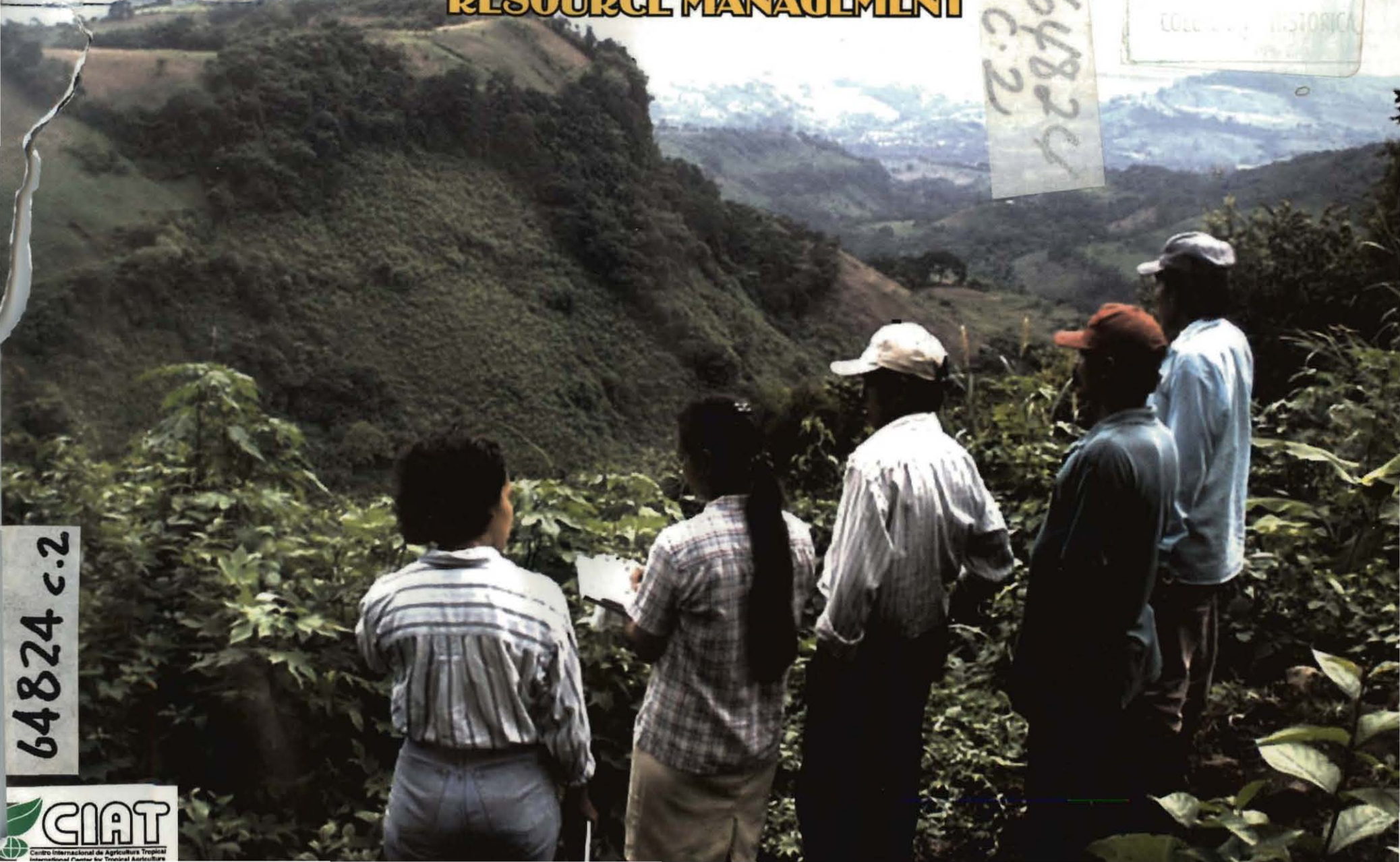
"LAND DISCOVERY" TRAINING AND TOOLS FOR DECISION SUPPORT TO STAKEHOLDER WATERSHED RESOURCE MANAGEMENT



The International Center for Tropical Agriculture (CIAT) is a nonprofit, nongovernment organization that conducts socially and environmentally progressive research aimed at reducing hunger and poverty and preserving natural resources in developing countries.

CIAT is one of 16 food and environmental research centers working toward these goals around the world in partnership with farmers, scientists, and policy makers. Known as the Future Harvest centers, they are funded mainly by the 58 countries, private foundations, and international organizations that make up the Consultative Group on International Agricultural Research (CGIAR).

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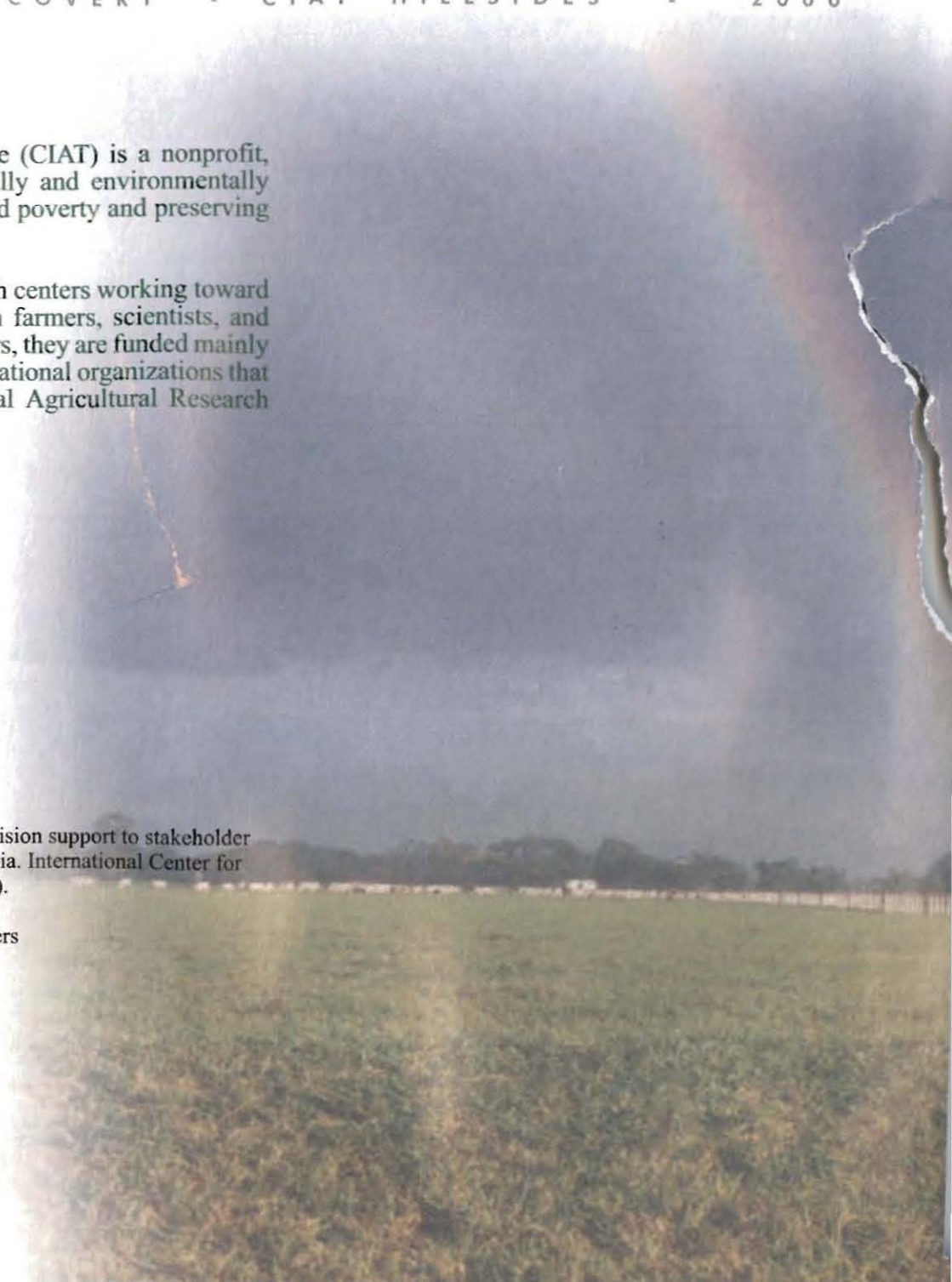
Working Document N° 181
500 copies
Print in Colombia
October 2000

Hillsides Group. Land Discovery Training and tools for decision support to stakeholder watershed resource management. Annie Jones. Cali-Colombia. International Center for Tropical Agriculture.2000. 56p. (Working document N° 181).

1.Watershed 2.Hillsides 3. Natural Resources 4.Stakeholders
5.Rural community



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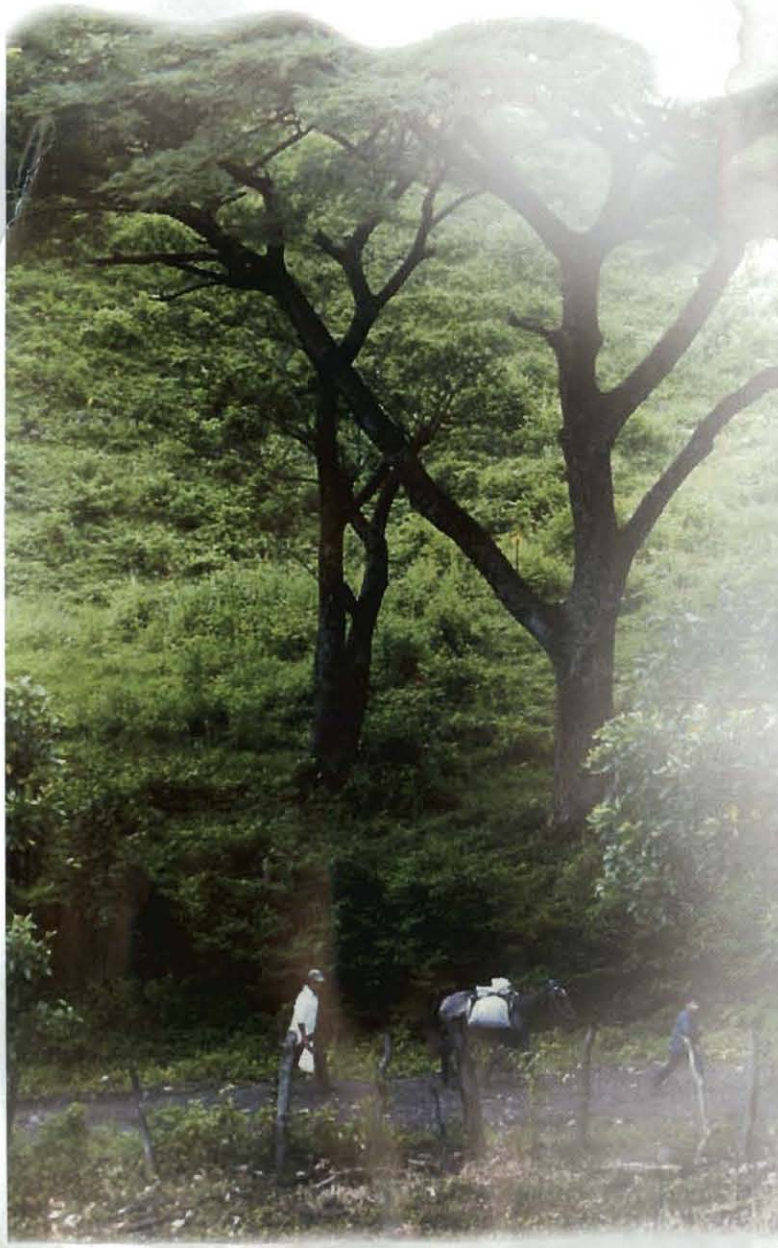


FOREWORD

This booklet has drawn on the ideas of many people who have worked together in a process of collective learning and discovery to improve stakeholder management of hillside watersheds in tropical Latin America. This has also been a joint effort in the testing and disseminating of new technologies, and in teaching procedures for use in stakeholder management of watersheds. In this process we have all become stakeholders in promoting and supporting an approach to land care and land literacy that emphasizes the importance of integrating research or what we call *discovery* into the participatory management of watershed resources.

Research and discovery of new ideas and information are essential ingredients of participatory, community-based natural resource management (NRM) because so many unknowns face experts and local stakeholders in making decisions about the preferred and optimal path to take to improve NRM. Watershed management involves decisions: in order to make good decisions stakeholders require reliable information and an understanding of cause-effect relationships, trade-offs, and each others' preferences. The task of research is to generate the right type, amount, and quality of information needed for good decision making. Some of this research needs to be done locally in a participatory way; other parts need to draw on expertise and knowledge from outside.

