COMMUNITIES & WATERSHEDS

PROJECT

PE-3

SUMMARY REPORT 2005

CIAT

Centro Internacional de Agricultura Tropical
International Center for Tropical Agriculture

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Contents

1. Project Description and LogFrame

1.1. Project description

Goal:
To improve water, food, and environmental quality and services through research on land-water-community interactions.

Outputs:
1. Improved watershed management based on knowledge of land-water interactions
2. More equitable highland-lowland resource (water) allocation
3. Provision of environmental services: water
4. Strengthened organizations: community and institutional capacity building
5. Efficient use of project resources through participatory project management

Gains:
Farmers and local organizations adopt technologies, tools, and methods developed by C&W and its partners within research watersheds. Results are sustainable, land use improved, and natural resources conserved at the watershed level. Partner organizations apply technologies, tools, and methods developed in conjunction with C&W for their planning and activities at local and regional levels. Decision makers at municipal and regional levels have information, tools, and methods provided by C&W to support their planning, monitoring, and decisions.

Users:

Primary clients:	local governments, local organizations, farmer groups, water-user associations
Secondary clients:	research institutions, national governments, nongovernmental organizations (NGOs)
Final beneficiaries:	farmers and communities

Principal collaborators[1]:
CGIAR: IWMI, Water and Food CP
Universities: CATIE (Costa Rica), UBC (Canada), National Agarian U. (Nicaragua)
NGOs: CGIAB (Bolivia), Corporación Grupo Randi Randi (Ecuador), ASOBOLO, CIPAV, Actuar (Colombia), CLODEST (Honduras), FIPAH (Honduras), CARE (Nicaragua)
GOs: CRQ, CVC (Colombia), INTA (Nicaragua), Municipalities of El Dovio (Colombia) and San Dionisio (Nicaragua), RENOC (Nicaragua)
Local associations: ACERG, Herederos del Planeta (El Dovio, Colombia), Asociación Campos Verdes (San Dionisio, Nicaragua)
Regional associations: CONDESAN
CIAT: Soils (PE-2), Land Use (PE-4), Forages (IP-5), IPRA (SN-3), Beans (IP-1), Information Systems Unit (ISU)

[1] For acronyms and abbreviations used in the text, see Section 9 at the end of the report.

1.2. Milestones

2005:

Pilot watersheds	Monitoring networks and baseline surveys	▪ A minimum of 2 water monitoring networks established within C&W watersheds ▪ Links to a minimum of 2 regional or national monitoring networks for data interchange ▪ A minimum of 2 baseline household-level water and resource use surveys designed and implemented within C&W watersheds, and analyzed by the end of the year
	Integrated watershed management	▪ Image analysis of land use and management (high resolution imagery and ground truthing) completed within 2 C&W watersheds ▪ Water availability and wetlands hydrologic response research established in 1 C&W watershed ▪ Riparian use and management studies initiated in 2 C&W watersheds ▪ Water-efficient technologies installed and monitored in a minimum of 2 C&W watersheds ▪ Best-management practices (BMP) assessment in a minimum of 2 C&W watersheds
Workshops and training activities (formal)	Watershed management	▪ 1 ESA workshop completed to support joint CIAT/GO "hot spot" analysis
	Youth research and leadership	▪ A minimum 2 youth leadership workshops conducted ▪ At least 1 joint UBC youth workshop conducted
	Students and interns	▪ 2 MSc theses to be completed ▪ A minimum of 1 ongoing student research activity supported ▪ A minimum of 1 internship project completed
Publications and communications	Information technology	▪ Web site re-designed and updated ▪ 1 CD-ROM highlighting project initiatives completed ▪ 1 ESA method CD-ROM completed
	Guides and brochures	▪ A minimum 2 guides produced on youth research for use by schools and communities by the end of the year
	Articles, books, conferences	▪ A minimum of 2 scientific papers written and/or presented
Fund raising	Special projects	▪ A minimum of 3 special project proposals written and submitted ▪ Specific donor targets: Kellogg for Colombia and CIDA for Honduras and Nicaragua

Continued

2006:

Pilot watersheds	Monitoring networks and baseline surveys	▪ Continuation of water quantity and quality monitoring within 2 C&W watersheds ▪ Expansion of monitoring sites within 1 C&W watershed ▪ Baseline surveys designed, implemented, and analyzed in 1 additional C&W watershed (based on successful fund raising)
	Integrated watershed management	▪ Image analysis of land use and management completed for 1 additional watershed ▪ Continuation of water availability and hydrologic response research that was initiated in 2004/05 ▪ Assessment of the water-efficient technologies that were monitored in 2005 in 2 C&W watersheds
Workshops and training activities	Youth research	▪ A minimum 1 youth research workshop conducted ▪ At least 1 joint UBC workshop conducted
	Students and interns	▪ A minimum of 1 student with ongoing research activities ▪ A minimum 1 intern for each of South and Central America
Publications and communications	Information technology	▪ Translation of 1 UBC CD-ROM text into Spanish completed ▪ Application of the ESA CD that was translated in 2005
	Guides and brochures	▪ Application of the guides produced in 2005 on youth research within 2 C&W watersheds
	Articles, books, conferences	▪ A minimum of 2 scientific papers written and/or presented
Fund raising	Special projects	▪ A minimum of 2 special project proposals written and submitted

Continued

2007:

Pilot watersheds	Monitoring networks and baseline surveys	▪ Continuation of water quantity and quality monitoring within 3 C&W watersheds ▪ Expansion of monitoring sites within 2 of partners' watersheds in South America (based on successful fund raising) ▪ Baseline surveys designed, implemented, and analyzed in 2 of partners' watersheds in South America (based on successful fund raising)
	Integrated watershed management	▪ Water balance and availability assessment completed for 1 C&W watershed ▪ Environmentally Sensitive Area Assessment pilot project initiated to adapt the UBC methodology to Latin America (based on successful fund raising)
Workshops and training activities	Youth research	▪ At least 1 joint UBC workshop conducted
	Students and interns	▪ 1 UBC PhD dissertation completed ▪ A minimum 1 intern per South and Central America
Publications and communications	Information technology	▪ Web site and CD-ROM developed, highlighting research results in 1 C&W watershed
	Articles, books, conferences	▪ A minimum of 2 scientific papers written and/or presented
Fund raising	Special projects	▪ A minimum of 2 special project proposals written and submitted

1.3. LogFrame 2005–2007

Project: **Communities and Watersheds**
Manager: José Ignacio Sanz

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
Goal: To improve water, food, and environmental quality and services through research on land-water-community interactions	Water quantity and quality parameters Water efficiency (use and technologies) Farmer adoption of technologies and methods	Local research and monitoring networks Comparable indicators Watershed comparisons	The environmental, social, economic, and political conditions are maintained on a macro level
Purpose: To strengthen local processes of watershed management and sustainable agricultural development in tropical regions based on the experiences of NRM at research watersheds	Local capacity building and training programs Youth involvement in NRM Community-based involvement in watershed management	No. workshops conducted No. youth groups / projects Level of community participation in watershed management activities	Local partners continue project-related activities Donors interested in the proposed project objectives and provide support
Output 1 Improved watershed management based on knowledge of land-water interactions	Land-water interactions: Water quantity and quality parameters Land use: management and change	Field research Monitoring networks Primary data collection Image analysis and field verification	Climate variability is normal. Donor support is obtained. Social stability
Output 2 More equitable highland-lowland resource (water) allocation	Highland-lowland interactions: Water quality parameters Water quantity (drinking and irrigation) Water use (by sector)	Field research Monitoring networks Primary data collection Water use survey	Climate variability is normal Donor support is obtained Social stability

Continued

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
Output 3 Provision of environmental services: water	Water: Water quality parameters Water quantity parameters Water use by sector Riparian buffers (type and quality)	Field research Monitoring networks Primary data collection Water-use survey Riparian buffer inventory	Climate variability is normal Donor support is obtained Social stability
Output 4 Strengthened organizations: community and institutional capacity building	Training programs Youth group formation and activities Information dissemination (format and content) Partnerships	No. and type of workshops conducted No. youth groups and projects No. reports, CDs, Web site links, papers, presentations No. and type of partners (GO, NGO, local, regional)	Donor support obtained Social stability
Output 5 Efficient use of project resources through participatory project management	Approved projects designed with partners and donors Partners participate in fieldwork Data-sharing agreements Lessons learned by the project and its partners disseminated New projects adopt methods, techniques, and experiences generated by the project and its partners Alliances: strategic and special project	No. new projects funded No. and type partners and level of participation No. data-sharing agreements No. papers, brochures, Web site links, CD-ROMS, documentation of replication of methods and techniques No. and type of partners (GO, NGO, local, regional)	Institutional linkages are maintained Donor support is obtained

2. CGIAR Performance Indicator Element 1: Outputs 2005

	OUTPUTS	OUTPUT TARGETS/MILESTONES 2005	OUTPUT TARGET CATEGORY	ACHIEVED?
1	Improved watershed management based on knowledge of land-water interactions. Farmers adopt approaches and technologies developed with CIAT and its partners to establish environmentally sound management and livelihood alternatives.	Establishment of water-monitoring networks for assessing water use, quality, quantity, and availability	Capacity	Achieved
2	Improved watershed management based on knowledge of land-water interactions. Farmers adopt approaches and technologies developed with CIAT and its partners to establish environmentally sound management and livelihood alternatives.	Environmentally and socially sensitive area (ESSA) analysis methodology applied in prioritized watersheds	Practices	Achieved
3	More equitable resource allocation based on highland-lowland interactions and trade-off analysis. Identify and monitor indicators of highland-lowland resource interactions. Promote community-based approaches for resolution of inequities.	Documentation and study of IWM interactions, allocations, community priorities, and best-management practices	Other kinds of knowledge	Achieved
4	More equitable resource allocation based on highland-lowland interactions and trade-off analysis. Identify and monitor indicators of highland-lowland resource interactions. Promote community-based approaches for resolution of inequities.	Economic evaluation of hydrological services, which aim to overcome problems of water scarcity, by looking at incentives for sustainable practices and resource preservation	Policy strategies	Achieved
5	Strengthened organizations. Local and national organizations involved in sustainable agricultural development at various levels (site, national, regional) use the technical and methodological	Continuation of capacity-building programs at local and national level on common baselines and indicators for IWM to overcome lack of coordination among	Capacity	Achieved

	resources developed by the project in their decision-making and other activities. Interinstitutional coordination is enhanced.	GOs, NGOs, and communities (disarticulation among policies, programs and interests of the rural population).		
6	Strengthened organizations. Local, national, and international organizations involved in sustainable agricultural development at various levels (site, national, regional) use the technical and methodological resources developed by or with the project in their decision-making and other activities. Interinstitutional coordination is enhanced.	Strategic alliances and partnerships strengthened as important links for science and outreach by achieving synergies between sharing knowledge and integrating activities, and integrality of problem-driven capacity building.	Capacity	Achieved
7	Efficient use of project resources through participatory project management.	Internal and external partners as co-researchers directly participate in project management to ensure adequate and efficient use of the project's resources.	Practices	Achieved

