 7. Some of the Project's relations and linkages.

Project Relations



Donors: During 1997, the Project received approximately 80% of its funding through direct, highly restricted funding from SDC, IADB (BID), IDRC, the Ecoregional Trust Fund for Methodological Research, Danida, and the CGIAR Systemwide Initiative: "Tropical America Eco-Regional Program".

In an attempt to reduce paperwork and concomitant transaction costs, the Project reached agreement with donor representatives from SDC and IDRC for greatly simplified reporting procedures. And together with the Trust Fund, it has been agreed that the Project will organize a common external review to be held the second semester of 1999.

Collaborators: CIMMYT and CIP have special collaborative relations, supporting a percentage of senior staff time (CIMMYT, 20% and CIP 50%). Other collaboratorative linkages include IFPRI, IIMI, IICA; universities of Florida, Georgia, King's College, Wageningen, Bern (WOCAT), Guelph, Nacional Agraria (Nicaragua); CURLA (Honduras); DICTA, INTA, CONDESAN, CIPASLA. **(see inside front cover for complete listing)**

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

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

Documentation

During 1997, the Project was required to prepare three technical progress reports (not including the present report or sections of reports for other CIAT Projects) for donors who have supplied the Project with highly restricted funding. These included two for the Ecoregional Trust Fund for Methodological Research and one for SDC. Copies are available upon request.

During 1997, Project personnel participated in a variety of international conferences, steering committee meetings and workshops. The following are a cross-section of project documents prepared during 1997.

Documents

Prepared in Colombia (1996-1997)

Beinroth, F.H., J.W. Jones, E. B. Knapp, P. Papajorgji, J.C. Luyten, in press. Application of DSSAT to the evaluation of land resources. (Chapter 14). IBSNAT, Honolulu.

Fraiture, C. de, J. E. Rubiano, C. Alvarez. 1997. Actual versus Potential Water use in Cabuyal Watershed. Colombia. P. 59. CIAT, Cali, Colombia.

Hansen, J.W., E.B. Knapp, and J.W. Jones, 1997. Determinants of Sustainability of a Colombian Hillside Farm. Experimental Ag. Vol. 33, pp 1-24.

Knapp, E.B., J.A. Ashby, H. M. Ravnborg, and W.C. Bell. 1997. A Landscape that Unites: Community-led Management of Andean Watershed Resources. Invited paper for "Global Challenges for Ecosystem Management on a Watershed Context", a conference of the Soil and Water Conservation Society, Toronto, Ontario, Canada. 22-26 July, 1997.

Knapp, E.B., J.A. Ashby and H.M. Ravnborg. 1996. Natural Resources Management Research in Practice. In: Agricultural Research and Sustainable Management of Natural Resources, ed. Hans-Joachim Preuss. Lit Verlag Munster-Hamburg.

Kool, Stefanie de. Dec. 1996. Exploring Soil Health through Local Indicators and Scientific Parameters. MSc. Thesis. Wageningen Agricultural University.

Ravnborg, H.M, and J. A. Ashby. 1996. Organizing for Local-level Watershed Management: Lessons from Río Cabuyal Watershed, Colombia. AgREN Network paper, No. 65, 001, London.

Ravnborg, H. M. and M. P. Guerrero. 1997. Stakeholder Analysis in Natural Resource Management, In: LEISA, ILEIA Newsletter for Low-external-Input and Sustainable Agriculture, April 1997, Volume 13, no. 1.

Donor Reports:

1. Reporte Técnico y Financiero para Fase 1 (para COSUDE/SDC). Proyecto: "Mejoramiento Sostenible Agrícola y de la Calidad de Vida en la Zona de Laderas de América Central", Proyecto SDC #: t.311 América Central 14, CIAT, Cali, Colombia, julio 1997.

2. "Mejoramiento Sostenible Agrícola y de la Calidad de Vida en la Zona de Laderas de América Central", Proyecto SDC #: t.311 América Central 14, CIAT, Cali, Colombia, noviembre 1996.

3. Informe de Evaluación Externa, Proyecto CIAT Laderas de América Central (CLAC), "Mejoramiento sostenible agrícola y de la calidad de vida en la zona de laderas de América Central". 3-15 junio de 1996. Mario Jáuregui, F. Omar Osorio y Urs Scheidegger, CIAT, COSUDE, Tegucigalpa, junio de 1996.

4. Technical and Financial Progress Report for SDC (COSUDE). Project: "Improving Agricultural Sustainability and Livelihoods in the Central American Hillsides, June 1995. CIAT, Cali.