Research alone is not enough to improve NRM. The information needed for decision making has to be accessible to multiple decision makers who need to reach consensus in order to plan and implement effective, sustainable management of watershed resources.

Consensus building is the reason that decision support becomes a vital ingredient of the process of moving on from the hopes and desires of stakeholders to concrete, feasible plans for action based on a sound understanding of the trade-offs any management decision entails.

FOREWORD

Individuals can use decision support, but it is of most value when used to share information among many groups representing different perspectives, whose own information about a situation in the watershed is only partial.

That is why we describe this approach as decision support based in *discovery*: because it is built around providing the tools and technologies that help to build capacity for the research and information management needed for making good decisions about watershed resource management. The local people or organizations themselves choose the tools they feel are required for their particular purpose and area, having first been trained in their use. We supply the training and tools; we do not make recommendations. Our approach helps people in the capacity of *discovering* what it is that they ought to do. We support their process of finding out what the options are, evaluating the options, and making well-informed decisions.

The approach offered in this booklet (Box 4 offers a summary) is not exhaustive and is in a continuing process of development and growth. It covers some key decision points and actions in the process of planning and implementing a learning process approach to stakeholder watershed management.

"LAND DISCOVERY"

TRAINING AND TOOLS FOR DECISION SUPPORT TO STAKEHOLDER WATERSHED RESOURCE MANAGEMENT

INTRODUCTION

Water and the sustainable management of watersheds are vital to the welfare of humanity. Even more than food, water has become a critical limiting factor in human development and the elimination of poverty. Massive urbanization in the developing world is putting huge strains on the capacity of the rural landscape, and in particular its watersheds, to provide burgeoning cities with healthy and adequate supplies of water. The elimination of rural poverty depends critically on intensifying agriculture on smallholdings, and on sustaining adequate stream flow to meet basic domestic, agricultural, and small-scale agroenterprise requirements. Rural and urban poverty is connected and interdependent through the need for water. Water is a product of the rural landscape and depends on sound land management just as much as does the production of food.

The CIAT approach to watershed management is not centered on the water itself, but rather on the relationship of people with natural resources. It is important to motivate the community and give the raise local interest in conserving their natural resources. We seek sustainable development at the local level. This means addressing the immediate needs of the people (increasing production) while dealing with, and making local people aware of possibility to, the need to care for the environment.

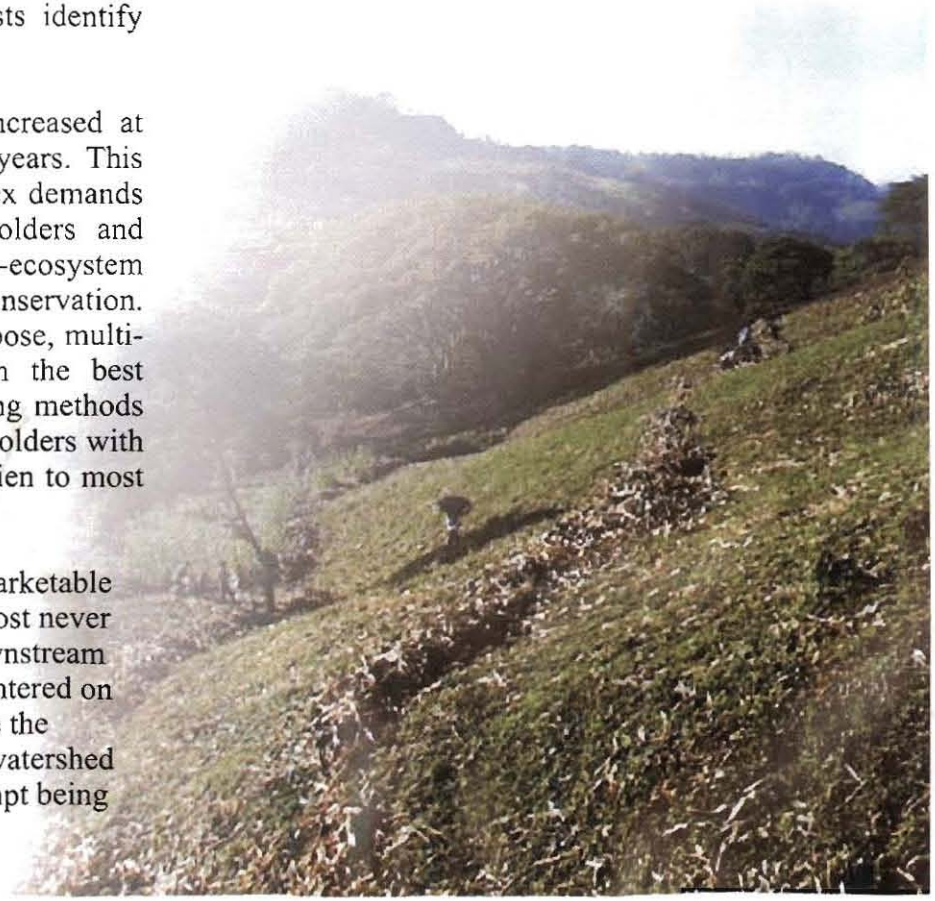
For the farm families managing the natural resources, sustainability may be more closely associated with their livelihoods and the survival of the family than with the natural resource base itself.

At the worst, increasing population, decreasing farm size, and declining labor productivity could combine to lead to a set of farmer decisions that result in soil erosion and fertility decline, deforestation, pesticide abuse, surface and ground water contamination, and eventual decertification (Ashby et al. 1994).

Individual farmers on their own farms cannot solve problems of land degradation in tropical America. This requires a landscape perspective. CIAT has developed a suite of tools linked to geographic information systems (GIS) and participatory methods as components of decision support (DS) systems that help stakeholders with conflicting interests identify common problems at the landscape scale (CIAT 1999a).

Projects of the participatory watershed type have greatly increased at national, international, and bilateral levels over the past 10 years. This approach appeals in its promise to satisfy Agenda 21's complex demands with a single coherent strategy of involving local stakeholders and communities at multiple scales and zones while addressing cross-ecosystem issues and interactions related to farming and natural resource conservation. However, the newness, complexity, and ambition of multi-purpose, multi-scale watershed approaches make success elusive even in the best circumstances. Organization is highly complex, and co-learning methods and computer-based tools are needed to deal with plural stakeholders with conflicting goals operating at levels and time scales usually alien to most agricultural and natural resource scientists (Rhoades 1998).

In a watershed, crops, livestock, and forestry products are all marketable and paid for. Water is another product of a watershed yet is almost never paid for, although it is sold onwards by a water authority to downstream users. Traditionally, the focus of watershed management has centered on the water itself, often only as a product for consumption outside the watershed even though it is intrinsically tied up with the other watershed products. Existing problems are addressed rather than any attempt being made to develop the resource.



In the past, a top-down planning approach was based on land capability, rather than on the capacities and needs of local people, and typically promoted activities that were forced upon residents and communities from outside. This lack of fit between human and biophysical boundaries has caused tensions and antagonisms between local populations and outside watershed project managers (Datta and Virgo 1998). The other extreme was to assume that participation would solve the failure of centrally controlled, externally driven watershed projects with no local ownership (Farrington and Lobo 1997). Presumably, respecting local views and tapping into local knowledge in making decisions on research and management questions can help design and have accepted more sustainable, locally-relevant management systems (Hufschmidt 1986). Neither of these extremes works well. We need a synergetic point between the perception and actions of both the local people and the specialists, a combination of both the technical and scientific aspects with local participation.

People and natural resources

The essential component of an agro-ecosystem is its people producers and consumers with all the dimensions that accompany them socially, economically, and environmentally (Waltner-Toews 1993). The people we most want to help tend to be concerned with daily problems; they may not look too far ahead. Their children are hungry now, production must be increased now, the effect on their natural resources lies in the future. We learn about situations, draw principles to develop the tools needed, then can extrapolate results and upscale them. Box 1 shows how the CIPASLA organization (a local consortium of watershed stakeholders in Colombia), using the CIAT approach, has helped increase the resources available to its members from research and development projects in the watershed.

Box 1. CIPASLA: Partnerships drawing on strategic and applied research

- Self-financed budget US$300,000 annually 1996-98 (3.2% CIAT)
- Over 3000 beneficiaries (in 1000 families)

Projects: 57 agriculture
41 environmental
18 livestock
4 agroindustry

A learning process approach is used rather than a "blueprint" approach because an understanding of the situation is required if the community is going to undertake watershed resource management. This learning approach is not new, it has been used successfully in other areas, and it has begun to be used in watershed management over the past decade. The type of tool used in training is new, incorporating scientific elements, GIS, collaborative work, models, et cetera in an accessible and usable form at municipality level. The approach can also be used as a complement to top-down management approaches to inform, adjust, and aid in decision making. Research management involves a series of decisions, we support people in making good decisions.

What is a watershed?

A watershed can be as large as the Amazon basin, accounting for a large slice of a continent, or as small as the runoff from a few fields into a stream (see Appendix 1). Why then do we in CIAT use a watershed as a unit of analysis for research, as a framework for organizing training, and as a foundation for the research and development of partnerships needed to do this research and training? Because, when combined with other issues of scale, it is a useful, demarcated, agro-ecological mosaic in which agricultural activity affects the yield and quality of water. The working size of a CIAT watershed is delimited by the groupings of farmers, foresters, and other enterprise owners that interact in its management. To a large extent, the stakeholders in a watershed define the boundaries of the geographical space in which it is meaningful to take decisions in order to improve their management of the watershed resources. Stakeholder interests define who is "in" the watershed and who is outside or off-site. The biophysical boundaries that define the watershed as a functional hydrological system are also essential to this approach. The watershed allows biophysical scientists to clearly delimit the study unit, making it easier to conduct input-output studies, decision-making and simulation models, and expert systems (El-Swaify and Yakowitz 1997, cited in Rhoades 1998).

A watershed is not a "natural" socioeconomic unit. Often a community "domain" covers different watersheds, and usually the same watershed is shared by different communities that also use the neighboring watersheds. This poses problems that should be addressed through collective action: CIAT facilitates this process through the formation and support to local consortia of watershed stakeholders provided in this approach. We combine the geographical unit (watershed, subcatchments) where water flows, with social units (communities, municipalities) where decisions are made. The social boundaries for decision making often overlap the watershed boundaries (see Figure 6). This is essential, because managing the multiple natural processes of a watershed requires dealing with multiple social actors.

How watershed activities affect water yield, quality, and stream peak flows

The many activities taking place within a watershed affect water quality, quantity, and stream peak flows. Cultivation affects sediment load and infiltration rates, thus changing water quality and soil/subsoil water storage. Good, economically viable, soil conservation measures can increase water quality and smooth stream flow peaks. Tree planting usually (but not always) reduces peak run-off and hence lowers flood risk and evens out water flow rates. It is normally a long-term investment and cannot compete with cropping as a source of income for watershed stakeholders. It has to be integrated with other watershed activities to be viable. Box 2 shows this type of conservation measure achieved by CIPASLA.