3. Research Highlights in 2005

The C&W Project has made significant progress towards its scientific goals in 2005. Research highlights include:

3.1. Output 1: Improved watershed management based on knowledge of land-water interactions

The goal is to improve watershed management by understanding land-water interactions, production systems, and land use. Understanding is achieved by quantifying linkages between production systems, nutrient management, land use change, and water; establishing monitoring networks; and conducting baseline surveys on the use of water, land, and resources. Case-based methods of community monitoring and management of watershed characteristics and processes can then be developed.

3.1.1. Water use, quality, and availability in the Los Saínos microwatershed, Colombia

Objectives: Watershed research aims to answer four questions:

- Can wetlands be restored to improve the quantity and quality of water?
- Where are the sources of water contamination?
- What is the relationship between use, quality, and availability of water?
- What are the options for improving water use?

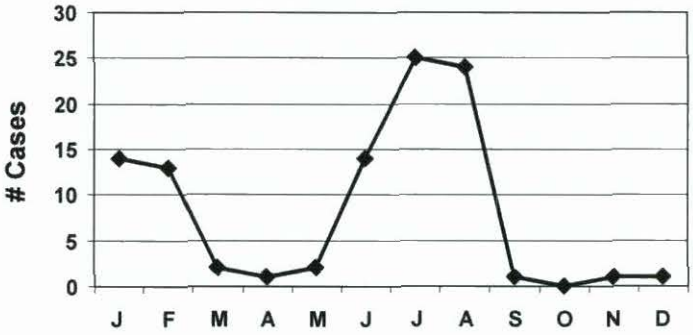
Water consumption: To understand the demand for water and compare it with the hydric offer, we measured on-farm domestic and production consumption of water. Families in the microwatershed are regularly prohibited from using water for activities such as crop irrigation and animal care. However, results showed that total consumption was only double domestic consumption, which was the same as normally used by urban inhabitants.

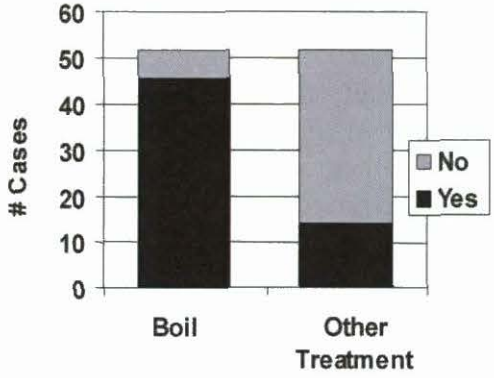
Water quality: Water quality was sampled in tributaries to the Los Saínos stream. Three major "jumps" in conductivity values were observed. The first jump was in the upper watershed. Although the area is protected, the nature of the soil made the water hard, as reflected by the quantity of calcium and magnesium ions. Conductivity values increased again in the central part of the watershed as a result of wastewaters discharged from the urban zone. Values increased yet again in the lower watershed as a result of discharges of water used to clean pigsties.

Activities: A community meeting was held to discuss the results of the study, and the following activities were taken up:

- A sand filter was installed at the local school.
- Fences were constructed and reforestation carried out in critical areas, with support from the Municipality of El Dovio.

- At one critical point of pollution, the landowner agreed to install a biogas digester, with the project's support.





3.1.2. Food security: biointensive vegetable gardening in the Garrapatas River watershed, Colombia

Objectives:

- To develop, through action-oriented research, leadership skills in the community.
- The technologies used will contribute to the integrated management and conservation of watersheds, thus improving food security and nutritional offer.
- Establish a teaching-learning model, based on lessons learned from this activity so that it can be replicated in other areas.

Methodology and results: An initial diagnosis showed that most vegetables consumed in the community are purchased, thus providing motive for the community to implement biointensive vegetable gardens. Community youths were trained to construct gardens, following practices of organic agriculture. They also learned about the importance of vegetables for improving the area's food security and nutritional offer, and studied differences between traditional and biointensive systems.

Biointensive gardens (right garden bed) permit better plant development by using resources more efficiently and consequently produce more food. A traditional gardening system is shown on the left.

Next steps: The production of organic inputs and vegetables for household consumption, especially those with high vitamin content, needs to be strengthened, using seeds from the area. Families need to be encouraged to see that biointensive gardens are easily implemented and economical, and provide nutrition and food security, and possible economic returns.

3.1.3. Integrated animal production systems, Garrapatas River watershed, *Colombia*

Background: Our research partner CIPAV developed a youth-led research project with three groups of youth co-researchers. Three alternative livestock production systems were evaluated: pig raising, chicken-range systems, and fish farming. The idea was to improve food security through more effective use of local resources.

Results: In all three cases, local resources were compared with purchased inputs. Differences were not significant, although, with the use of local resources, pigs took more time to reach saleable weights and chickens were slower to start laying. For fish farming, however, mortality rates were lower than expected for commercial farming. Overall production costs were higher with local resources because of the transport involved.

3.1.4. Characterizing local forests for ecological restoration, Los Saínos, Colombia

Objectives:

- To characterize the trees and shrubs of the villages of Bellavista and Los Saínos to identify useful species for initiating ecological restoration of the forest.
- To characterize the botanical composition and physiognomy of forest fragments.
- To discover what rural dwellers like about trees and shrubs and what they know about their use.
- To identify useful trees and shrubs to initiate ecological restoration of forests in degraded lands and to enrich secondary forests.

Results: Characteristics of the most appropriate trees for restoration were defined, such as symbiosis with nitrogen-fixing bacteria, ability to adapt to degraded soils, abundant

regeneration, rapid growth, high production of fruits and seeds, and suitability for protecting microwatersheds.

3.1.5 Evaluating the influence of riparian giant bamboo (*Guadua angustifolia*) forests on the quality of the aquatic ecosystem and its water

Background: The watershed of the El Dovio River possesses extensions of riparian forest dominated by giant bamboo. This bamboo is believed to protect the quality of the watershed's hydric network.

Objectives:

- To set up a series of monitoring stations that would quantify biological, physical, and chemical indicators that would permit comparisons of the river's physical, chemical, and biological characteristics at different stations.
- To establish monitoring stations in riparian forests that present different levels of forest management.
- To identify areas in the watershed where management action must be taken to conserve the forest and water sources.
- To develop a methodological proposal for environmental education on aquatic ecosystems and as possible support for managing this forest ecosystem.

Materials and methods: Ten sampling stations were selected along the stream Los Saínos, which flows into the Quebrada Grande (*lit.* "Large Stream"). Samples were taken in "summer" (dry season) and "winter" (wet season) of benthic macroinvertebrates associated with different substrates of the streams, and of physical and chemical measurements such as conductivity, total dissolved solids (TDS), pH, dissolved oxygen, temperature, nitrates, phosphates, and turbidity.

Results: As the water passed through the riparian forests, these acted as filters, trapping pollutants and sediments and, thus, decreasing the values of conductivity and TDS in the water. In contrast, increases in conductivity and TDS were seen at stations placed at other sites where organic matter entered the river from agricultural and livestock activities very close to the sampling stations. Biotic indices—calculated as total species richness, EPT species richness, and diversity—increased as the water moved from the forests.

Conclusions: Overall, the Los Saínos stream is being disturbed by agricultural and domestic activities from only a few kilometers from its source, but as it passes through the riparian forests, it is filtered, with its aquatic ecosystem restored until it reaches the urban area of the Municipality of El Dovio, where water quality deteriorates.

Further activities: To develop a proposal for a methodology to support environmental education on aquatic ecosystems. This methodology would be based on lessons learned from five workshops held with young people. Another product is an educational primer that is applicable to other sites.

3.1.6. Wetlands and water quality, Yorito Honduras

Background: One basic function of wetlands is to help reduce the levels of contamination in wastewaters. The urban zone of the Municipality of Yorito contributes grey waters from residences, which discharge into La Pimienta stream.

Measuring water quality: Young researchers conducted a study to quantify the number of macroinvertebrates (a tool for monitoring water quality) in La Pimienta. Results indicated a high presence of macroinvertebrates that tolerate pollution, especially from the family Oligochaeta, thus demonstrating that the stream was highly polluted.

Replication: The Municipality of Yorito, together with youths from the San Pedro Educational Institute, constructed another wetlands to filter waters flowing to the Aguan River, one of the most significant, agriculturally, in the country.

Activities for 2006: The young researchers, with support from the San Pedro Educational Institute and the Municipality, will continue to (a) monitor water quality (obtaining physical, chemical, and biological data), and (b) evaluate the performance of the wetlands. The data obtained will allow them to continue making adjustments to permit the wetlands' greater efficiency.