5. Project Report, Project: "Methodologies for Integrating Data Across Geographic Scales in a Data-rich Environment: Examples from Honduras", Reporting Period: 1 January - 30 April 1997, CIAT, Cali, Colombia, 15 May 1997.

6. Project Report, Project: "Methodologies for Integrating Data Across Geographic Scales in a Data-rich Environment: Examples from Honduras", Reporting Period: 1 January - 30 April 1997, CIAT, Cali, Colombia, 15 September 1997.

7. Final Technical Report for the project: "Improving Agricultural Sustainability and Livelihoods in the Tropical American Hillsides", IDRC Project File 93-0008, CIAT, Cali, Colombia, September 1996.

Prepared in Honduras (to October 1997)

1. Edy López, Luis G. Brizuela y Hector Barreto. Abril 1997. Resultados preliminares de ensayos de adaptación de germoplasma de gramíneas y leguminosas forrajeras en el Departamento de Yoro, Honduras.

2. Charlotte Gaye Burpee y Willmer R. Turcios. Mayo, 1997. Indicadores Locales de la calidad del suelo: resultados iniciales de Honduras. Tegucigalpa, Honduras: CIAT.

3. Pedro Jiménez. Julio 1997. Aldeas de Honduras: Población en 1988 a nivel de aldeas y proyección para 1993 y el año 2000. Reporte Interno. Tegucigalpa, Honduras: CIAT.

4. Hector Barreto. Atlas de los Municipios de Yorito y Sulaco, departamento de Yoro. Agosto de 1997. Reporte Interno. Tegucigalpa, Honduras: CIAT.

5. Dvorak, Karen Ann, Pedro Jiménez, Daysi Medrano García, José Santos Martínez F., Manuel Velásquez, Duilio Nivas, Donaldo Suerez y Nestor H. Velásquez. 1996. Resumen de los datos del sondeo sobre recursos agrícolas: Santa Lucía, Boaco, Nicaragua. Reporte Interno. Tegucigalpa, Honduras: CIAT. (mimeo.)

6. Raúl Moreno y Hugo Pocasangre. Febrero 1996. Estudio preliminar de adopción de prácticas de conservación de suelos en Danlí, El Paraíso, Honduras. Reporte Interno. Tegucigalpa, Honduras: CIAT. (mimeo.)

7. Dvorak, Karen Ann, Pedro Jiménez, Manuel Cantillano y Donaldo Velásquez. 1996. Resumen de los datos del sondeo sobre recursos agrícolas: Municipio de Yorito, Sulaco, Victoria y Morazán, Departamento de Yoro, Honduras. Reporte Interno. Tegucigalpa, Honduras: CIAT. (mimeo.)

8. Programa de Laderas, CIAT. Marzo 1996. Ayuda memoria de la segunda reunión del Grupo Consultivo, Tegucigalpa, Honduras, 21-22 de septiembre de 1995. Reporte Interno. Tegucigalpa, Honduras: CIAT. (mimeo)

9. Dvorak, Karen Ann y Pedro Jiménez. Marzo de 1996. Resumen de los datos del sondeo sobre recursos agrícolas: Municipios de Danlí y San Matías, Departamento de El Paraíso, Honduras. Reporte Interno. Tegucigalpa, Honduras: CIAT. (mimeo).

10. Dvorak, Karen Ann y Pedro Jiménez. 1996. Resumen de los datos del sondeo sobre recursos agrícolas: Municipios de Arizona, La Ceiba, La Masica y Tela, Departamento de Atlántida, Honduras. Reporte Interno. Tegucigalpa, Honduras: CIAT. (mimeo).

11. Dvorak, Karen Ann y Pedro Jiménez. 1996. Guía del sondeo sobre recursos agrícolas en América Central. Segunda edición. Reporte Interno. Tegucigalpa, Honduras: Centro Internacional de Agricultura Tropical. (mimeo.)

12. Dvorak, Karen Ann. 1996. Sondeo of resource management systems and practices: National Sampling Frame for Honduras. Project Report. Tegucigalpa, Honduras: CIAT. (mimeo)

13. Dvorak, Karen Ann. 1996. Catalogue of Soil Conservation Practices and Projects in Central America. Internal Report. Tegucigalpa, Honduras: CIAT. (mimeo)

14. Humphries, Sally. 1996. Migrants, dairy farmers and agricultural land-use in the humid, tropical hillsides of Northern Honduras. Internal Report. Tegucigalpa, Honduras: CIAT. (mimeo)

15. Dvorak, Karen Ann. 1996. Database of soil conservation projects and practices in Honduras. Internal Report. Tegucigalpa, Honduras: CIAT.