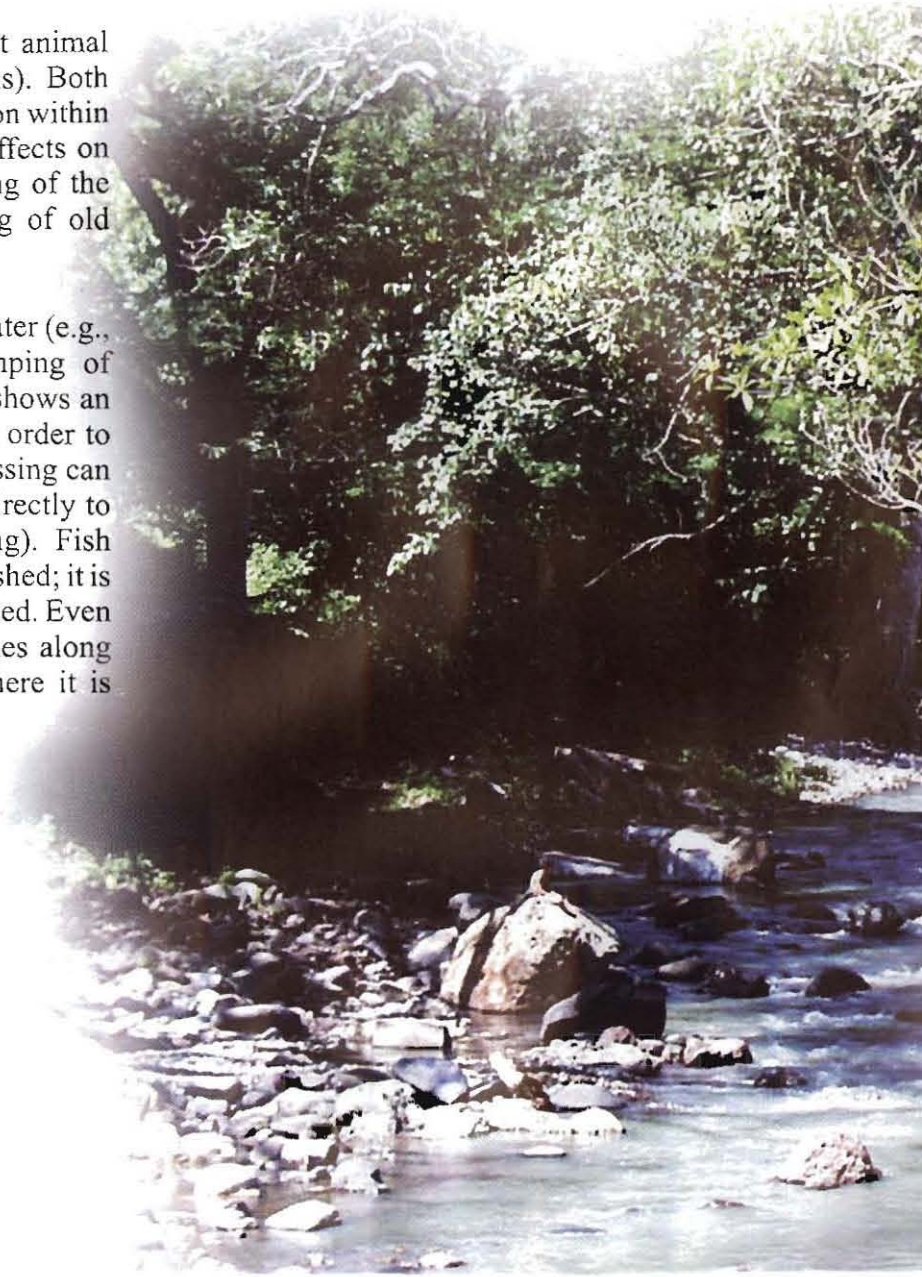
Box 2. CIPASLA: Changes in Land Management Achieved in 5 years Using the CIAT Approach

- 52 km of forest buffer zones established and monitored locally
- 152,300 trees for firewood and reforestation
- 1025 fruit trees planted
- 7500 meters of soil conservation barriers

This has taken place in the Cabuyal watershed, home to about 6500 people in a political unit consisting of 7000 hectares.

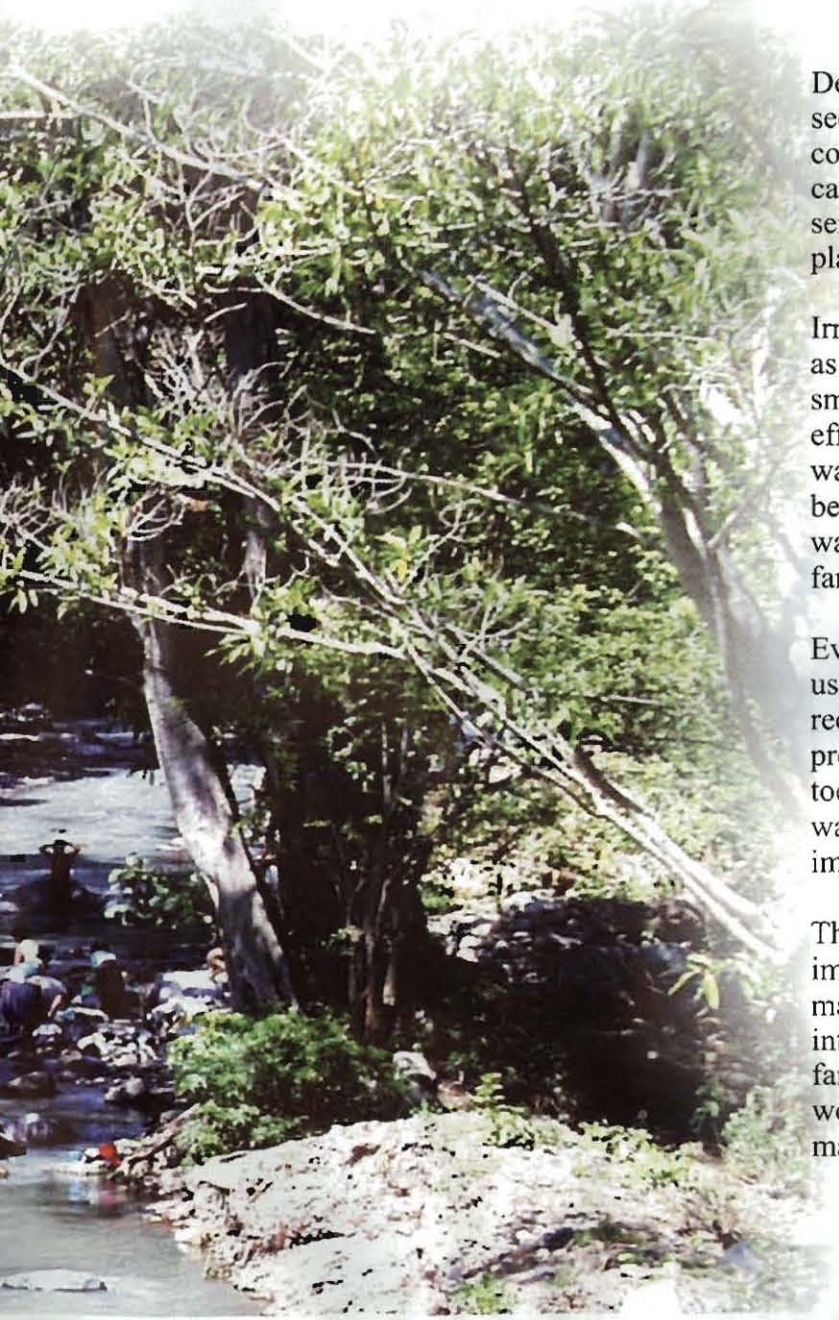
Pastures planted for livestock often stabilize against erosion, but animal effluent can affect water quality (nitrates plus disease organisms). Both forestry and permanent pastures actually increase water consumption within the watershed. Rapid changes of land use can have unforeseen effects on water quality, yield, and stream flow peaks if the full functioning of the watershed is not well known. For example, large-scale plowing of old pastures can result in a flush of nitrates to the stream flow.

Pesticide and herbicide residues may wash directly into flowing water (e.g., from inappropriate washing of application machinery, or dumping of residues), or may leach through the soil to ground waters. Box 3 shows an example of one project where farmers are farming organically in order to reduce agrochemical pollution of ground water. Postharvest processing can be a source of stream pollution if residues are allowed to drain directly to streams (e.g., in cassava starch production and sisal processing). Fish farming, although local, may be a major water user within the watershed; it is also a major polluter if the tank and processing effluents are not treated. Even small areas of dense vegetation acting as stream flow buffer zones along stream boundaries can ameliorate the effects of dirty runoff where it is unavoidable.



Box 3. Reducing agrochemical pollution through an integrated approach to NRM

In some areas of the Andean zone, farmers spray their crops as often as once a week. The "chemical culture" these farmers embrace is reinforced by habit and rooted in their fear of crop failure. Under a CIPASLA-sponsored project, extension workers from Colombia's Servicio Nacional de Aprendizaje (SENA) are helping farmers establish organic gardens of aromatic and medicinal herbs, among other crops, for sale in nearby urban markets.



Deforestation usually results in raised stream flow peaks and increased sediment load. These effects can sometimes be improved if correct countermeasures are planned. Domestic and livestock water supply is often a cause of conflict within the watershed, and domestic sewage effluent is a serious problem both within the watershed and downstream. Community planning and consultation can often resolve these problems.

Irrigation needs to be carefully planned in consultation with all stakeholders as it is probably the largest potential use for water in many watersheds. Even small-scale trickle irrigation for horticultural products may have a serious effect on other water users. Spring line movement is often a consequence of water use policies within the community, although more natural variation can be expected as Global Climate Change takes effect. It can result in accessible water (especially for stock, although other uses are significant) moving off a farmer's property.

Eventually, everything within the watershed (e.g., land use, deforestation, use of fertilizers, and soil erosion) affects the water. It is important to recognize that human activity is the main cause behind environmental problems, including problems of quality and quantity of water. The CIAT tools and training approach are used to help stakeholders plan the use of their watershed resources and resolve any conflicts of interest that may arise in implementation.

This booklet aims to provide an overall guide to the process of planning and implementing an approach to **stakeholder-based** watershed resource management. By stakeholders are defined as a person or a group with an interest or concern in the process of watershed management including farmers, researchers, planners, technical experts, community development workers, different agency professionals or others involved in the use and management of natural resources.

The booklet suggests, for the different work areas of this process, when and how stakeholder can make use of a number of tools for decision support, collecting and organizing information, organizing, and monitoring and evaluation.

The CIAT publication "Decision making for sustainable natural resource management: Nine tools that help" (CIAT 1999a) describes the main tools used in the process up to present.

The glossary at the end of this booklet explains some of the terminology used that is specific to this subject.

THE CIAT APPROACH
TO STAKEHOLDER WATERSHED RESOURCE MANAGEMENT

DECISION SUPPORT

The sustainable management of natural resources depends on people's capacity to take "sustainable" decisions, whether the level of decision making is the municipality, the watershed, or the village. Thus, the CIAT Methodological Guides are support tools for decision taking and not resource management tools *per se*.

With this in mind, the focus of attention moves, for example, from the problem of the quantity and quality of water available for human consumption to the exploration of future scenarios that the community wishes to construct to guarantee sufficient quality and quantity of water for the next 20 years, based on present decision taking (Knapp et al. 1999).

The approach offered in this booklet (Box 4 offers a summary) is not exhaustive and is in a continuing process of development and growth. It covers some key decision points and actions in the process of planning and implementing a learning process approach to stakeholder watershed management.

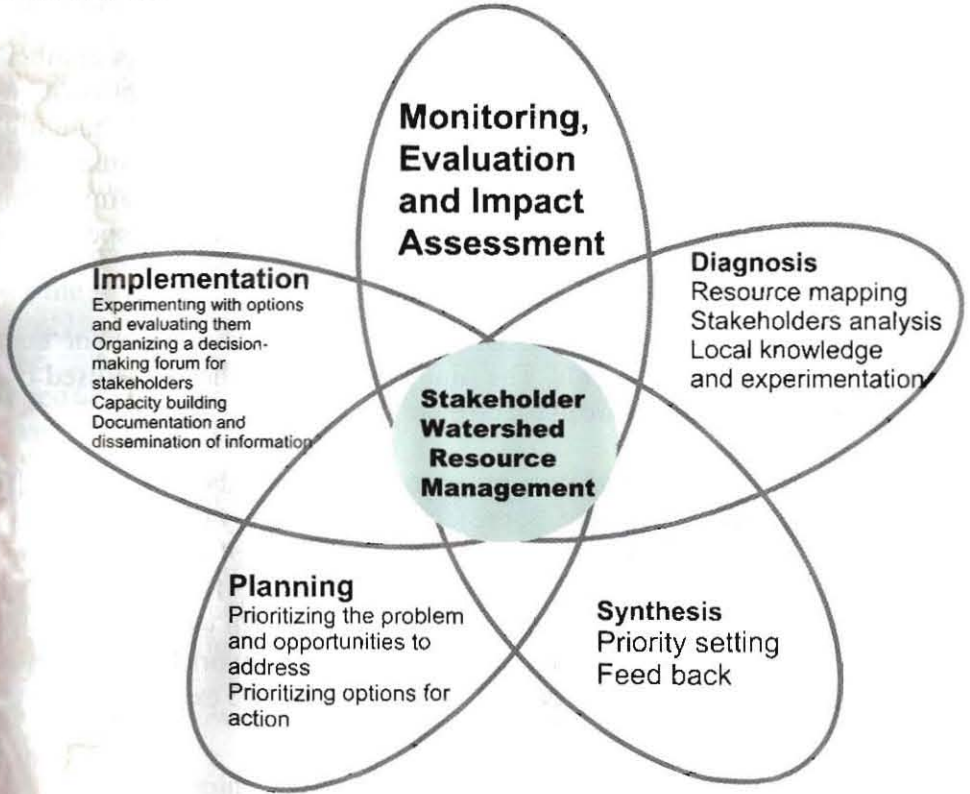
Box 4. The CIAT learning process approach is aimed at stimulating its users to identify new work areas and new tools that they need to include in their process, to develop their own applications of methodological tools, and to systematize their experience into guides like those we provide. People have to make decisions, we aim to help them. The CIAT approach addresses the following questions.