REPÚBLICA DE HONDURAS
MUNICIPIO DE YORITO
DEPARTAMENTO DE YORO

LA CORPORACION MUNICIPAL
DE YORITO, YORO

OTORGA EL PRESENTE DIPLOMA DE

Reconocimiento

A: CIAT

Por su invaluable apoyo en la gestión municipal 2002 - 2006

Yorito, Yoro 25 de enero de 2006

MANUEL DE JESÚS CASTELLANO
ALCALDE MUNICIPAL

DANIA MENCIA
SECRETARIA

Recognition:
The Municipality of Yorito, Honduras, awarded CIAT with a certificate recognizing the Center's "invaluable support" in the Municipality's management of water, and agricultural and natural resources.

3.1.7. Water sources: their potential contamination and management, Tascalapa River watershed, Yorito, Honduras

Background: In 2003, the Municipality of Yorito established that water resources are facing costly deterioration in their quality and quantity. However, historical information on both water quantity and quality is deficient, making impossible the statistical analyses needed for identifying high-risk zones in terms of water use.

Objectives: To help communities and local government obtain basic information, a baseline survey of water was conducted to georeference and characterize areas of irrigation-ditch construction, water-storage tanks, and potential permanent springs. It also located communities and updated their data.

Results: The numbers of people, communities, and water boards were established, together with the numbers of springs and their uses; irrigation ditches (and associated water-storage tanks) and their state of maintenance, size of protected areas, and predominant forest species; and the threats that these water sources face such as the advancing agricultural frontier, livestock, burns and forest fires, agrochemicals, and deforestation.

A design for the Aguan River wetlands, Yorito, Honduras.

Water quality and quantity: Few water boards in the Tascalapa River watershed had quantifiable historical data on water quality and quantity. What data existed could not be compared with the aforementioned data because they had been obtained at the household level and monitoring points were different, or measuring methods varied. Overall tendencies showed, however, that flows were declining and investments in water projects were increasing to transport water over longer distances.

Water boards: These local organizations have been given legal functions over potable water and sanitation and to monitor water quality and quantity. However, because they carry out their jobs on a volunteer basis, they tend to show little interest on an entity basis. Water resources in the Tascalapa River watershed are therefore being handled by communities, with no private entities involved.

Activities: With support from IDRC (Canada), an integrated strategy for managing water resources was developed jointly with the Municipality, water boards, and young rural researchers, covering the water "production chain" from water source to final use and afterwards. Principal activities are to evaluate water quality at the source, collection

tank, and dwelling; determine multiple uses of water and efficiency of use with respect to availability (quality and quantity); identify and evaluate practices for managing and disposing liquid and solid wastes carried out by beneficiaries; implement practices to improve water quality; and estimate the value of hydric services in terms of costs in maintaining the water systems and thus initiate, with the Municipality, a scheme of payments for environmental services.

3.1.8. Managing water sources, San Dionisio, Nicaragua

Background: The Cálico River's principal course is very low in the dry season, giving rise to serious problems of supply. Some farmers in the central part of the watershed also dam the river to irrigate grapevine and vegetable crops. The river's undrinkable water is contaminated mainly by wastewaters from coffee processing, agrochemicals (in surface runoff, which also carries erosion products), dead animals, solid wastes, animals bathing, detergents, and feces. Nearby streams and springs are also contaminated. Water for human consumption comes mainly from smaller natural sources such as springs and mini water supply systems located in high areas.

Water sources: Of the 106 water sources located in the watershed of the Cálico River, about 40% are well protected, mostly by being in the upper part of the watershed, where natural vegetation and trees grow and little agricultural activity exists. Those sources with the least protection (21% of all sources) and, hence, the most vulnerable, concentrate in the lower part of the watershed, including at the river. About 50% of dwellings are supplied with potable water through pipes. However, for 16% of families, the piped water is insufficient and they must therefore obtain water from other sources. About 8% of families receive their water directly from the river.

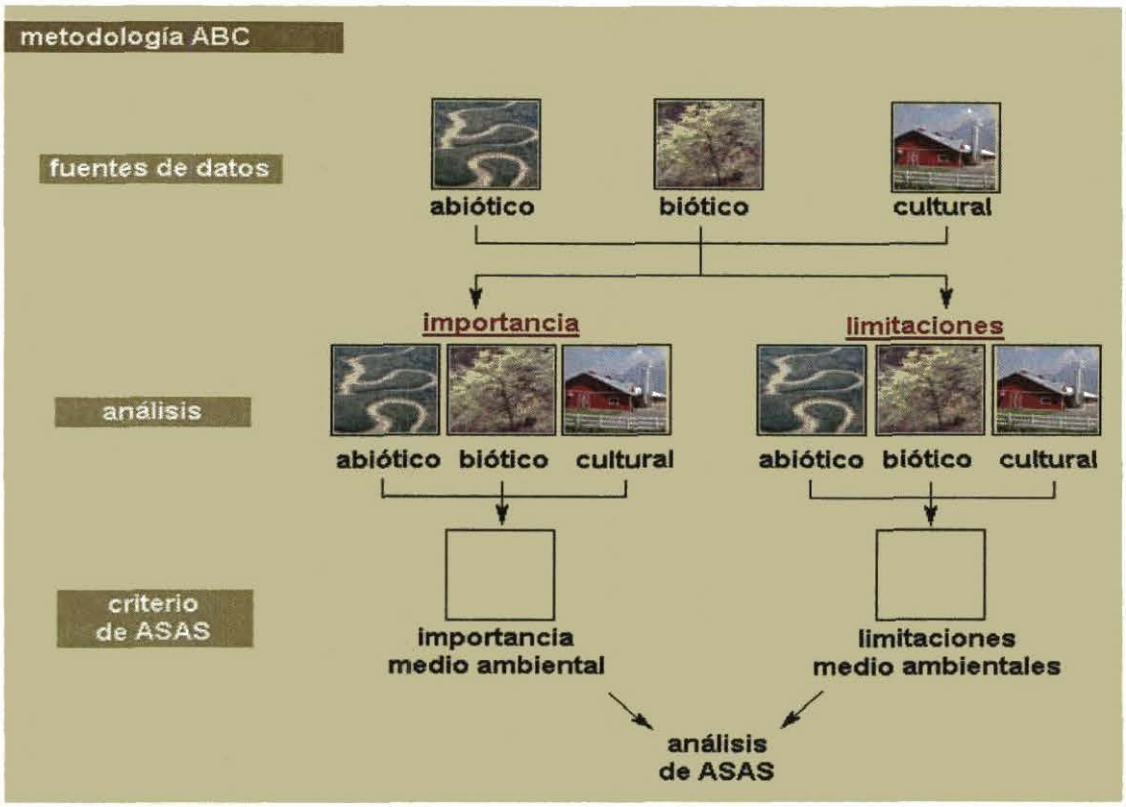
Local organizations: The Cálico River watershed is managed by the Committee for Municipal Development, with other local associations managing small community projects. Water management in the communities is achieved through committees for potable water (CAPs), who, because of their volunteer nature, do not provide the same level of management in all communities. This results in a continual limitation of piped water supply.

Economic valuation: Water rates are paid differently according to community, with those not receiving the service having to walk to the natural sources to obtain water for domestic consumption. With 42% of families having to bring their own water from the closest source, the total cost per year is about US$36,268.

Activities: Because information on water quality and quantity in the watershed of the Cálico River is scattered, a monitoring network was established jointly with the Ministry of Health, the Mayor's Office of San Dionisio, and the CAPs to conduct periodic samplings over time.

3.1.9 Environmental and Social Sensitivity Analysis (ESSA): a case study on the Cálico River watershed, Nicaragua

Background: The Project of INTA/UNA/CARE/CIAT Strategic Alliance executed in 2004, gave emphasis to identifying criteria for environmental and social sensitivity.



Abiotic, biotic, and cultural (ABC) methodology for developing criteria for conducting an Environmental and Social Sensitivity Analysis (ESSA) of a watershed.

Inventorying data for ESSA analysis: In 2005, with the collaboration of local partners, we began implementing the methodology in the Cálico River watershed, Municipality of San Dionisio. We first took data inventories of *abiotic* (topography, soils, contours, and the hydrological network), *biotic* (forest cover, riparian forests, and biodiversity), and *cultural or social* factors (water quality and quantity, potential for tourism, land use and tenure, level of local organization, social information on levels of poverty, education, and health). These inventories enabled us to generate interpretative maps and analyze the importance and limitations of the environment.

Classifying criteria. The ranges between specific criteria and their values for applying to watersheds under study were defined to permit determining high, medium, or low sensitivities.

ESSA guidelines: The guidelines on managing ESSA in the Cálico River watershed were developed and disseminated to municipal development committees, interest groups in the

microwatersheds, and related interest groups (e.g., soil, youths, farmers, and livestock producers). Themes included natural resource management (e.g., soil, water, forests, and animals), managing production systems, and aspects of tourism.

3.1.10. Water diagnosis, use, and quality in the Titiri/Totora and Tiquipaya watersheds, Bolivia

Introduction: The Youth Bolivia alliance for water science strives to build local capacity of youths involved in integrated water management science. The project focuses on water use and access, working with youths from upstream and downstream communities. Youths participate as co-researchers to develop their capacity to analyze natural resource issues, improve communication skills, and build linkages with local organizations involved in water management.

Diagnosis: Two diagnostic workshops were conducted, one in Titiri and Totora (upper watershed) and the other for Tiquipaya (lower watershed), each centered on three components: issues, research needs, and youth priorities. Diagnostic trees, grouping similar themes, were constructed. The youths discussed research needs in relation to the diagnostic trees, and the activities they could undertake in relation to those themes.

Baseline and water-use training: A workshop was held to design a survey to be conducted by the youths. After practice, the youths interviewed households and compiled information on land tenure, access to basic services, land management and production systems, animal holdings, water sources, water shortages, water culture, and food security. Data analysis is ongoing and results will be presented to local communities in the coming months.

A workshop on water-consumption monitoring was also held to train youth co-researchers in quantitative methods for measuring domestic and production water use. Water use has now been assessed on a preliminary basis, and measurements are being repeated to determine "typical" headwater and downstream water use for domestic and production uses.