16. Dvorak, Karen Ann y Jiménez, Pedro. 1996. Guía del sondeo sobre recursos agrícolas en América Central. Tercera edición. Reporte Interno. Tegucigalpa, Honduras: Centro Internacional de Agricultura Tropical (mimeo.)

17. Dvorak, Karen Ann. 1996. Sondeo de Sistemas y Prácticas de Manejo de los Recursos: Muestreo nacional para Honduras. Reporte del Proyecto. Tegucigalpa, Honduras: CIAT (mimeo.) (Translation to Spanish of original version in English).

18. Dvorak, Karen Ann. Base de datos de proyectos y prácticas de conservación de suelos en Honduras. Reporte Interno. Tegucigalpa, Honduras: CIAT (mimeo) (Translation to Spanish of original version in English).

19. Dvorak, Karen Ann. 1996. Catálogo de Prácticas y Proyectos de Conservación de Suelos en Centro América. Reporte Interno. Tegucigalpa, Honduras: CIAT. (Translation to Spanish of original version in English).

20. CIAT-Laderas. 1996. Visita del Director General del CIAT a Honduras. Memoria. Tegucigalpa, Honduras: CIAT. (Mimeo.)

21. Jiménez, Pedro, y Dvorak, Karen Ann. 1996. Resumen de los datos del sondeo de sistemas y prácticas de manejo de recursos agrícolas: Comunidades con sistemas de producción de cultivos anuales con tracción animal, Honduras. Reporte Interno. Tegucigalpa, Honduras: CIAT

22. Jiménez, Pedro, y Dvorak, Karen Ann. 1996. Resumen de los datos del sondeo de sistemas y prácticas de manejo de recursos agrícolas: Comunidades con sistemas de producción de cultivos anuales con uso de riego, tracción animal y mecánica, alta, Honduras. Reporte Interno. Tegucigalpa, Honduras: CIAT.

23. Jiménez, Pedro, y Dvorak, Karen Ann. 1996. Resumen de los datos del sondeo de sistemas y prácticas de manejo de recursos agrícolas: Comunidades con sistemas de producción, con un porcentaje alto en áreas con cultivos anuales, agricultura de secano, sin tracción mecánica y animal, Honduras. Reporte Interno. Tegucigalpa, Honduras: CIAT.

24. Jiménez, Pedro, y Dvorak, Karen Ann. 1996. Resumen de los datos del sondeo de sistemas y prácticas de manejo de recursos agrícolas: Comunidades con sistemas de producción de cultivos, con áreas agrícolas pequeñas, un alto porcentaje de cultivos anuales, y tracción animal, muy alta, Honduras. Reporte Interno. Tegucigalpa, Honduras: CIAT.

25. Jiménez, Pedro y Dvorak, Karen Ann. 1996. Resumen de los datos del sondeo de sistemas y prácticas de manejo de recursos agrícolas: comunidades con sistemas de producción, con un porcentaje alto de cultivos permanentes; y un porcentaje bajo de cultivos anuales, en secano, Honduras. Reporte Interno. Tegucigalpa, Honduras: CIAT.

26. CIAT/UNAH. Marzo 1995. Localización y sistematización de la literatura gris sobre agricultura en laderas de Honduras. Tegucigalpa, Honduras. CIAT. (mimeo.)

27. Barreto, Héctor y K. A. Dvorak. Mayo 1995. Plan operativo. Reporte Interno. Tegucigalpa, Honduras: CIAT. (mimeo.)

28. Barreto, Hector y K. A. Dvorak. Junio 1995. Los comités locales del Programa de Laderas-CIAT en Honduras y Nicaragua: Fase de organización. Reporte Interno. Tegucigalpa, Honduras: CIAT. (mimeo.)

29. Moreno, Raúl. Agosto 1995. Resumen de la primera reunión del Grupo Consultivo del Proyecto de Laderas de América Central, La Lima, Cortés, Honduras, 18-20 de mayo de 1994 y Objetivos y conclusiones del taller de consulta en Managua, Nicaragua, 27-28 agosto 1993. Reporte Interno. Tegucigalpa, Honduras: CIAT. (mimeo.)