- Where are we going to work? We need to define the physical boundaries and the decision-making or social units.
- Who are the key people for the key problems in this our priority area?
- What is the vision of the future for this watershed? How should we organize for better management?
- What technological options do we have for change?
- How do we monitor and evaluate and check that the watercourse is really becoming a better place to live in, that conservation is occurring, and the watershed is being managed for the long-term?

We train and help in the use of tools to answer these questions. Then we go through the process of the five components below, and the tools we have developed fit in as and where required. Finally, we hold a forum where the people of the watershed address the questions together and the process is worked through with the tools that they choose to use.

The main elements of the process here described are called components. It is an iterative process and cannot be carried out one component at a time, or with one component following another; usually several components will be implemented at a time. Some might be started before others are finished. At any one time, the user may need to go backward or forward in the list of components outlined below.

Some of the components (e.g., implementation which might be promoting the use of recommended conservation practices) may be well advanced in a watershed when users start introducing a stakeholder-based approach, while most of the other components may not have been done at all, and users need to start them.



The tools developed by CIAT and our many collaborators came into being as a demand was seen to exist for them. There is no "best way" of using the tools; they cannot be conveniently slotted into areas of use. Stakeholders are trained in the use of all the tools and then they make their own decisions as to which tools they need to use for their own particular purpose and area. Several tools can be used at different stages as a way to support different decisions.

Stakeholder analysis

Grimble et al., 1995 define stakeholder analysis as:

> "An approach for understanding a system by identifying the key actors or stakeholders in the system and assessing their respective interests in that system. Stakeholders include all those who affect, and are affected by, the policies, decisions, and actions of the system; they can be individuals, communities, social groups or institutions of any size, aggregation,or level in society. The terms thus include policymakers, planners and administrators in government and other organizations, as well as commercial and subsistence user groups."

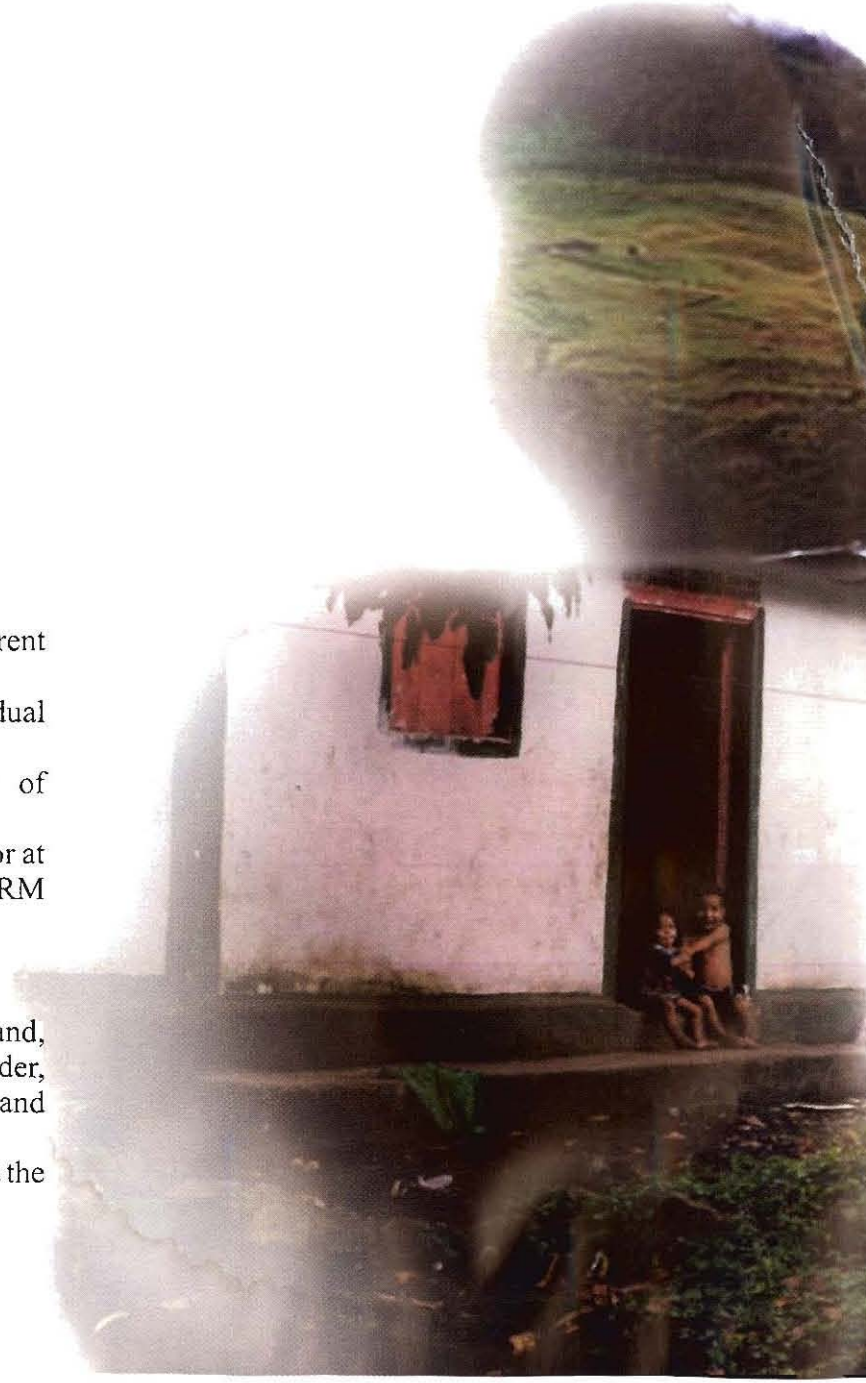
Stakeholder analysis is relevant for NRM because:

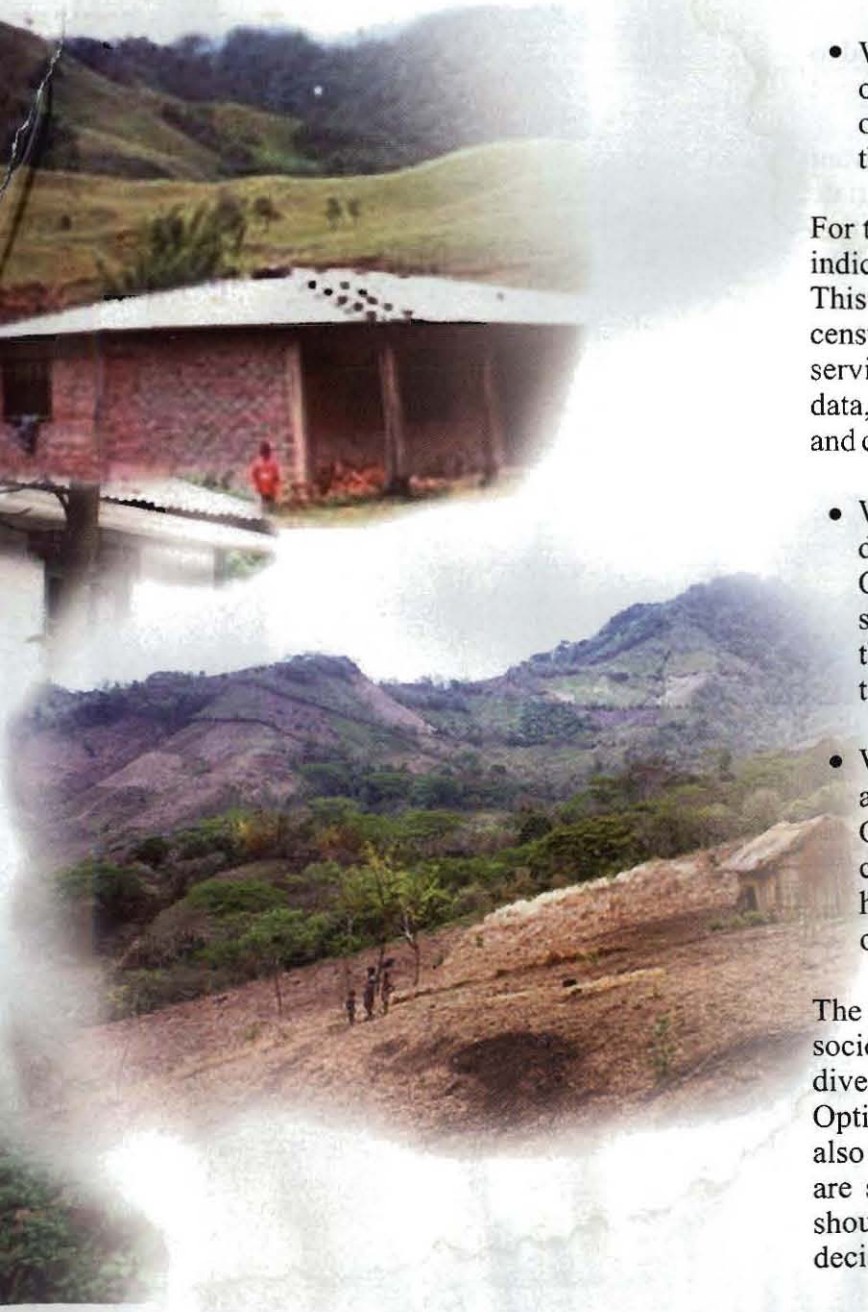
- NRM problems cross boundaries thus involving a range of different decision makers,
- Cause and effects/gains and losses are not limited to the individual decision makers in question,
- Appropriation of natural resources affects future availability of production, and
- Natural resources tend to have multiple uses that are not compatible or at least must be managed by multiple users acting competitively. Thus NRM often involves issues of conflict.

Stakeholder analysis addresses the following points.

- Who are the stakeholders in relation to watershed resources like land, water, flora, and fauna and what is their relationship in terms of gender, ethnicity et cetera? Which stakeholders capture benefits on-site, and which off-site?

  Answers to these questions depend upon the issue addressed and what the goal is.





- What is the poverty or wealth of different stakeholder groups? Depending on the "system" or the issues in question we may need to know the levels of poverty existing and the spatial distribution of poverty or well-being in the watershed.

For that purpose we have developed a methodological tool to identify local indicators of well- being and to construct regional profiles for rural poverty. This is integrated with and complementary to demographic databases such as census data with variables relating to, for example, the accessibility of services, type of house construction, and levels of education. With this kind of data, we can begin to draw profiles of the basic resources available to farmers and can get some idea of what people have at their disposition.

- What are the ownership and usufruct rights and customs that guide how different stakeholders use these resources?
  Ownership is sometimes available on census data, but can be a delicate subject on which people do not always speak frankly or truthfully, and this should be borne in mind. At present, CIAT does not research these topics.

- What are the formal and informal organizations active in the watershed and their objectives? How do they work together?
  Organizations can work together through consortia. Inter-institutional consortia should involve at least the formal organizations. Workshops help bring together different organizations and have them define their objectives.

The main stakeholder with whom CIAT works is the local organization at socioeconomic level. In the technological sense, stakeholders are much more diverse. Producers continue in participatory research (e.g., the Hillsides Options Supermarket or SOL, its Spanish acronym, where strategic research also takes place and different types of partners are involved, see Box 6). There are stakeholders at watershed and higher levels (municipalities), and we should also consider those stakeholders beyond the watershed who are decision makers and should be involved.

All of these are connected on separate questions. The vision is not limited to the watershed, but goes beyond, those outside are also important.

For stakeholder management of watershed resources, the relevant stakeholders need to be brought together to decide on the appropriate management innovations, how to enforce them, how to reward or sanction them, how to monitor compliance, who is better or worse off as a result of the changes, and whether these are having the desired effect on the watershed. Some stakeholders may like these changes, some may be opposed, and others may be indifferent. The stakeholders of a collective decision-making process need to decide who are the relevant people who need to meet for this purpose. Leaving out some stakeholder group could be fatal to success.