Water quality: In the upper watershed, in the community districts of Titiri and Totora, various springs and wetlands provide the principal sources of water for consumption and irrigation downstream for the Tiquipaya and Cochabamba communities. Youths and co-researchers from the CGIAB were trained to use the Oxfam-DELAGUA water-testing kit to quantitatively determine coliforms in water. Cattle excrement was noted near streams. Canal structures appeared to impede contamination. The highest bacteriological contamination was found downstream, in untreated portions of the distribution system. Wells were also used and usually free of contamination.

3.2. Outputs 2 and 3: More equitable highland-lowland resource (water) allocation, and Provision of environmental services (water)

The goals of these two outputs are (1) to allocate resources, including the provision of environmental services, more equitably between upper and lower watersheds, and (2) encourage focus on water issues. Water resources are generated in upland watersheds, the "water towers" for downstream communities. Improper management often results in problems of supply and pollution for both upper watershed environments and downstream users. Highland-lowland interactions, trade-off analyses, and quantifying environmental services are key to conflict resolution and the equitable allocation of resources, including water. Research on water availability and hydrologic response is fundamental to improving water allocation and administration. Economic evaluation of hydrological services is needed to develop retribution models.

3.2.1. The role of Andean wetlands in small-catchment hydrology, Barbas watershed, Colombia

Hypothesis: That the wetlands located in upper watersheds regulate the hydric balance and availability of water for users in lower watersheds.

Analyzing hydrologic response: Fluctuations in water levels of monitored wetlands and major slopes suggest that wetlands help regulate overland flows. Although the peaks produced by heavy rainstorms quickly convert into runoff, wetlands apparently help retain the flow at outlets.

Monitoring network: A monitoring hydrological network across the wetlands was established with equipment such as fluviometers, anemometers, measures for air temperature and relative humidity, evaporation tanks, and limnigraphs. Measurements were taken of interception, runoffs, water flows, water levels within and outside the wetlands, and water levels at wetland outlets.

Wetland as "buffers": To quantify their contributions as "buffers", an inventory of wetlands and their characteristics was made, using satellite imagery and field measurements. One preliminary inventory listed 59 wetlands distributed across three watersheds.

Wetland plants: To determine the influence of wetland plant communities on the hydric balance, their botanical compositions were inventoried. We hoped to design options for managing wetlands and thus conserve water.

Organic matter decomposition: Samples of three species were weighed and buried, some in the wetlands and others in well-drained areas, and evaluated every 4 months. The slower decomposition rate in the wetlands is an indicator of their greater potential to retain water.

Integration and application: The components of this study will be used to determine hydric balance and water availability. The results will then be compared with water consumption of populations under different scenarios of, for example, land use (comparing three watersheds), variability of annual rainfall (short term), and impact of climate change on the vegetation (efficiency of the ecosystem on water use).

3.2.2. Economic evaluation of the offer of hydric environmental services (HES), watersheds of the Cálico and Jucuapa Rivers, Nicaragua

Background: In 2005, an economic evaluation of the offer of HES was conducted in the reference sites of the C&W's project (Cálico) and CATIE–FOCUENCAS' project (Jucuapa). The assumptions, common to both, were:

- Water scarcity motivated the populations concerned to prioritize this resource.
- No incentives existed that were sufficient to encourage suppliers to adopt sustainable practices to protect the HES.
- The water was not paid for, which probably discouraged protection.

Principal objectives: To economically evaluate the costs of protecting the hydric resource and so increase the offer, and to propose payment for the HES.

Methodology:

- Conduct a field diagnosis to collect socioeconomic and biophysical information.
- Select and prioritize critical areas for the provision of water.
- Characterize potential providers of HES.
- Conduct an economic analysis of the costs of changing practices and land uses and thus determine the potential size of the fund to compensate farmers directly involved in protecting hydric resources.
- Design and validate proposals for compensation, that is, payments for HES.
- Estimate over 10 years, the effects of changes in land use and implementing technologies to protect soil and water, assuming 15 ha per year.

Results: The critical areas of the Cálico watershed, itself 17,000 ha, comprised 6000 ha (35%); and of Jucuapa (4000 ha), 620 ha (15%).

For the Jucuapa watershed, a scheme for paying HES cannot be implemented because of the small number of beneficiaries, who would not be able to maintain the necessary fund. Neither can the institutional situation support such a scheme.

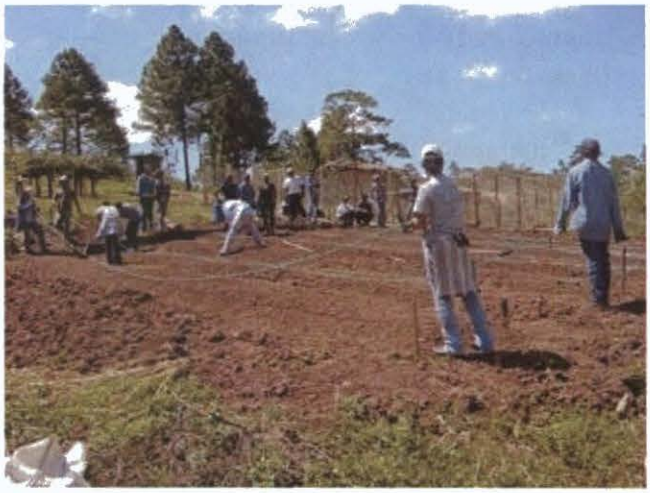
For the Cálico watershed, the situation is more favorable, and a project is being considered with the Municipality of Cálico to submit to financial organizations.

Problems of infrastructure and distribution of water must be handled at the same time as running schemes for protecting the water because otherwise compensation plans will not be viable. This implies including, from the beginning of any activity, the local water supplier.

3.2.3. Drip irrigation, biointensive vegetable production, and water efficiency in Yorito, Honduras

Introduction: This project, with local partners—especially young researchers of the region—is setting up biointensive gardens as an innovative technology to increase food production. It involves managing small areas by double digging. The double dig improves soil texture and structure, increases water-retention capacity, better regulates soil temperature, better aerates the soil, and enables plants to assimilate more nutrients.

Establishing and managing biointensive gardens: In 2004, biointensive gardening began with a workshop for youth groups, focusing on topics such as the double dig, use of organic fertilizer, installing a drip irrigation system, planting in staggered parallel rows, and planting aromatic plants around garden edges.



- The youths began by arranging and constructing garden plots, preparing organic fertilizer (in the bin on the platform), and constructing raised seedling beds.

Next steps: During 2006, with COSUDE's support, youth groups will focus their activities on installing and managing biointensive gardens, together with market studies and the definition of high-value crops. They will also work on rainwater catchment systems that permit efficient water use. These activities will strengthen the youths' capacity for research to better manage water harvesting, linked with drip irrigation in biointensive gardens.

República de Honduras
Secretaría de Educación
Dirección Departamental de Educación
Instituto "San Pedro"
Yorito, Yoro

Otorga

Reconocimiento

Centro Internacional de

A: Agricultura Tropical CCIAT)

Por su decidido apoyo en las actividades ejecutadas con el Proyecto de Investigación Participativa con Jóvenes en Seguridad Alimentaria y manejo de Recursos Naturales y el fortalecimiento del Bachillerato en Ecología y Medio Ambiente.

Yorito, Yoro 20 de noviembre de 2006

Recognition:
The San Pedro Institute of Education, Yorito, Honduras, awarded CIAT a certificate of recognition for its work with youths on food security and natural resource management.

3.3. Output 4: Strengthened organizations: community and institutional capacity building

The goal is to strengthen the capacity of organizations—from local to national levels—for watershed resource management and allocation by means of workshops and training activities. Interinstitutional collaborative mechanisms are used to build multiple operational partnerships and facilitate the dissemination of research results. Methods and case-based examples are developed to illustrate techniques for capacity building specific to water and watershed management, and for integrating rural communities in research relevant to development issues.

3.3.1. *Rural Youth in the Management of Natural Resources and Food Security*, project in the Garrapatas Canyon, Colombia: the lessons learned

The project: The project's goal is to develop an educational model based on research themes that are of priority to Latin American rural areas, that is, natural resource management and food security. More specifically, our objectives are to:

- Promote the development of juvenile rural leaders.
- Develop research on natural resources through partnerships with research centers, universities, companies, and local organizations.
- Facilitate the development of a youth company for the sustainable and profitable use of abundant local natural resources.
- Facilitate the generation of mechanisms whereby youths finance their own companies and studies.
- Incorporate the project's processes into local, national, or regional networks through partnerships, thus expanding the project's impact.

The breadth of this project's goals demanded the formation of a wide network of national, international, and local institutions to cover different aspects of the project.

Lessons learned: Marginalization of rural areas strongly affects the opportunities young people have to develop their human potential. Hence, ongoing activities to develop leadership skills in young people to constructively influence their families, educational centers, and communities have an enormous impact on rural youths who had never been exposed to such tools and dynamics.

Monitoring the youths' progress in terms of their leadership skills is important for establishing the effectiveness of these tools. Hence, links must be made with teachers who show great individual commitment and with the educational institutions where they work.

Because leadership tools can often make young people more capable than their teachers and parents, thus generating conflicts, the educational community of marginalized areas should also be targeted by projects aiming to have impact on young people.

Partners should include local institutional and regional actors who, through permanent accompaniment, can appropriate the process on behalf of the institutions and rural communities.

The maintenance of resources contributed by project partners and collaborators have considerable impact on achieving objectives because they tend to increase investments in project activities and create the dynamics for searching for resources within local organizations and youth groups.

We confirmed the hypothesis that the participation of youths was important in discussions of problems and creation of alternatives for their communities.

3.3.2. Interinstitutional alliances and strengthening organizations in the Municipality of El Dovio, Colombia

Background: The lack of coordination between GOs, NGOs, and local communities involved in the El Dovio region has led to a lack of articulation between policies, programs, and the interests of the rural population. The lack of sufficient and timely information has also meant low levels of participation by local organizations in decision making.