30. Barreto, Hector. August 1995. Digital database of the IV National Agricultural Census for Honduras at municipio level. Internal Report, not for distribution. Tegucigalpa, Honduras: CIAT. (mimeo.)

31. Dvorak, Karen Ann y Pedro Jiménez. Septiembre 1995. Guía para el sondeo sobre recursos agrícolas en América Central. Reporte Interno. Tegucigalpa, Honduras: Centro Internacional de Agricultura Tropical. (mimeo.)

32. Barreto, Héctor. Octubre 1995. Atlas digital de Nicaragua. Reporte Interno. Tegucigalpa, Honduras: CIAT. (mimeo.)

33. Hillsides Research Working Group. October 1995. Proceedings of the working group on hillsides research in Central America, 1-3 March, 1995, Trujillo, Colón, Honduras. Tegucigalpa, Honduras: Hillsides Research Working Group. (mimeo.)

34. Grupo de Trabajo de Laderas. Octubre 1995. Memoria del grupo de trabajo para la investigación en laderas de Centro América, 1-3 marzo 1995, Trujillo, Colón, Honduras. Tegucigalpa, Honduras: Grupo de Trabajo de Laderas. (mimeo.)

35. Trejo, Marco Tulio y Hector Barreto. Noviembre 1995. Base de datos de los levantamientos de suelos y sus resultados analíticos en Honduras. Reporte Interno, Tegucigalpa, Honduras. Centro Internacional de Agricultura Tropical. (mimeo.)

36. CIAT, 1993. Improving agricultural sustainability and livelihoods in the Central American hillsides: A proposal for Swiss Development Cooperation (SDC). Cali, Colombia: CIAT. (mimeo.)

Prepared in Nicaragua

1. Primer Taller Nacional de Coordinacion de Unidades con Sistema de InformaciónGeografica (SIG). Memoria. Managua, 7 y 8 de noviembre de 1996. FNUAP – CIAT - COSUDE - UNA - SETAB/MARENA - MAG.

2. Primera Reunión de Seguimiento Metodología CIAL en Nicaragua. Memoria. Abril 1, de 1997, Managua. PASOLAC/CIAT.

3. Diagnóstico Rural Participativo. Algunos Elementos Básicos. Proyecto CIAT- Laderas/Proyecto IPRA. Managua, Nicaragua. 1997.

4. Pelletier, Nicole y Vernooy, Ronnie, El Técnico La Promotora Como Facilitador(a) Del Desarrollo Participativo. CIAT. Managua, Nicaragua. Junio1997.

5. Mendoza, Bismarck y Baltodano, María Eugenia, El Metodo IPRA: Una Propuesta Metodológica para el proceso de investigacion con agricultores. Documento resumen para discusión con estudiantes. CIAT. Managua, Nicaragua. Agosto de 1997.

6. Vernooy, Ronnie y Tijerino, Dominga, La Investigacion Participativa: Notas Introductorias e interrogantes. CIAT. Managua, Nicaragua. Agosto de 1997.

7. Fundamentos Básicos de Cuencas Hidrográficas. Curso-Taller Corto. Universidad Nacional Agraria (UNA), Facultad de Recursos Naturales y del Ambiente. CIAT. Unión Nacional de Agricultores y Ganaderos (UNAG) Programa Campesino a Campesino. Matagalpa, Nicaragua, 6 de Junio, 1997.

8. Manejo Sostenible de Cuencas: Una Introducción. Taller. Universidad Nacional Agraria (UNA), Facultad de Recursos Naturales y del Ambiente. CIAT. CEFER San Dionisio, Matagalpa, Nicaragua, 10 de Septiembre, 1997.

9. Vernooy, Ronnie, Manejo sostenible de cuencas: Una Introducción. Memorias del taller. Managua, octubre 1997. 40 páginas.

10. Vernooy, Ronnie; Baltodano, María Eugenia; Tijerino, Dominga. Abriendo Caminos: Objetivos, premisas y pasos metodológicos del Proyecto Laderas en Nicaragua. Managua, septiembre 1997.

11. Baltodano, María Eugenia; Vernooy, Ronnie; Tijerino, Dominga. Proceso de Identificación y Características de la Cuenca de Trabajo, Río Calico-San Dionisio. Managua, septiembre 1997.

12. Tijerino, Dominga; M.E. Baltodano, R. Vernooy. Proceso de formación de los CIAL en la Subcuenca del Río Calico, Municipio de San Dionisio, Departamento de Matagalpa, Nicaragua. Managua, septiembre 1997.