Local knowledge and experimentation

Scientists and technicians know their subject, but farmers have local knowledge and traditions. It is important to get to know them in order to work with them, we cannot assume that anyone's knowledge is complete. Thus, on arrival in a work area, a quick sounding is taken to interact with the farmers, find out their customs, way of working, socioeconomic factors, the tools they use, the crops they grow, and so forth. Through dialogue, those farmers who can help and those who have problems are identified. Producer and technician share their knowledge to identify local indicators of soil use, plants, fertility, physicochemical properties of land et cetera through local terminology and classification.

This makes it possible to take better decisions on the management of natural resources in relation with their state of degradation. The Committees for Local Agricultural Research (CIALs, the Spanish acronym) are a good example of how this works. These committees of four or more farmers, elected by their community, carry out adaptive technology testing in the local environment, combining local knowledge and exotic technologies, on topics chosen by the community (Ashby et al. 1995).

Collecting local information and knowledge can be done in many ways, from a participatory diagnostic to some type of formal interviewing. The use of a maqueta is helpful for bringing the information together (Box 5).

Box 5. ***Maquetas.*** The people with local interest are those who best know the countryside. A tool we have found highly useful in gathering local knowledge is the "*maqueta*", a three-dimensional structure made of the watershed out of papier-mâ ché or other locally found materials. The community puts it together, using some GIS information such as altitudes, but mostly their own knowledge of the area. They put houses, schools, roads, et cetera in place then work out the land uses, in effect constructing their watershed. The great advantage of this is that they become sensitized, are made aware of, the larger environment beyond the small boundary of the farm, and that they look at the larger picture. They come to realize that their problems relate to what happens outside their own small sphere. They visualize the actual natural resources of the region and are thus able to better understand project possibilities. The *maqueta* is a powerful tool for stimulating group discussion and creating a sense of community.

Local knowledge and information is an important input to decision making involving the natural resources of a watershed.

PRIORITY SETTING DECISIONS

At the end of the diagnostic process, a synthesis can be made of the actual present situation. Problems and opportunities, their relationships, and their causes and effects are identified. Both the human aspect and natural resources are included.

This component brings together all the gathered information to analyze the situation, to understand what is happening, and to propose and prioritize solutions and innovations.
This is an important decision-making point at which stakeholders reflect on what the real priorities are and how they should be addressed. Specific information is needed for successful decision making and planning.

DECISIONS IN THE PLANNING STAGE

Sharma and Krosschell (nd, cited in Rhoades 1998) delineate three approaches in watershed projects:

1)Indigenous *in situ*,
2)Building on local cultures by projects, and
3)Implementation without regard to local culture.

These three types also represent a gradation from success to failure, implying that using local knowledge, building on indigenous worldviews, and encouraging ownership are the best predictors of long-term sustainable success. The importance of the CIAT focus is that it is not based on the usual top-down methods used in watershed management. With them identify what is in place, then mobilize local institutions so that they deal with problems or take advantage of opportunities. We do not make decisions for people, we give support and training so that they can make their own decisions.

Prioritizing the problems and opportunities to address

In every case, CIAT aims to increase the natural resources and improve the quality of life for producers. Both these aspects are being worked upon, generating sustainable uses and giving technological help at the small-scale level and moving outwards to watershed level. The priority is that the producers use the tools developed, that the whole group involved in the watershed can collaborate, and that CIAT complements the work being undertaken.

Demand-driven research and development means that stakeholders will talk about **all** problems, not just water and crops (Rhoades 1998), which may lead to the pitfall of unrealistic expectations. However, planning from local demand through the participatory planning by objective helps to identify further strategic research and research for collaborators or for opportunities in adaptive research (Figure 1).

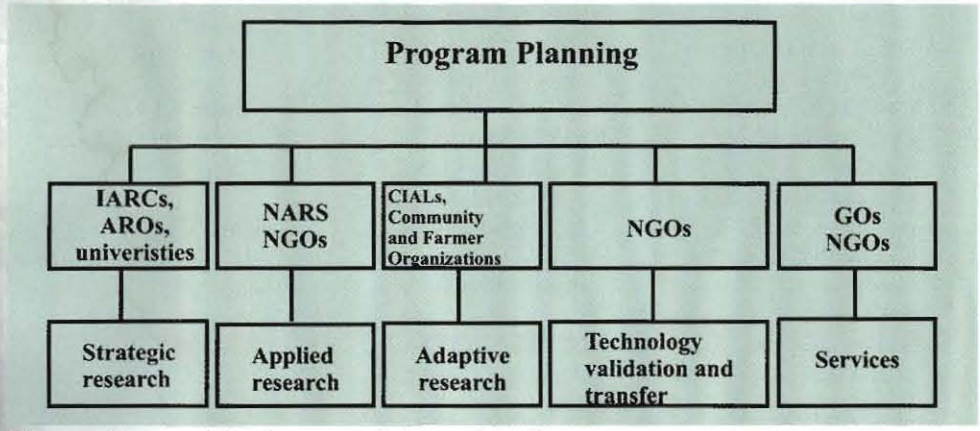


Figure 1. The demand-driven planning process.

The organizational idea is to support the basic users producers, *campesinos*. The focus is to get them to look towards the organizations that are becoming more cooperative. The CIAT strategy is to strengthen existing local consortia, or help form new ones if necessary, to keep the sustainability of natural resources at a higher level (e.g., Campos Verdes see Box 7). Impact cannot be immediate, a period of 5 years is more realistic, when the consortia has become strong enough to manage projects and when clients in the projects have resource conservation in mind as well as productivity. Figure 2 shows what demand-driven research is being conducted to date using the CIAT approach to watershed management.

Decisions have to be made on what are the priorities and opportunities that can be realistically addressed. The approach supports those collaborating in making these decisions.

DEMAND-DRIVEN RESEARCH

STRATEGIC (IARCS)	APPLIED (NARS & NGOs)	ADAPTIVE (CIALs)	TECHNOLOGY VALIDATION AND TRANSFER (NGOs)	SERVICES (GOs & NGOs)
1. CIAT • **Hillsides (PE-3)** ✓ Agronomic technologies (SOL) ✓ Small seed enterprises (CIMMYT, CIP) ✓ Rooting/live barriers ✓ Decision support (Guides) ✓ Organizational models (Consortia: CIPASLA, CLODEST, Campos Verdes) • **Soils (PE-2)** ✓ Biological soil processes (SOL) ✓ Farm/systems/ watershed scale ✓ Soil/nutrient loss • **Agroenterprises (SN-1)** ✓ Market options ✓ Integrated production projects • Local support systems ✓ **Tropical grasses & legumes (IP-5)** ✓ Participatory selection and use of germplasm • Targeting germplasm to environment ✓ **IPRA (SN-3)** ✓ Telecenters Training ✓ Participatory research **2. CIP (future)** ✓ Camote (SOL)	**1. INTA** ✓ Evaluation of maize and bean varieties at SOL (germplasm from CIMMYT and CIAT through PROFRIJOL) **2. PRODESSA** ✓ Evaluation of rice varieties at SOL (germplasm from CIRAD, CIAT, local organizations) **3. UNIVERSITIES** ✓ Applying Guides ✓ Thesis work **4. DICTA-SERTEDESO** ✓ Participatory selection **5. CATIE (future)** ✓ Integrated pest management at SOL	**1. Women's CIAL** ✓ Evaluation of soybean varieties and processing (milk and meat substitute) **2. Wibuse CIAL** ✓ Evaluation of bean varieties **3. Jicaro CIAL** ✓ Evaluation of maize	**1. CARE** ✓ Soil conservation (erosion barriers) ✓ Diversification (*pitaya* at SOL) ✓ Campaigns against forest burning **2. PCAC** ✓ Establishment of nurseries ✓ Reforestation campaigns **3. POSTHARVEST**	**1. Municipal** ✓ Roads ✓ Education ✓ Health (outhouses)

Figure 2. Examples of demand-driven research being conducted using the CIAT approach to stakeholder watershed management.

Prioritizing options for action

How does one work out what options are available and then prioritize those that merit pursuit? Guide 1 (Local Soil Quality Indicators) promotes an understanding of soils through the different technical visions and experiences of the small-scale farmer.

A theoretical framework is established using a simplified model of the origin of soils. It is applied both to modern concepts of pedology and to soil classification so that the producer and technician can share their knowledge to understand and analyze the origin, evolution, and distribution of soils. In this way it is possible to take better decisions on the management of soils in relation with their state of degradation.

When choosing combinations of technology options to test for cropping systems, agroforestry, agrosilvopastoral systems et cetera, the use of soil quality indicators (SQIs) impacts on choices more to do with the timing of certain management options. For example, if we have a system to recover degraded soil (e.g., green manure systems), identifying or using certain SQIs can guide us as to when the soil has fully recovered before returning to the next cropping phase.

This is important in the efficiency of using time and space in an agricultural set-up. The LSQI (Local Soil Quality Indicators) Guide also covers the issue of upscaling. This links with how LSQI at plot scale are affected by management at the farm scale, and how the collective management of several farms within a watershed can provide an impact at the watershed scale that can be measured or synthesized in the water quality for example.

We are now aiming at establishing a link between water and soil quality indicators. These types of indicators help in making decisions on the best options for the use of the land.

In choosing options for crop diversification, an institution within the watershed undertakes a market study. The products identified are evaluated to find out which are the most promising options including participation with farmers. Introduction of high value crops can increase farmers' benefits in the long run, making it worthwhile for farmers to use the resource conserving practices (Figure 3). Evaluation is made with the farmers using a concept board outlining in simple form what the best options offer (already screened for their agronomic and economic viabilities), including profits. It becomes a joint decision-making process as to which options the farmers develop as projects. It ends in a portfolio of possible products. The system has been used in Cabuyal- Colombia, Yoro-Honduras, and Pucallpa-Peru with good results. For example, in Cabuyal, the growing of blackberries was shown to be viable and through its own dynamism, this is now a principal crop in the area. Dairy products were also identified through this approach; a small processing plant has been set up producing yogurt and cheese (Figure 4).

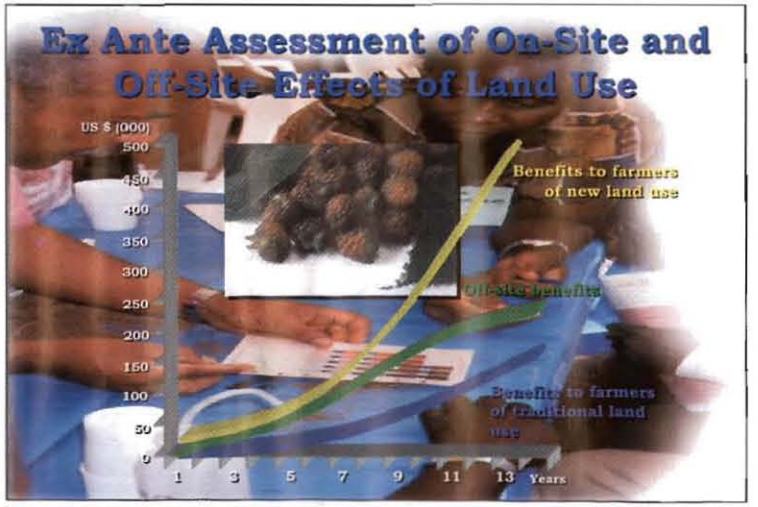
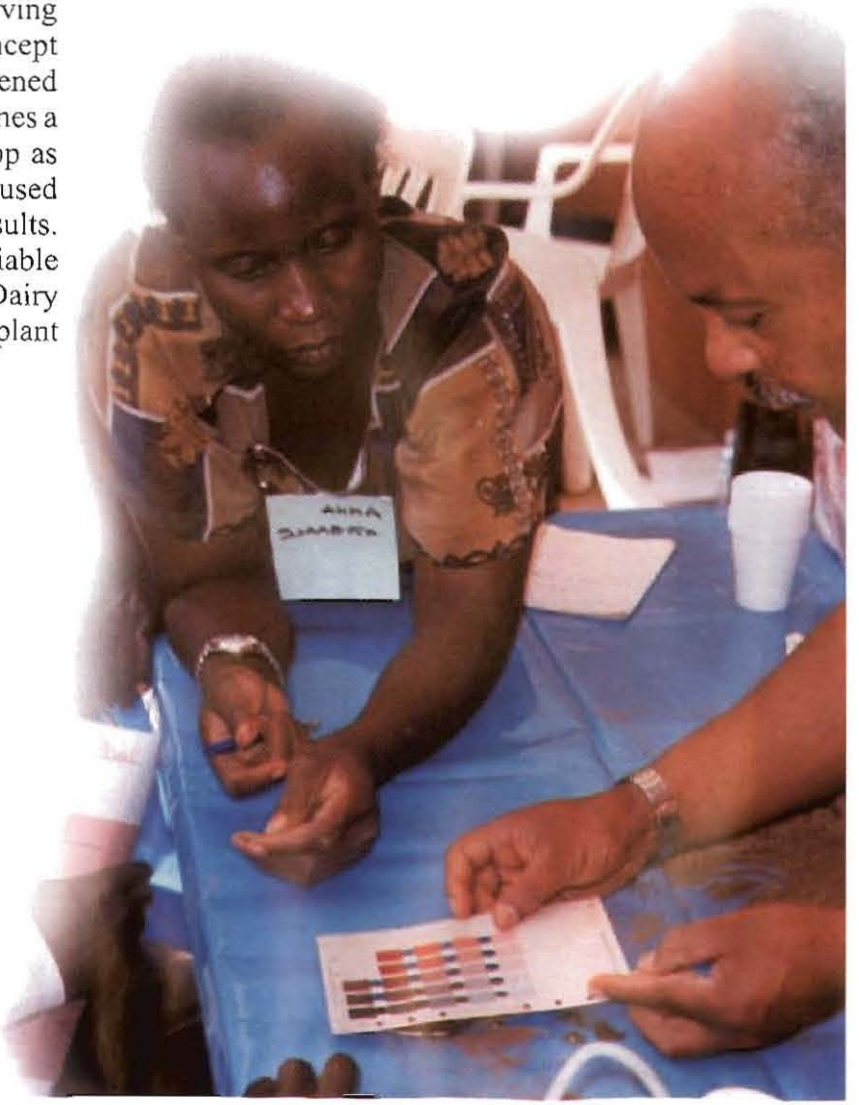