Organizational strengthening: The Mayor of El Dovio, representatives of the Municipal Unit for Technical Assistance (UMATA), and the project's field technicians from CIAT exchanged experiences through visits to another reference site for CIAT, the Tascalapa River watershed in Yorito, Honduras. The participants discussed interinstitutional coordination, indicators for integrated watershed management, and working with youths in natural resource management.

Preparing a baseline: A baseline is now being prepared, using indicators for integrated watershed management that were developed by municipal committees for rural development. This activity will permit greater integration between local actors, as, through institutional agreement, the indicators have been prioritized. Likewise, information will be systematized and processed, and projects of intervention will be prepared in a more integrated fashion.

3.3.3. Preparing baseline indicators for the Garrapatas River watershed, Colombia

Context: The baseline survey was carried out as part of an alliance with local institutions in the Municipality of El Dovio, in the central part of the Garrapatas River watershed. Activities were carried out within the framework of the Municipal Committee for Rural Development.

Information collected: Data showed that:

- In contrast to other municipalities, 70% of El Dovio inhabitants own their land, albeit as smaller holdings.
- Predominant land use is natural forest and clearing, followed by livestock production, which generates very little employment.
- The area suffers from a high emigration rate from a combination of factors, including low employment and armed conflict.
- While more El Dovio inhabitants have received primary school education than those dwelling in other municipalities, they compare less favorably for secondary schooling.

- The patterns of general morbidity indicate widespread consumption of polluted water, suggesting a significant motive for carrying out works to improve water quality, prevent diseases, and treat water in village water-supply systems.
- Although the Municipality is well supplied with electric lighting, firewood is most used for cooking—an aspect that suggests strong pressure exists on the natural forest.

Conclusions: By discovering the general state of a region, we can determine the degree of intervention needed, and use the collected data to support decision making and prioritization of activities to undertake.

3.3.4. Youth leadership in the Garrapatas River watershed: challenges, objectives, and abilities

Background: Leaders are those individuals who can think for themselves, use their personal strengths, communicate their thinking and feelings to others, influence and motivate others to follow a common cause, and work collectively to achieve results. They have high standards of achievement. Leadership is a set of skills and attitudes that can be learned and developed.

Designing workshops: After 3 years of working in research projects with youth groups, we designed a series of workshops on juvenile leadership on two assumptions: (1) all people have potential to become leaders, and (2) the most critical skills for effective leadership, including the capacity to understand and interact with others, are developed predominantly in adolescence and early adulthood.

Workshop content varies according to the level of the young participants, but encompasses the following aspects:

- *Knowledge of themselves*: To give the youths tools for understanding themselves and developing self-esteem and confidence.
- *Communication skills*: Theory and practice of effective public presentations; facilitation abilities; and corporal conscience.
- *Teamwork.*
- *Participatory video*: A tool for diffusing the experiences and results of research and development.

The workshops still need more precise development. We need to design and use verifiable indicators of leadership skills developed by young people, and guarantee the sustainability of the workshops through training teachers in educational centers.

Next steps:
- To develop the methodology of workshops on leadership skills that will support rural youths involved in learning and research processes.
- To develop verifiable indicators of the impact of leadership skills on young people, their academic performance, and their relationships with their families and communities.
- To develop a training system for teachers who can accompany these processes on a local scale.

3.3.5. Rural enterprise to manage, process, and market giant bamboo, Garrapatas River watershed, Colombia

Background: In seeking new income alternatives for family sustenance and the development of the El Dovio region, institutions such as the Mayor's Office, CIAT's C&W Project, and Actuar Quindío have jointly made a significant effort to implement the first phase of a training process on the use and processing of *guadua* (giant or building bamboo) to create handcrafts and furniture. The course has a strong component of business management and criteria for the sustainable management and use of resources.

Objective: To carry out an environmentally and economically sustainable but integrated management of giant bamboo and associated resources (e.g., water, soils, and biodiversity) in the central part of the Garrapatas River watershed.

Activities: One-year training with Actuar Famiempresas of Quindío and the Colombian Laboratory of Design. Training components include administration; technical and production development of giant bamboo (from planting, through use and treatment, to processing into crafted pieces); group visits from technical assistants; and seeking niches in local, regional, national, and even international markets for crafted products.

Results: The Association of Giant Bamboo Artisans of El Dovio, Valle "Guadua Madura" was created with 28 associates who were trained to produce high-quality handcrafts from giant bamboo and were strengthened in leadership skills such as teamwork, commitment, and group strengthening. The group developed a catalog of over 50 designs of marketed handcrafts, and has a craft workshop that is equipped with heavy industrial machinery for handcraft manufacture. It also has a warehouse of handcrafts in El Dovio. The group participates in craft fairs, and has established local strategic alliances with local, regional, and national entities, and with CARITAS International.

Lessons learned:

- The association required the participation of new institutions to contribute training and machinery (CVC, SENA, and CARITAS).
- Young people still do not have the level of developed commitment to mount rural agrobusinesses, and need more institutional accompaniment and monitoring of activities.
- Armed conflict in the area has hindered the participation and permanence of young people in the project.

3.3.6. *Youth News*: a communications project brings results to the local community, Garrapatas River watershed, Colombia

Background: The young people of the Garrapatas Canyon are affected by the lack of communication media in the area. The great distances between villages prevent adequate flow of information on events in villages generally and on activities of young people in particular.

Objectives: To create and produce a magazine through which youths can manifest and express their experiences, reflections, and knowledge, and which would open up a communication channel that would help integrate young people from different villages and schools throughout the entire Garrapatas River watershed. Such integration would promote community organization and integration, encourage young people to reflect on the process they are experiencing to develop the project, and enhance young people's knowledge of information technology, reading and writing, and oral expression.

Activities: A meeting and workshop were held with educational institutions and communities of the area to establish the production team for the youth magazine and determine committee roles and positions for that team. The team was trained in communications media and information technology, and introduced to the computer environment, using packages such as PowerPoint, Word, and Publisher. The team also attended reading and writing workshops at the CIAT Communications Unit, and toured the newspaper *El Pais*.

Results: Four copies the area's youth magazine were published and sold within the community. Funds were obtained to produce more copies and the young people who participated in the magazine's production were recognized for the leadership skills they displayed.

Front page of the youth magazine published in the Garrapatas River watershed, Colombia. The magazine featured different activities and events of educational institutions and the characteristics of young people in the region.

Next steps: To promote the management and accompaniment of local institutions that support such activities to ensure their permanence and sustainability.

3.3.7. Designing a model for replication: CERES, El Dovio, Colombia

Background: In the last 3 years, we identified a key factor to maintaining the C&W project's dynamics in the El Dovio region and being able to replicate these dynamics in other scenarios. This was partnership with institutions and people dedicated to youth education. For this reason, we saw the convocation made by the Colombian Ministry of Education to cofinance regional centers for higher education (CERES, their Spanish acronym) as a great opportunity to initiate

partnerships that would enable us to consolidate the results we have so far obtained, rely on the support of institutions interested in rural youth, and support our results on a broader scale.

Problems: Like with much of Colombia, higher educational and professional technical programs are non-existent or scarce in the region, limiting the development of businesses or maintenance of natural resources as the production base. To obtain higher education, rural youths must be displaced to major cities, but this alternative is available only to those with the resources to do it. The higher education system is therefore inequitably spread to the disadvantage of the poor and rural dwellers. The quality and relevance of educational institutions are also often questionable.

The CERES program: The CERES are conceived as alliances in which the government, civil society, and the academe participate to create opportunities for the social and economic development of marginalized communities by offering programs that are relevant to their production vocations. The national government acts as promoter and facilitator, and contributes resources; the local governments and representatives of civil society and production sectors channel community realities and create production projects explicitly for the area and its requirements; and the academe puts its knowledge to service the region's development.

Expected results: By accessing, without leaving the area, good quality and relevant higher education through the virtual programs offered by CERES, young people can maintain their production activities and continue to generate income that, in most cases, is fundamental to their families' economy. The community would benefit from young people staying with their families while finishing their studies and then becoming involved in, or strengthening or creating local businesses. Companies and production associations would have trained technical personnel able to create opportunities to improve the production base, manage the natural resources on which the watersheds' production and quality of life depend, create opportunities for business, and administer these.

3.3.8. Youth Bolivia: an alliance for water science and the future

Background: Youth Bolivia is a partner for water science in the collaborative project funded by CGIAR and CIDA. The project helps broaden the CIAT/UBC research alliance through the exchange of researchers and researcher collaboration with CGIAB.

Researcher exchange: The exchange of scientists from CIAT, UBC, and CGIAB has helped enhance collaboration and exchange of lessons learned, develop youth capacity, and compile scientific baseline information on water issues for the Tiquipaya watershed. Scientific exchange has included joint workshops on baseline survey techniques, leadership, water consumption, and water quality. Workshops focused on transferring techniques and tools from CIAT and UBC to CGIAB, who then adapted the tools for Bolivia, thus facilitating improved application by UBC and CIAT. The workshops also significantly contributed to the building of youth capacity through specific skills such as diagnostic trees, questionnaire design, interviewing techniques, water-use monitoring techniques, water-quality monitoring procedures, data analysis, and presentation skills.

Leadership training for youth co-researchers: The first workshop was conducted in Bolivia, focusing on self-knowledge, teamwork, and public speaking. It combined two youth groups (upper and lower watershed), involving them in activities of integration and creating an atmosphere for feedback. The workshop was a positive first step towards developing youth capacity within the project and was a challenge for many participants who had limited exposure to public speaking, teamwork, or self-expression and/or self-awareness. Exchange between the two groups of youths also provided opportunities for them to present their work on water resources, and discuss common interests and differing perspectives.

3.3.9. Conflict and stakeholder analysis: the case of the Tiquipaya watershed, Bolivia[2]

Background: The Tiquipaya watershed in Bolivia represents several cases of conflict and collaboration over water resources:

Irrigation *usos y costumbres* versus upstream tenure rights and social claims: User rights to lake water resources are based on a mix of centuries-old customary law termed *usos y costumbres* (*lit.* uses and customs) and contemporary tenure rights. Relationships, both economic and social, between upstream farmers and irrigation farmers date back to the Incas and their irrigation systems. However, these inter-Andean relationships are increasingly being confronted by modern and external factors, particularly urbanization and commercialization, which claim large shares of water resources. Upstream farmers are exposed to huge temptations by public and private actors to sell land around lakes for irrigation, industrial production, and electricity production. Thus, upstream farmers and their structures and institutions are undergoing transition, with one foot in traditional *usos y costumbres* and the other foot in modern processes of commercialization and privatization.