Figure 3. An example of an ex-ante assessment showing positive off-site efforts of adopting soil conservation (green curve), but not much benefit for farmers with traditional land use (blue curve) in Cabuyal, Colombia.



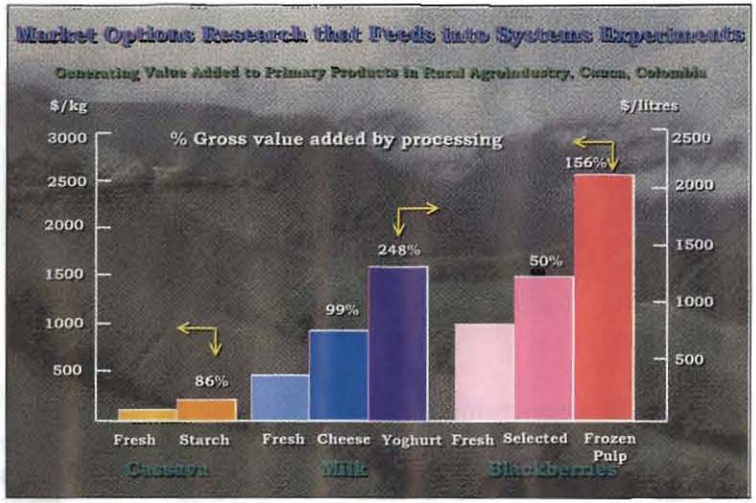


Figure 4. Example of market options, showing yogurt and frozen blackberry pulp identified as highly promising complementary activities to the existing artisanal cassava starch industry, Cabuyal, Colombia.

DECISIONS ABOUT IMPLEMENTATION

At this stage, an Action Plan comes about as a result of planning and synthesis (prioritization). The "Methodology for decision taking for multiple interest groups" (Knapp et al. 1999) calls in data from the information technology tools. It is a goal-oriented as opposed to problem-oriented methodology. A forum or workshop is held to go through the activities (see page 30). Goals are defined by desired future conditions giving specific targets. This is useful for planning activities, because specific information is needed for planning, and the models are naturally called into process to give concrete quantitative information about system variables.

Decision makers need to come together, have as much information available as possible, and discuss and compare in order to make valid decisions. The decision support system (DSS) is a methodology designed to help multiple stakeholder groups come to terms with the future of their landscapes.

It incorporates:

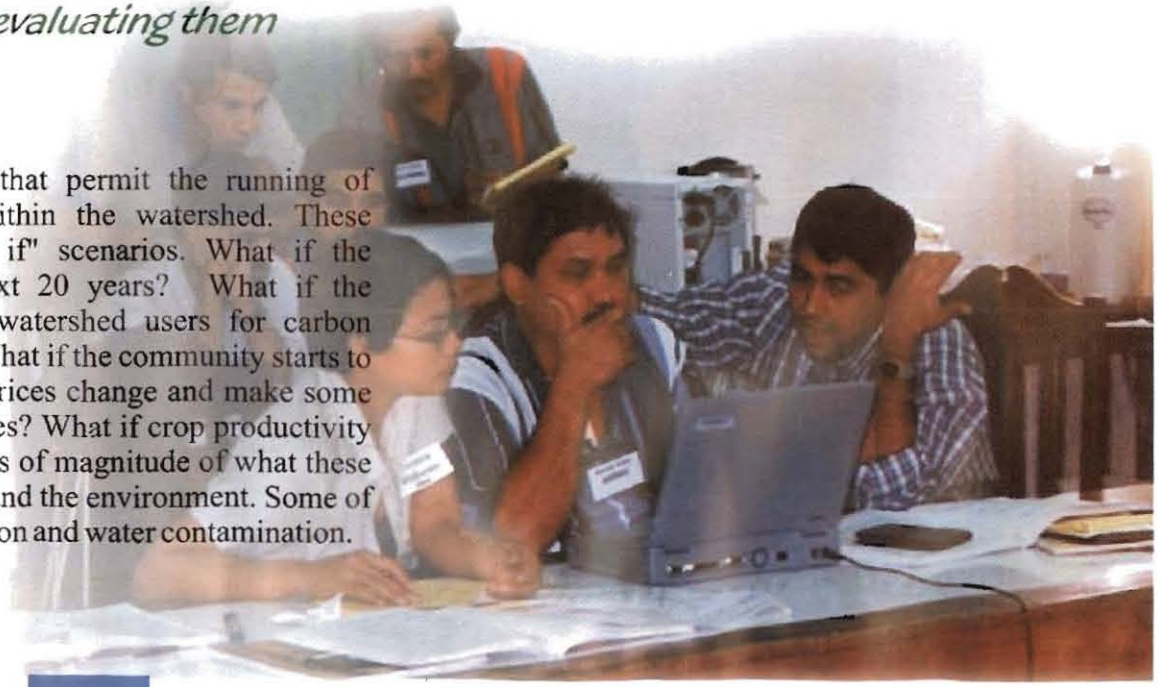
- Analysis of the missions of the different stakeholders,
- Their stakes in a given watershed or municipality,
- Goal formulation,
- Analysis of indicators for goal achievement,
- Identification of problems to achieve the goals,
- Development of decision alternatives and their evaluation, and
- Selection of a final decision, setting the stage for decision implementation.

The methodology is accompanied by a user friendly computer program that is able to record all information that is collected and condensed during group discussions. The DSS is able to bring forward all information that has been obtained through the use of the other CIAT Guides.

Experimenting with options and evaluating them

Simulation and modeling

Watershed models are computerized tools that permit the running of simulations under different assumptions within the watershed. These different simulations draw different "what if" scenarios. What if the population continues to increase in the next 20 years? What if the international community will start to pay watershed users for carbon sequestration or for clean water production? What if the community starts to plant trees around springs? What if relative prices change and make some new crops more attractive than the current ones? What if crop productivity increases by 20%? The models can give orders of magnitude of what these changes would have on production, incomes, and the environment. Some of these models can predict likely changes in erosion and water contamination.

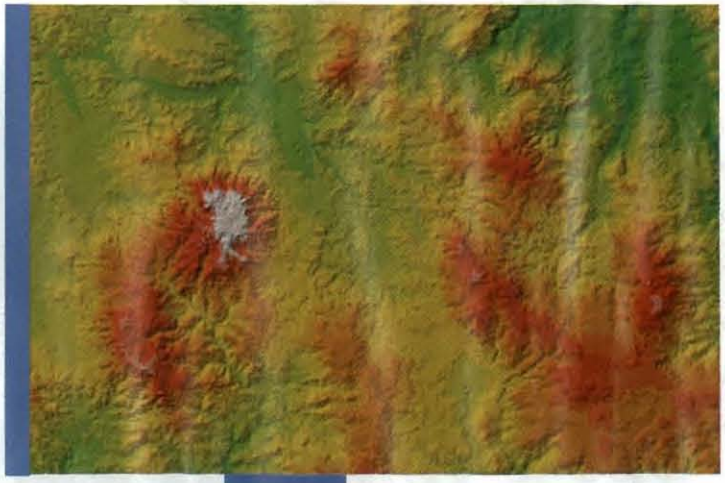


Simulations are not predictions but are "coherent stories" that can help a group to envision what would be the effect of different courses of actions. Simulations are less "decision support tools" than "negotiation support tools".

They should not be used in the spirit of a central planner who "knows better", but in the spirit of helping the different stakeholders in their negotiation process. Most watershed uses are conflictive and one wants to support all the groups who have a stake in the watershed, especially the weaker ones.

There now exist different types of models that can compare alternative scenarios. CIAT has been testing several of these model types such as biophysical watershed models, optimization models, and cellular automata. Most of these tools are made user friendly so as to allow local technicians to run them and explain the results in an easy way.

Some of the applications include 3-D presentation of the watershed so as to see in quasi real-life how the landscape would change under different decisions or external driving forces. CIAT's objective is now to make these tools available to local organizations that are involved in watershed management or in conflict resolution to help in their decision making.



Digital Model Evaluation
Yoro Watershed
Honduras
50 mts.pixels

Field trials

From 1982-88, the Crop Systems Units of the CIAT Programs ran many field trials evaluating germplasm and exploring aspects such as varieties, fertilization, and planting density. Verification trials took place with the participation of producers. Demonstration work was also undertaken and was similar to later work with the CIALs. Research was working on how to select work areas/farms/number of places in which to conduct trials to be taken into account for trustworthy statistics.

CIAT has the expertise to help farmers in running their own trials or in forming organizations that do so. The SOL sites provide another area for farmer-run and scientific trials. The SOL (Box 6) is an initiative of the CIAT-Hillsides project to develop technological options and offer these to poor farmers, technicians, producers, and institutions. The aim is to develop technologies that establish profitable, sustainable production systems through multi-institutional alliances, using a participatory approach (design, planning, monitoring, and assessment), which includes shared responsibility at all decision-making levels. The SOL links farmer experimentation with formal research.

Box 6. The SOL (Supermercado de Opciones para Ladera, or Hillsides Options Supermarket) aims to develop technological options that are economically viable and environmentally sustainable. A participatory approach is used that includes shared responsibility at all decision-making levels. Strategic principles allow for extrapolation and upscaling. In Honduras, the SOL site is the Tascalapa River watershed, in Nicaragua, the Wibuse-Jicara watershed. Men and women of the communities actively participate in different activities (e.g., alternative grass species, seed production for grass and legume spp., soil conservation, natural regeneration of native species, and identification of market products). While still in the initiating stages, the SOL sites are expected to help develop technological options that small-scale farmers will readily adopt.

Farmer experimentation and evaluation

The CIALs are a method for experimenting with options and they use tools such as the CIAL Primers. A committee of four farmers, elected by their own community, analyze and execute research themes determined or identified by their community in different places of the same. Eight steps are followed:

1. Motivate community
2. Elect committee
3. Committee and technicians prepare work
4. Plan trials
5. Get under way
6. Evaluate trials
7. Analyze results
8. Feedback to community

Technicians act as support and fill in any gaps that occur.

Five CIALs were formed in Cauca, Colombia in 1990 and nongovernmental organizations (NGOs) began to be involved in the following year. During 1995-96 the CIAL project spread to other countries. At present, it is working well, with 250 CIALs formed in eight countries. An impact study is underway and comparison is being made with other kinds of organizations. It appears that CIALs have stimulated more diversity in the crops grown.

Technologies are being adopted, neighbors are picking up successful techniques, and they have spread beyond boundaries, even into other Departments.

Postharvest and value-added processing

In the past, the CIAT Seeds Unit gave training and investigated and generated postharvest seed handling technology. This first began with industry in mind, then moved to supporting small-scale producers. Small-scale technology was generated including equipment for seed cleaning, selection, drying, storage, and treatment. The equipment was of wooden construction and artisanal type, but equally as efficient as industrial equipment.