Rural versus urban access and control over water resources: Traditional irrigation farming often comes into conflict with growing urban needs. For example, rapid urbanization in the semi-urban zones in the Municipalities of Tiquipaya and Colcapirhua demanded the design of a sanitation project and potable water supply. However, the municipal authorities planned the project without sharing much information and with less participation from citizens and their organizations. Community potable-water committees and the irrigation federation therefore protested against the project, seeing their exclusion from the project as a consequence of a municipal body prioritizing urban needs over rural needs. A citizens' protest finally paralyzed the project and set in train negotiations on a multiple stakeholder platform.

Settlement and land tenure rights versus water resource protection in Tunari National Park: Local and national authorities and environmental NGOs want the national park established to protect water resources, whereas local communities and illegal settlers want the land. Local communities also oppose the Park's establishment on the grounds of legal ambiguities, particularly for those who had gained legal property rights before the law on the Tunari National Park was promulgated or through political and economic pressures they were able to put on municipal authorities. Urban settlers, particularly poor immigrants from other parts of the country, remain illegal and live precarious lives without basic infrastructure such as roads,

[2] This section forms part of a PhD dissertation on water access, negotiation, and power, using the Tiquipaya watershed as a case study.

potable water, or waste collection. As yet, few attempts have been made to remove these settlements, and most municipalities recognize that an efficient and sustainable management of the Tunari National Park will almost certainly have to include a solution to illegal settlement and its accompanying problems.

The Andean world view of water versus the modern vision of water as a commodity and/or private property: Two fundamental different views exist on water: on the one hand, indigenous organizations, NGOs, and universities argue that water is a human right that should be free for all (although not necessarily open to access). On the other hand, water is increasingly recognized as an economic good that should be managed according to principles of full cost recovery. This principle has often been associated with and accompanied by increased commercialization and privatization of water resources and supply. Conflicts arise because the economics of water management are often linked to formal and powerful authorities like governments and international financial organizations. A Bolivian example of such conflicts is the Cochabamba "water war".

3.3.10. Multiscaling baselines in Nicaraguan watersheds

Background: The INTA/UNA/CARE/CIAT Strategic Alliance aims to strengthen the institutional capacity of INTA and its partners in Nicaragua. An integrated watershed management approach is being used to employ knowledge in synergetic ways and integrate activities and extension.

Results: INTA scientists received training from the Alliance, and have since produced baselines and indicators for the integrated management of the country's prioritized watersheds of the Viejo, Ochomogo, and Tecomapa Rivers. They also presented three papers to the "III Foro Nacional de Cuencas Hidrográficas", held 8–9 November 2005 and organized by RENOC. The papers dealt with the participatory preparation of a minimum set of indicators, socializing this set with the principal local actors of the areas for intervention, and collecting primary and secondary information. The Forum awarded these papers with first, second, and third places as the best works presented on methodology and municipal strengthening.

Next steps: INTA will start a second phase of this initiative to replicate these experiences in 11 more prioritized watersheds. This new phase is linked with CIDA's Nicaragua Integrated Watersheds Project, which has incorporated the ESSA methodology from the UBC/CIAT alliance.

3.4. Output 5: Efficient use of project resources through participatory project management

The C&W Project ensures that project resources are efficiently used. For example, C&W designs its projects with partners and donors; ensures partners participate in fieldwork; draws up data-sharing agreements; disseminates lessons learned during the project's execution; adopts, for new projects, methods, techniques, and experiences generated by the project and its partners; and establishes strategic and special project alliances.

4. Indicators: Publications List

4.1. Refereed journals

Brown S; Kennedy G. A case study of cash cropping in Nepal: poverty alleviation or inequity. Agric Human Values 22:105–116.

Brown S; Merz J; Shrestha B; Von Westarp S. The need to incorporate gender in sustainability: women, water and workloads, a case study from Nepal. Water International. (Submitted.)

4.2. Chapters in books

Brown S; Schreier H. Introducing innovations to watershed management. In: Price M, ed. UNESCO–MAB. (In press.)

Brydon J; Roa MC; Brown SJ; Schreier H. Integrating wetlands into watershed management: effectiveness of constructed wetlands to reduce impacts from urban stormwater. In: Wetlands. Kluwer Acad Publ. (NATO Science Series.). 11 pp. (In press.)

Zandbergen P; Brown S; Schreier H. 2005. Watershed management education and training CD-ROMs. In: France R, ed. Facilitating watershed management: fostering awareness and stewardship. Rowman & Littlefield Publ, Oxford, UK. pp 129–141. (A Web-enhanced book.)

4.3. Theses

Baltodano ME. 2005. Economic evaluation of the offer of hydric environmental services in the sub-watersheds of the Jucuapa and Cálico Rivers, Nicaragua. MSc thesis in Environmental Socioeconomics. CATIE, Costa Rica. 117 pp.

Lanza MG. 2005. A network analysis of the Barbas watershed: non-material environmental flows, Colombia. MSc thesis in Environmental Sciences. Wageningen University, Netherlands. 83 pp.

Roa C. 2005. Relationships between water availability, multiple uses of water, and land use in the microwatershed Los Saínos. MSc thesis in Sanitary and Environmental Engineering. Faculty of Engineering, Universidad del Valle, Cali, Colombia. 84 pp + appendixes.

4.4. Workshop and conference papers

Arana V. Línea base subcuenca del Río Ochomogo. Paper presented at the III Foro Nacional de Cuencas Hidrográficas (organized by RENOC), held 9–10 November 2005, Managua, Nicaragua. 9 pp.

Baltodano ME; Alpízar F; Madrigal R. Valoración económica de la oferta del servicio ambiental hídrico en las subcuencas de los Ríos Jucuapa y Cálico, Matagalpa, Nicaragua. Paper presented at the III Foro Nacional de Cuencas Hidrográficas (organized by RENOC), held 9–10 November 2005, Managua, Nicaragua.

Brown S. Allocating mountain water: uncertainty and impacts. Paper presented at the Glochamore 3rd thematic workshop on Sustainable Land Use and Natural Resource Management in Mountain Regions, held 14–17 March 2005, Sierra Nevada, Spain (organized by the Centre for Mountain Studies, UHI Millennium Institute, Perth, UK). UNESCO–MAB.

Brown S. Water in the Andes: conservation and human use. Paper presented at the UNU–INWEH/UNESCO–MAB–IHP International Workshop on Water Resources Management in Diverse Ecosystems and Providing for Human Needs, held 14–16 June, Hamilton, Canada.

Bucardo M; Torres C; Navarrete R; Mairena LM; Montenegro N; Arauz N; Franco J. Línea base: Microcuencas de la parte alta de la subcuenca del río Viejo, San Rafael del Norte y la Concordia, Jinotega. Paper presented at the III Foro Nacional de Cuencas Hidrográficas (organized by RENOC), held 9–10 November 2005, Managua, Nicaragua. 9 pp.

Espinoza N. Percepción de los habitantes de la subcuenca del río Cálico sobre el uso y manejo del recurso agua, San Dionisio, Matagalpa, Nicaragua. Paper presented by Diego Gómez at the III Foro Nacional de Cuencas Hidrográficas (organized by RENOC), held 9–10 November 2005, Managua, Nicaragua.

Giraldo G; Beltrán JA; Franco JB; Sanz JI. Pequeñas empresas de semilla – PES: Un innovador enfoque para mejorar la competitividad de los productores de las laderas en mercados dinámicos. Communities and Watersheds Project, CIAT, Cali, Colombia. (Document available at www.ciat.cgiar.org/iir/recuentos.)

Lorio AL; Gutiérrez A. Línea base: Enfoque de cuencas en la subcuenca del río Tecomapa, Somotillo. Paper presented at the III Foro Nacional de Cuencas Hidrográficas (organized by RENOC), held 9–10 November 2005, Managua, Nicaragua. 12 pp.

Orozco PP; Piccand V; Zanelli S; Beltrán JA. Estrategia de involucramiento de actores locales en la generación de datos para línea base con indicadores mínimos en manejo integral de cuenca: Estudio de caso microcuenca Wibuse / Jicaro, subcuenca del río Cálico, San Dionisio, Matagalpa. Paper presented at the III Foro Nacional de Cuencas Hidrográficas (organized by RENOC), held 9–10 November 2005, Managua, Nicaragua.

Roa MC; Brown S. Variabilidad en la capacidad de almacenamineto de agua en la cuenca alta del río Barbas. Paper presented at the International Conference on Climate Change: Impacto en los Sistemas de Alta Montaña, held 21–23 November 2005, Bogotá, Colombia.

Sanz JI. Actuación del CIAT con los INIAs en América. Paper prepared on invitation of INIA–Spain for presentation at the IV Encuentro del Sistema de INIAs de Ibero-América, held 30 May–3 June 2005, Rio de Janeiro, Brazil.

Sanz JI. Communities and Watersheds: an integral approach to water and ecosystem management (a). Paper presented during the Side Event on Integrated Water and Ecosystem Management, in response to an invitation by the Natural Resources Unit of the United Nations Environment Programme, Regional Office for Latin America and the Caribbean, held 9–14 October 2005, Montego Bay, Jamaica.

Sanz JI. Communities and Watersheds: an integral approach to water and ecosystem management (b). Paper on the conceptual framework of CIAT's Communities and Watersheds Project, prepared at the request of OAS to complement the presentation for the Side Event on Integrated Water and Ecosystem Management. Presented at the Fifth Inter-American Dialogue on Water Management, held 9–14 October 2005, Montego Bay, Jamaica.

4.5. Technical reports and others

Amaya JE. Investigando y promoviendo la instalación y manejo de huertos biointensivos en la subcuenca del río Tascalapa, Municipio de Yorito, Yoro, Honduras. Internal report, CIAT, Honduras. 22 pp.

Brown S; Cordero E. Youth Bolivia: alliance for water science and the future. Annual report for the CGIAR/CIDA Canada Linkage Fund. CIAT; UBC; CGIAB, Bolivia. 15 pp.

Lanza GM. Evaluación de la cantidad y calidad del recurso hídrico en la subcuenca del río Tascalapa, Yoro, Honduras. Consultancy conducted for the Communities and Watersheds Project, CIAT, Tegucigalpa, Honduras. 84 pp.

Orozco PP; Gómez D; Beltrán JA; Piccand V; Zanelli S. Línea base subcuenca río Calico, cuenca del río Grande de Matagalpa. Internal report. CIAT, San Dionisio, Matagalpa, Nicaragua. 24 pp.

Pineda M. Georeferenciación y caracterización de las obras toma (Bocatomas) en la subcuenca del rio Tascalapa, Yorito, Yoro, Honduras. Internship paper presented to the Communities and Watersheds Project. CIAT, Tegucigalpa, Honduras. 75 pp.

Roa MC; Sanz JI; Brown S; Dossman S. The role of youth in natural resource management and food security: improving education for rural development; final report to the Kellogg Foundation. CIAT; ACERG; CIPAV; Herederos del Planeta, Colombia. 37 pp.

Stauble M. Tecnologías de cosecha de agua para propósitos de micro-irrigación: Recopilación de tecnologías sobre cosecha y almacenamiento de agua de bajo costo y bajo impacto ambiental que fortalezcan los sistemas de micro-irrigación; Evaluación del sistema de riego por goteo en huerto biointensivo en la subcuenca del río Calico. Internship paper presented to the Communities and Watersheds Project. CIAT, Managua, Nicaragua. 61 pp.

4.6. ICTs

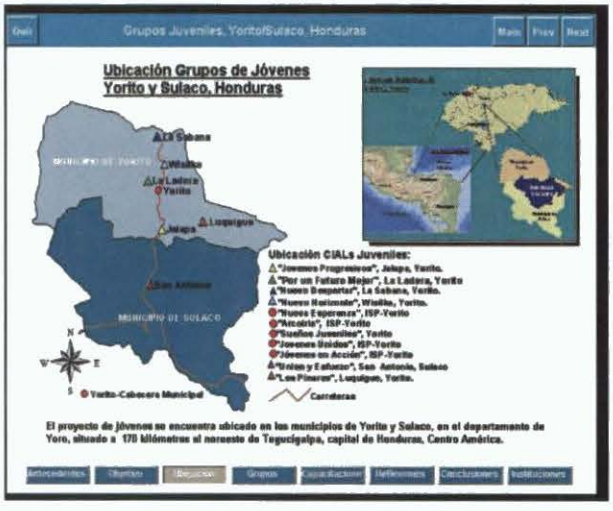
4.6.1. Web site for the Communities and Watersheds Project

The main objective is to update the Project's Web page so that it may become an informative tool for our clients, partners, and donors, as well as for CIAT, the CIAT Board of Trustees, and the Science Council.

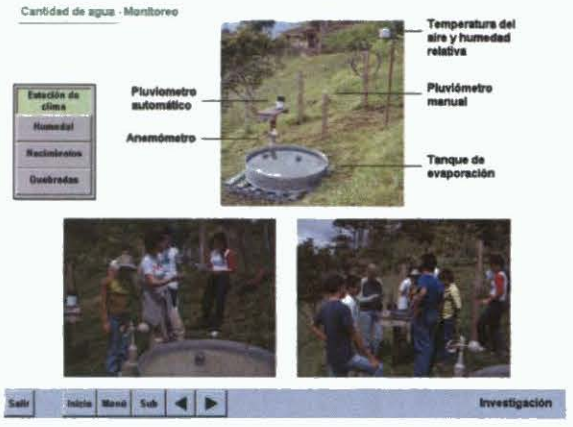
We achieved this by structuring the Web page around the last approved Medium-Term Plan, ensuring that we reported according to the Outputs, and specifically to the annual Output Targets agreed upon.

4.6.2. CD-ROMs

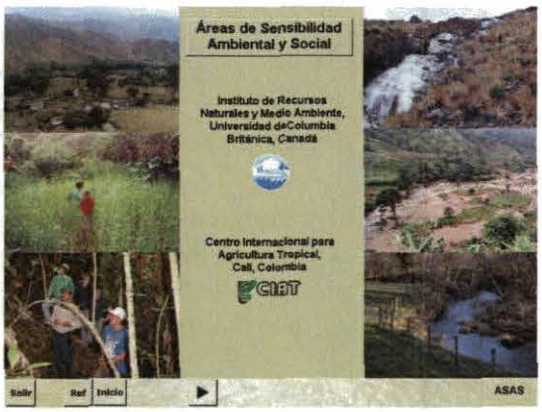
4.6.2.1. Youth Researchers, CIAT–Honduras



4.6.2.2. Youth Researchers: Education, Food Security, and Natural Resources, CIAT–Colombia



4.6.2.3. Environmentally and Socially Sensitive Area Assessment, CIAT/UBC



4.7. Posters

A series of posters on results from youth co-research projects in Colombia were produced, highlighting objectives, specific aims, methods, observations, results, recommendations, and conclusions.

Poster themes included:

- Relationships between multiple water use, water quality, and land use
- Monitoring the availability and temporal variability of water
- Ecological restoration
- Sustainable artisanal enterprise in giant bamboo
- Food security: biointensive vegetable gardens and basic grains
  Integrated animal production systems: poultry, pigs, and fish farming

5. Resource Mobilization List

5.1 List of Ongoing Special Projects

Description	*Donor*	*CIAT budget (US$)*	*Partners' budget (US$)*	*Total value of budget*
Youth researchers, Colombia	W. F. Kellogg	265,000	35,000	300,000
Youth and water science, Bolivia	CIDA	35,170	67,571	102,741
Strengthening INTA microwatersheds, Nicaragua	FUNICA	75,429	44,570	120,000
FAO, Honduras	FAO	52,929	0	52929

5.2 List of Special Projects Approved in 2005

Description	*Donor*	*CIAT budget (US$)*	*Partners' budget (US$)*	*Total value of budget*
Water contamination and restoration, Yorito	IDRC	29,990	0	29,990
Water and carbon cycles, Colombia	IDEAM	48,000	0	48,000
Isotopes, Colombia (CGIAR/USAID/U. Idaho Linkage)	USAID	12,000	0	12,000
Youth researchers, Honduras	SDC–COSUDE	28,000	2,000	30,000
Farmer experiences in Nicaraguan watersheds	POSAF-BID	96,250	12,000	108,250

6. Capacity Building

6.1. Training: workshops, courses, and seminars (international)

Description, participants [no.]	*City or country*	*Days (no.)*
Training course on biointensive gardens [20]	Nicaragua	5
C&W approach, COSUDE [10]	El Salvador	2
C&W approach, CRS and CARE [6]	Guatemala	2
Collaboration, AECI	Spain	1
Carta de Navegación (document), CONDESAN	Lima (Peru)	4
Representing CIAT at the INIAs–Ibero-America meeting	Spain	5
Strategic Alliance, UBC (Canada)	Vancouver (Canada)	5
Youth leadership workshop, Bolivia	Titiri/Totora	10
Measuring water consumption, quality, and quantity	Titiri/Totora	5

6.2. Training: workshops, courses, and seminars (national)

Description [number of participants]	*City or country*	*Days (no.)*
Workshop on planning and research with youths [51]	Yorito (Honduras)	2
Monitoring a group of youth researchers [31]	Honduras	1
Workshop on sustainability strategies or SOL (*lit.* supermarket of options for hillsides) [31]	Honduras	1
Monitoring, COSUDE [11]	Yorito (Honduras)	1
Workshop on managing biointensive gardens [54]	Yorito and Luquigue (Honduras)	5
Water harvesting [17]	Buenos Aires-Chancaya (Honduras)	2
Exchange of experiences with youth group [25]	San Antonio and Yorito (Honduras)	1
Planning *Youth as Partners* Project [35]	Yorito (Honduras)	1
Water treatment system [10]	Jesús de Otoro (Honduras)	1
Research line of C&W Project [20]	Yorito (Honduras)	1
Research-to-action methodology [55]	Yorito (Honduras)	1
Training workshop on computation, Youth group *Cuerpo de Paz* [31]	Yorito (Honduras)	20
Managing solid and liquid wastes [27]	Yorito (Honduras)	1
Identifying market opportunities (IDOP) [34]	Morazán and Yoro (Honduras)	5
Exchange of experiences with youths from Guatemala [4]		5
Agricultural production systems [28]	Yorito (Honduras)	1
Meeting of youth groups to exchange results [116]	Yorito (Honduras)	2
Methods of participatory research [20]	Estelí River watershed	6

	(Nicaragua)	
Participatory diagnosis in NRM [16]	Estelí River watershed (Nicaragua)	2
Planning field trials [16]	Estelí River watershed (Nicaragua)	2
Mounting a trial with a farmer group [16]	Estelí River watershed, Nicaragua	2
Techniques of participatory evaluation of production systems [20]	Estelí River watershed (Nicaragua)	6
Monitoring and systematizing results [20]	Estelí River watershed (Nicaragua)	6
Planning and coordination, CERES [2]	El Dovio (Colombia)	1
Artisanal fair, *Guadua Madura* Group [4]	Bogotá (Colombia)	8
Coffee Zone artisanal fair, *Guadua Madura* Group [2]	El Dovio (Colombia)	1
CERES meeting [40]	Ibagué (Colombia)	3
Measurements in the Los Saínos microwatershed [8]	Los Saínos (Colombia)	4
Workshop on water use and quality [20]	Los Saínos (Colombia)	2
Meeting, CERES, IDEAM, Ministry of Finance [5]	Bogotá (Colombia)	3
Workshop on project results, El Dovio [47]	El Dovio (Colombia)	2
Youth leadership workshop, Colombia [42]	Versalles (Colombia)	5
International conference on climate change	Bogotá (Colombia)	3
Field activity on microwatersheds in Filandia (led by Hans Schreier)	Filandia (Dept. of Quindío, Colombia)	1
Meeting, Jóvenes Buenaventura	Buenaventura (Colombia)	2