Research on agroenterprises through integrated cassava projects eventually led into the development of Guide 7 (Identifying Market Opportunities), broadening out and being applied to a wider range of products. The final section of Guide 7 deals with the design of integrated production projects. After training, national institutions can do all of this work. Others are taking the document and adapting it to their own situations.

Within watersheds, consortia (e.g., CLODEST and CIPASLA) identified diversification and marketing as being necessary to be able to reach sustainable production systems. When new crops are identified, diversification occurs, incorporating higher value crops into the production system with or without processing; or value may be added through postharvest handling and processing of existing and introduced crops. These generate income and employment in the region, leading to reduction in poverty, then farmers become motivated to invest in their resource base, breaking the vicious circle of mining their resources. This can lead to more sustainable landscapes.

Experimenting with options and evaluating them is a necessary basis on which to make decisions on land use.

Organizing a decision-making forum for stakeholders

Six tasks have been identified as critical for community-level organization (Knapp et al. 2000):

1. Identifying stakeholders and ensuring their representation in management effort.
2. Providing forums for analysis and negotiation of diverse interests.
3. Defining rules and norms for the use of resources within the watershed.
4. Initiating a process of local-level resource monitoring research.
5. Formulating and exerting demand for services from external institutions in support of local management efforts.
6. Negotiating internal vs. external watershed interests.

Organizing a forum could be ad hoc. It may include stakeholders who do not have a real commitment to what is under discussion. Once their positions are made clear and they approve of the project, they may not want to take actual part. The method of participatory planning by objectives method helps in the organization of a forum or workshop.

In organizing a network for GIS information exchange, the Intelligent Team/Decision Support System (IT/DSS) synthesizes the six tasks identified above. The "Intelligent Team" modifier connotes that our DSS is designed to support a team of multiple-goal-pursuing stakeholders as opposed to single-problem, single stakeholder decisions. The most important part is forum management. The IT/DSS electronic forum workbook is now complete and in the process of publication in a similar format to the DS tools. The electronic forum solicits information and adds a further dimension to the work model used by the Hillsides team. The forum component motivates and compels participants towards making decisions for sustainable NRM.

Box 7. ***Campos Verdes*** This association was formed in 1997 in the Calico River watershed, Nicaragua and has successfully obtained funding for community projects through national and international institutions and nongovernment organizations. It has established direct links with three NGOs (CARE, PRODESSA, PNUD), three GOs (the Mayor's Office, MAGFOR, UNA) and three local organizations (*Cooperativo Sueños Realizados*, UCOSD, CIALs), about 38% of the 27 entities involved in the San Dionisio Municipality. The association contributes effectively to community development in such a way that GOs and NGOs find it an efficient support for their programs, demonstrating the convenience of its permanency and actions in the different communities.

Muller S. 1995. How to measure sustainability: an approach for agriculture and natural resources. Discussion Paper Series on Sustainable Agriculture and Natural Resources, no. 1. Instituto Interamericano de Cooperación para la Agricultura-Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung-Deutsche Gesellschaft für Technische Zusammenarbeit (IICA-BMZ-GTZ).

Rhoades RE. 1998. Participatory watershed research and management: where the shadow falls. Gatekeeper Series no. 81. International Institute for Environment and Development (IIED), UK. 19 p.

Saravia, J. 1998. Guía para la planificación de proyectos por objectivos. Introducción al método, definiciones básicas y procedimientos básicos. (*A guide to project planning by objectives. An introduction to the method, basic definitions, and proceedings*). Internal document. CIAT, Cali, Colombia. 18 p.

Sharma P, Krosschell C. nd. An analysis of and lessons learned from case studies of people's participation in watershed management in Asia. Food and Agriculture Organization (FAO)/United Nations Development Programme (UNDP) Participatory Watershed Project in Asia. Mss.

Waltner-Toews D. 1993. Ecosystem health: a framework for implementing sustainability in agriculture. Paper presented at the Instituto Interamericano de Cooperación para la Agricultura-Deutsche Gesellschaft für Technische Zusammenarbeit (IICA-GTZ) project on sustainable agriculture.

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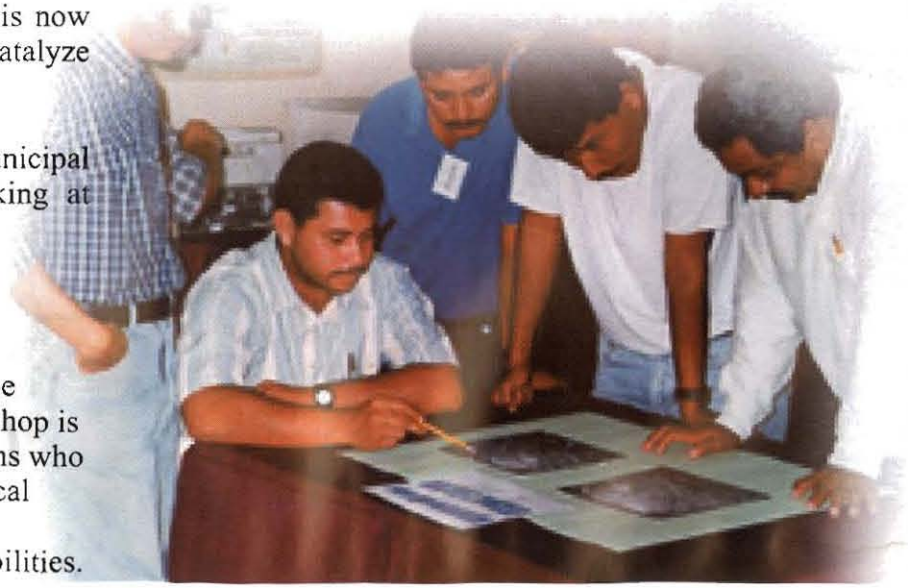
Organizing a semi-stable organization such as CIPASLA is especially important for the local monitoring of research. Using the local organizations leads to greater and faster impact. The organizations of CIPASLA in Colombia, Campos Verdes in Nicaragua (Box 7), and CLODEST in Honduras are already in place and functioning. CIAT helped form them and helped them start working through strengthening local organizations. This happens spontaneously. For example, a new group has recently been formed in Bolivar - Valle, Colombia following Training Workshops on the methodological tools.

The Action Plans that came out of the training all corresponded to areas in central and northern Valle del Cauca, and discussions suggested the need for a new organization. A planning workshop was held and strategy discussed at various meetings forming the basis of an interinstitutional Consortium that has put together CORPOCUENCAS, (the government agency for watershed management in Valle del Cauca), EcoFuturo (12 grass-roots groups for ecological management of natural resources),and CIAT. An interinstitutional cooperation agreement was signed by these organizations to carry out a pilot project throught which the decision support tools will be applied in 10 agroecological sites of Valle del Cauca. As of about March, this is now another new mechanism through which CIAT can strengthen and catalyze watershed management decision making.

The support of associations, local organizations, institutions, and municipal government create space for better planning and decision making at municipal level.



Capacity building

Capacity building is done through a series of workshops in which the Guides are brought together and validated. First an Induction Workshop is held for decision makers and candidates and trainers from institutions who have expressed interest in applying one or more of the methodological Guides or in helping others apply them. This is an opportunity for explaining more about the Guides and clarifying roles and responsibilities.

Action Plans and their important role are explained. All candidates are interviewed for the final selection of 16 to make up a national team of trainers who are given copies of the Guides to study.

Later, a Training of Trainers Workshop takes place after a meeting with CIAT instructors to go over the trainees' knowledge of the Guides. In the workshop, trainees work in groups with instructors, going through the Guides and how to use them. The new trainers can then hold national Workshops, with some supervision at first from CIAT instructors. At these workshops, Action Plans are elaborated (Box 8). These are small projects through which people commit themselves at institutional level to use what they have learned during training with the Guides. Organizations participating in Workshops are asked to write down their mission and vision so that everyone in the forum can understand exactly with whom they are going to work. The Action Plans identify who could be affected and who should be involved in what is being planned.

Box 8 Action Plans cover in simple tabular form:

1. The character of the institution involved, its address, mission, and reason for wanting to use the tools.
2. Identification of the desired situation, who will be affected, and how decisions will be taken.
3. Methodological tools to be applied and the environment or areas where they are to be applied.
4. Specific objectives and strategies for their achievement.
5. Institutional commitment for the Plan's application and what resources are offered.

Participants at Training Workshops are from NGOs and GOs and are those who then write up the Action Plans and make commitments, thus this is an important part of the implementation of the training Guides at local level. Action Plans open the way for integrated production projects and other research approaches (e.g., SOL). The trainers of the workshops later monitor the results of the Action Plans that come out of the training, derive principles and lessons learned, and use them for extrapolation and/or upscaling.

The training in the use of the Guides leads to the making of Action Plans, which are decisions taken by participants on what needs to be done and how to do it in their specific areas.

Documentation and dissemination of information

It is highly important to maintain an efficient information system within a project and with its partners, and particularly so in situations of multiple collaboration such as occur in watershed management. It is also highly important to exchange information with other projects to share experiences, learn from our mistakes, and provide assessments.

Hillsides work is accessible on www.ciat.cgiar.org to which the Community Management of Hillside Resources will soon be connected. Existing information and experiences of CIAT in Honduras and Nicaragua are compiled and centralized through a user-friendly system on the CIAT-Hillsides Web page at http://www.intertel.hn/org/ciathill. For those without access to this technology, a 2-monthly bulletin is produced and has been circulated to over 30 institutions in Honduras and Nicaragua to date.

The published Guides give training materials for trainers to use with the community. The Guides are also to be published on two CD-ROMs with a user manual. English editions of the Guides will be available by the end of 2000. Countries in Africa and Asia (e.g., Vietnam, Uganda) have solicited training with the Guides for technicians, professionals, and researchers.

The CIAL Primers are aimed directly for farmer use. During 2001, Primers are to be developed corresponding to each of the Guides so that members of the organizing groups of the community can use them as workbooks.

At local level, interviewing to gain local information can work both ways, the occasion being used to inform farmers of what is being done or may be done in the watershed and of projects that are underway. The Workshops to which they are invited also disseminate information at the local level.

Good decision making depends upon access to good and ample information.

DECIDING WHAT COUNTS IN MONITORING AND EVALUATION

Project monitoring is considered both as a tool for measuring the impacts of the activities carried out and as providing ongoing opportunities for analysis and reflection about the progress made toward achieving the project's objectives. This in turn provides feedback to improve the monitoring system. Figure 5 illustrates the process.

This goes together with the implementation component. It needs to be a tool for reflection on what has been and is being done, giving the experience of those involved. It is a feedback and improvement of the process. At this stage we work on the most important aspects for follow up and later define the indicators to use. We determine the initial situation or base line then follow up the implementation and how this influences the indicators of process.

We use this information for motivating people's reflection on whether they are doing well, the results are as expected, why or why not, what to do next, and so on. This is a "learning by doing" approach (Implementation), which Monitoring and Evaluation (M&E) promotes. Including the M&E of the process of implementing our approach is vital to its success, that is, M&E both looks at the outcomes of improving resource management and improves the process. It also improves people's decision-making abilities.

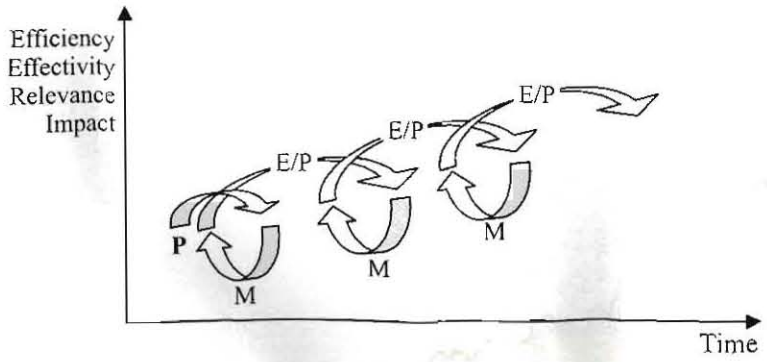


Figure 5.Planning (P), monitoring (M) and evaluation (E) in the project management cycle

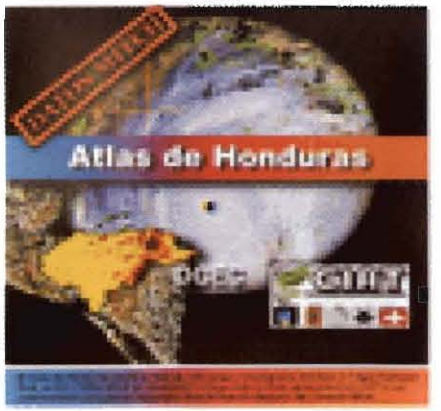
CONCLUSIONS

When confronted with multiple stakeholders with the sanctioned right to press for their needs, grass-roots workers need not only a "paradigm shift" but good science, appropriate methods, organizational skills, workable technologies, sufficient funding, and donor patience (Rhoades 1998).