6.3. Higher Degree Students and Local co-Researchers

6.3.1. Higher degree students

Colombia

María Cecilia Roa	PhD Candidate / Associate Researcher, Water Resources, UBC
Olaf Westermann	PhD Candidate, Collective Action, Roskilde University, Denmark
Katerine Tehelen	MSc Student / Assistant, CATIE
María Gracia Lanza	MSc Student, Environmental Economics, Wageningen University, Netherlands
Clara Roa	MSc Student, Sanitation and Water Resources, Universidad del Valle, Colombia

Honduras

María Pineda	BSc Student, Water Quality and Quantity, Universidad de La Paz, Costa Rica

Nicaragua

Pedro Pablo Orozco	MSc Student, Soils and Watersheds, CATIE / Production Systems, Research Assistant in Production Systems
M. Eugenia Baltadano	MSc Student, Environmental Economics, CATIE / Research Assistant
Michael Stauble	BSc Student, Water Harvesting, Swiss College of Agriculture

6.3.2. Local co-researchers

Colombia

Mauricio Henao	Water balance
Jaidy Suárez	Plant inventory and land use mapping
Julian Giraldo	Climate and wetland response
Daniel Giraldo	Water use and availability
Edwin Caro	Animal husbandry related to food security

Honduras

Justa Mérida Barahona	Youth Project Coordinator
M. del Carmen Brizzo	Youth Project Coordinator
Melvin López	Youth Project Coordinator

7. Staff List

Colombia

Jóse Ignacio Sanz	PhD, Soil Science, Project Manager
Jorge Alonso Beltrán	MSc, Agronomy, Associate Scientist (*from October 2005*)
Sandra Brown (50%)	PhD, Resource Management, Senior Staff, UBC/CIAT Alliance
María Cecilia Roa	PhD Candidate / Associate Researcher, Water Resources, UBC
Sandra Dossman	BSc, Graphic Designer, Strategic Marketing Specialist, Communications Assistant
Adriana Domínguez	BSc, Finances, Administrative Assistant
Lina Andrea García	MSc, Watershed Management, Assistant Researcher
Pedro Lorenzo Burgos	BSc, Agronomy, Research Assistant (*left during 2005*)
Katerine Tehelen	MSc Student, CATIE / Assistant
Wilson Celemin	Officer
Gustavo Duque	Worker
Luis Enrique Exheverri	Worker
Mauricio Henao	Worker
Daniel Giraldo	Worker
María Gracia Lanza	MSc Student, Environmental Economics, Wageningen University, Netherlands

Clara Roa	MSc Student, Sanitation and Water Resources, Universidad del Valle

CIAT/CONDESAN, Colombia

Rubén Darío Estrada	MSc, Economics, Leader, Policy Analysis
Ernesto Girón	BSc, Topographical Engineering, Research Expert
Ximena Pernett	BSc, Agricultural Engineering, Research Assistant

Honduras

Juan Evangelista Amaya	BSc, Forest Engineering, Research Assistant
Villa Escober (50%)	BSc, Journalism, Administrative Assistant
Guillermo Giraldo	MSc, Agronomy, Consultant, Seed Systems (*left during 2005*)
Gilman Palma	Technician, Production Systems, Field Assistant
Rosalio Mencía	Paratechnician, Field Assistant, Yorito
Justa Mérida Barahona	High School Ecology and Environment, Local Youth Project Coordinator (*left during 2005*)
María Gracia Lanza	MSc, Environmental Economics, Consultant, Water Resources, Yorito
María del Carmen Brizzo	High School Ecology and Environment, Local Youth Project Coordinator (*left during 2005*)
Melvin López	Primary Education, Local Youth Project Coordinator
María Pineda	BSc Student, Water Quality and Quantity, Universidad de La Paz (Costa Rica)

Nicaragua

Jorge Alonso Beltrán	MSc, Agronomy, Liaison Officer (*until October 2005*)
Diego Gómez	MA, Environmental Socioeconomics, C&W Liaison Officer (*from October 2005*)
Pedro Pablo Orozco	MSc Student, Soils and Watersheds, CATIE / Research Assistant in Production Systems
Juan Bosco Franco	BSc, Agronomic Engineering, Research Assistant
María Eugenia Baltadano	MSc Student, Environmental Economics, CATIE / Research Assistant
Elvis Cayetano Chavarria	Field Assistant, San Dionisio
Michael Stauble	BSc Student, Water Harvesting, Swiss College of Agriculture

8. Summary Budget, 2005

For Headquarters and Latin America and the Caribbean:

ACTUAL EXPENDITURES 2005

PROJECT PE3: Communities and Watersheds

SOURCE	AMOUNT US$	PROPORTION (%)
Unrestricted Core	506,643	80%
Restricted Core		0%
		0%
Sub-total	**506,643**	**80%**
Special Projects	126,672	20%
		0%
Total Project	**633,315**	**100%**

9. Acronyms and Abbreviations Used in the Text

9.1. Organizations and Projects

ACERG	Asociación de Centros Educativos del Cañón del Río Garrapatas, Colombia
Actuar	A local NGO, Colombia (*"actuar" is Spanish for "to act"*)
AECI	Agencia Española de Cooperación Internacional, Spain
ASOBOLO	Asociación de Usarios del Río Bolo, Colombia
CARE	Cooperative for Assistance and Relief Everywhere, Inc., USA
CARITAS	A Catholic agency for overseas aid and development (*"caritas" is Latin for "love, charity, and compassion"*)
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica
CGIAB	Comisión para la Gestión Integral del Agua en Bolivia
CGIAR	Consultative Group on International Agricultural Research
CIDA	Canadian International Development Agency
CIPAV	Fundación del Centro para la Investigación en Sistemas Sostenibles de Producción Agropecuaria, Colombia
CLODEST	Comité Local para el Desarrollo Sostenible de la Cuenca del Río Tascalapa, Honduras
CONDESAN	Consorcio para el Desarrollo Sostenible de la Ecorregión Andina, Peru
COSUDE	Coordinating Office of Swiss Development Cooperation
CRQ	Corporación Autonóma Regional del Quindío, Colombia
CRS	Catholic Relief Services, USA
CVC	Corporación Autonóma Regional del Valle del Cauca, Colombia
FAO	Food and Agriculture Organization of the United Nations
FIPAH	Fundación para la Investigación Participativa con Agricultores de Honduras
FOCUENCAS	Proyecto de Fortalecimiento de la Capacidad Local para el Manejo de las Cuencas y la Prevención de Desastres Naturales, CATIE
FUNICA	Fundación para el Desarrollo Tecnológico Agropecuario y Forestal, Nicaragua
IDEAM	Instituto de Hidrología, Meteorología y Estudios Ambientales, Colombia
IDRC	International Development Research Centre, Canada
IHP	International Hydrological Programme, UNESCO
INIA	Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria, Spain
INTA	Instituto Nicaragüense de Tecnología Agropecuaria
INWEH	International Network on Water, Environment and Health, United Nations University, Canada
IP-1	Project IP-1: Bean Improvement for the Tropics, CIAT
IP-5	Project IP-5: Tropical Grasses and Legumes: Optimizing Genetic Diversity for Multipurpose Use, CIAT
IPRA	*also* IPRA Project; Investigación Participativa en Agricultura/Participatory Research in Agricultura, CIAT
ISU	Information Systems Unit, CIAT
IWMI	International Water Management Institute
NATO	North Atlantic Treaty Organisation

OAS	Organization of American States
Oxfam	Oxford Committee for Famine Relief, UK
PE-2	Project PE-2: Tropical Soil Biology Fertility Institute/Overcoming Soil Degradation, CIAT
PE-4	Project PE-4: Land Use in Latin America, CIAT
POSAF	Programa Socio-Ambiental y de Desarrollo Forestal, Ministerio del Ambiente y Recursos Naturales, Nicaragua
RENOC	Red Nacional de Organísmos de Cuencas, Nicaragua
SDC	Swiss Agency for Development and Cooperation
SENA	Servicio Nacional de Aprendizaje, Colombia
SN-3	Project SN-3: Rural Innovation Institute: Participatory Research, CIAT
UBC	University of British Columbia, Canada
UHI	University of the Highlands and Islands, UK
UNA	Universidad Nacional Agraria, Nicaragua
UNAN	Universidad Nacional Autónoma de Nicaragua
UNESCO-MAB	Man and the Biosphere Programme of the United Nations Educational, Scientific, and Cultural Organization
USAID	United States Agency for International Development

9.2. Other Acronyms and Abbreviations

BMP	Best-management practices
CAP	Comité de agua potable, Nicaragua
CD-ROM	Compact disk-read only memory
CERES	Centro regional de educación superior, Bolivia
CP	Challenge program, CGIAR
EPT	*also* EPT species richness; Ephemeroptera, Plectoptera, and Trichoptera species richness in river basins
ESA	Environmental sensitivity analysis
ESSA	Environmental and social sensitivity analysis
GO	Governmental organization
HES	Hydric environmental services
ICT	Information and communication technology
IDOP	Identification and evaluation of marketing opportunities
INIAs	Instituciones nacionales de investigación agropecuaria
IWM	Improved watershed management
NGO	Nongovernmental organization
NRM	Natural resource management
PES	Pequeña empresa de semillas (*Spanish for* small seed business)
pH	Pouvoir hydrogène (*French for* hydrogen power; *a measure of acidity or alkalinity of a solution*)
SOL	Supermercado de Opciones para Laderas (*Spanish for* Supermarket of Options for Hillsides)
TDS	Total dissolved solids
U.	University
UMATA	Unidad municipal de asistencia técnica agropecuaria, Colombia