Since its inception over 30 years ago, CIAT has accumulated a great deal of information and experience and is well placed for strong impact at watershed level. We also take into account what other entities are doingthis aspect is important and needs constant verifying. In Central America many other institutions are working at watershed level, but more on rural development and less on research, training, and the use of tools. Concentrating on these aspects, CIAT is filling a void.

It is important to involve other partners (research and development institutions) with comparative complementary advantages who can contribute in making up a package that satisfies the expectations of the technological component for the management of natural resources. In an ongoing research process, CIAT continues to design and validate new methodological guides.

Amongst these are the "Design, use, and updating of a GIS at local level", "Use of three-dimensional models for the development of a holistic understanding of the environment-*maquetas*", and "A decision support system for groups of multiple interests".
Also planned are guides on the IT/DSS, the SOL, organic matter and soil management, and soil macrofauna (in collaboration with the CGIAR SWNM, www.swnm-org, systemwide program on Soil, Water and Nutrient Management), *maquetas*, site similarity analysis, and gender analysis. As work continues, other needs will emerge and further guides will be developed.



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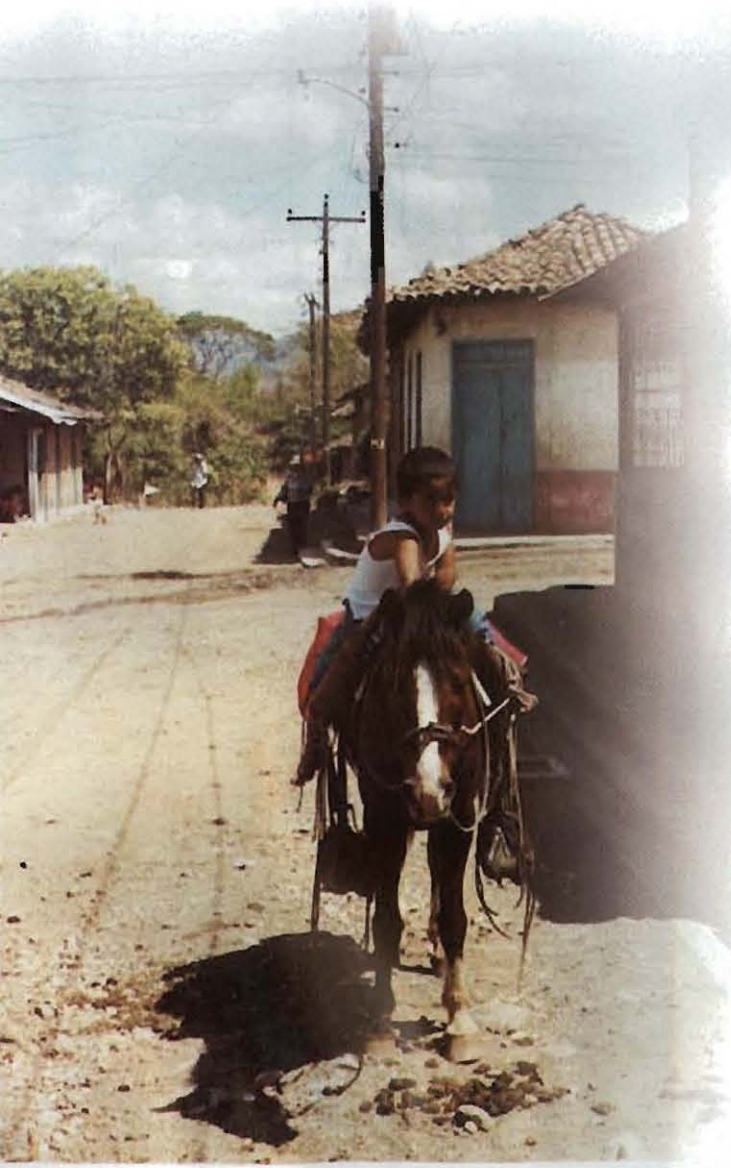


The CIAT approach of decision support to stakeholder watershed resource management has been used with some success for local sustainable development in small areas. It takes into account socioeconomic and environmental aspects. The results of this approach can be seen relatively quickly from the socioeconomic perspective (Box 9); its effects on natural resources will take longer to quantify. CIAT can readily apply its ample experiences and this methodology to watershed management.

Box 9. What results can we expect of using this learning process approach?

We can expect changes in:

- Resources both natural and human (welfare)
- Management
- Skills and knowledge
- Organization

These can be seen in the success of the CIPASLA

Although watersheds are a useful unit for organizing research, this does not imply that the objective will always result in management plans that optimize water resources (Knapp et al. 2000). Rather, the objective is to include the analysis of water as well as soil and vegetation in the family of indicators that provide a "feedback mechanism" for stabilizing and sustaining hillside production systems (CGIAR 1996).

When poor farmers seize the chance to make decisions themselves, to exploit the best of traditional wisdom and formal science, they take a crucial step on the slow path to prosperity. CIAT continues working to empower poor farmers, presenting them with wider choices, new opportunities, and hope for a better life (CIAT 1999b).

APPENDICES

I. TYPES OF WATERSHED

Watersheds can be described in very specific geographic terms using the water catchment (ridgeline) as the dividing line on a diagram of rivers. Where the river goes into the sea is then the primary watershed, where the river divides becomes the secondary one, and so forth. This is a theoretical way of dividing the rivers into a graph, but it does not give an idea of watershed size. There is a hierarchy of different sizes of watershed depending upon the type of terrain.

A hierarchy of communities also exists. CIAT works in watersheds because they often coincide with communities of people who work together, or interact, in terms of what goes on in the physical area of the watershed. The community sizes are much related to the hierarchy of watersheds country boundaries, regional organizations, local government, *veredas* (local parishes). These overlie a physical watershed in different ways.

The physical watershed interacts with the community depending upon the terrain and scale. How the river network/ terrain/ watershed reacts with the community mainly depends upon the type of countryside. Figure 6 is intended to give some idea of the complexity of scales and the overlays of different boundaries.

Communications tend to run in the same patterns as rivers. In some areas, the river system is used as transport and becomes the form of communications, whereas in other areas the rivers may be fast running or difficult to cross in the wet season and therefore impede communication.

In mountainous terrain, the ridgeline of very high mountains is often an impediment, while in the mid-elevation Andes the community of a municipality is often on both sides of the ridge between the rivers. In the forest margins, in many cases communications run along the rivers, and deforestation and colonization tend to spread out from either a river or a road.

If a valley is shallow with good agricultural ground on either side, then the community forms by the river and is demarcated by the ridges. There may even be a different community on either side of the river. Yoro and Yorito are examples of fluvial communities (in the valley and going up the side of the hill), while Cauca, Cabuyal, and Ovejas tend to be interfluvial as the rivers cut deeply into the hills.

The size of community we can manage to work with is what defines the watershed. We try to find a community that fits into a communication catchment area and that is defined by a watershed pattern. We try as much as possible to capture the human interaction in the area, thus it is natural to stop at a boundary to communications. The idea is that if we can define a particular type of catchment area where people form a coherent unit, then when we find another similar area results can be extrapolated to it by using site similarity analyses.

CIAT at present works with multiple partners in the following watersheds:

Colombia

Cabuyal watershed, southwestern Cauca Department, 3200 hectares in size with a political unit consisting of 7000 hectares, which is home to about 6500 people. CIAT began working here in 1993.

Guadalajara watershed, Department of Valle, 68,760 hectares in size with a rural population of 12,200 inhabitants. CIAT has participated through CIPASLA in work with the CMDR (Municipal Office for Rural Development).

Honduras

Cuscateca watershed, 4236 hectares in size with political unit (municipality of Danli) of 376,610 hectares and 100,799 inhabitants.

Tascalapa watershed, Yoro Department, 35,000 hectares in size. Main municipalities are Yorito with 20,475 hectares and 9,539 inhabitants, and Sulaco with 23,688 hectares and 11,150 inhabitants. CIAT began working here in 1995.

Nicaragua

Calico watershed, Matagalpa Department, 17,000 hectares in size with a population of 16,000 inhabitants. CIAT began working here in 1996.

San Dionisio watershed, 840 hectares in size with political unit (San Dionisio Municipality) of 14,400 hectares with a total population of 5,917 inhabitants, 1848 urban and 4069 rural. CIAT began working here in 1997.

Country

Department

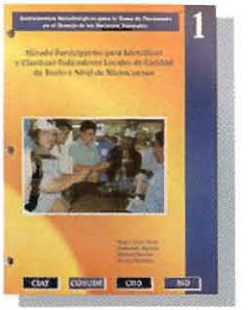
Municipality

Watershed

Figure 6. An example of the way in which different boundaries may overlay the watershed

II. TOOLS DEVELOPED BY CIAT AND OUR COLLABORATORS

The nine CIAT Guides



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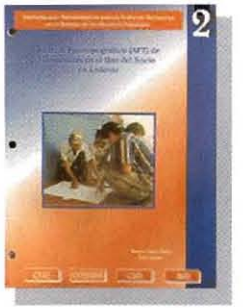

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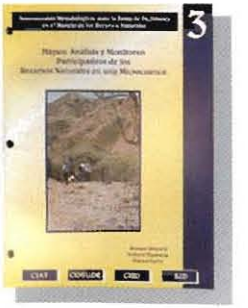

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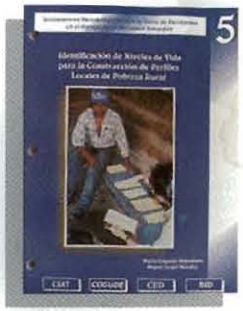

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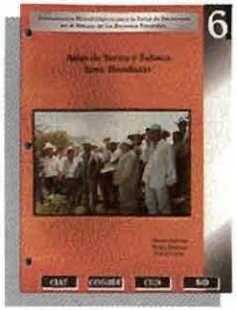

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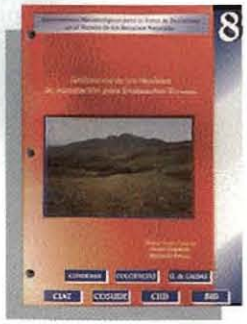

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Tools related to the information technology sector

These include human/social/economic/productive mapping, and the use of remote sensing, aerial photos, and other GIS tools. Water/hydrological modeling is also useful, but should be calibrated; CIAT has models for the Central American and Andean regions. We can do model aspects of water management, e.g. estimate how much water is produced, when it is produced, the times of cleanest water, times of shortage et cetera.

1. The Accessibility Wizard - We have developed computer-based tools that produce, for example, accessibility maps that allow us to make maps of time to markets etc.

2. Soil-water budget model (SWBM). This model allows simulation of future scenarios as fitness tests for the water component, the ability of the landscape to regulate water. We can then apply scenarios as stresses to the watershed to see what reaction ensues.

3. "Methodology for decision taking for multiple interest groups" calls in data from the information technology tools. It is a goal-oriented as opposed to problem-oriented methodology.

4. The IT/DSS is a computer version of the above methodology that gives more time to do the analysis needed for planning.

CIAL Primers

1. El Ensayo (*The Trial*)
2. Los Comités de Investigación Agrícola Local (*The Local Agricultural Research Committees*)
3. El Diagnóstico (*The Diagnosis*)
4. El Objetivo del Ensayo (*Planning the Trial*)
5. La Planeación del Ensayo (*Designing the Trial*)

6. La Evaluación del Ensayo (*Evaluating the Trial*)
7. Cosas que Pueden Pasar (*Things that Can Happen*)
8. Compartimos los Resultados de Nuestro Ensayo (*Feedback to the Community*)
9. Un Caso Real (*Actual Cases*)
10. Las Experiencias también Cuenta (*Experience also Counts*)
11. Las Cuentas Claras (*Clear Accounts*)
12. Es Bueno Saber a Tiempo si Vamos Bien (*It's Good to Know in Time How We Are Doing*)
13. Guías para Conocer Nuestro Camino (*Guidelines to Help us Along the Way*)

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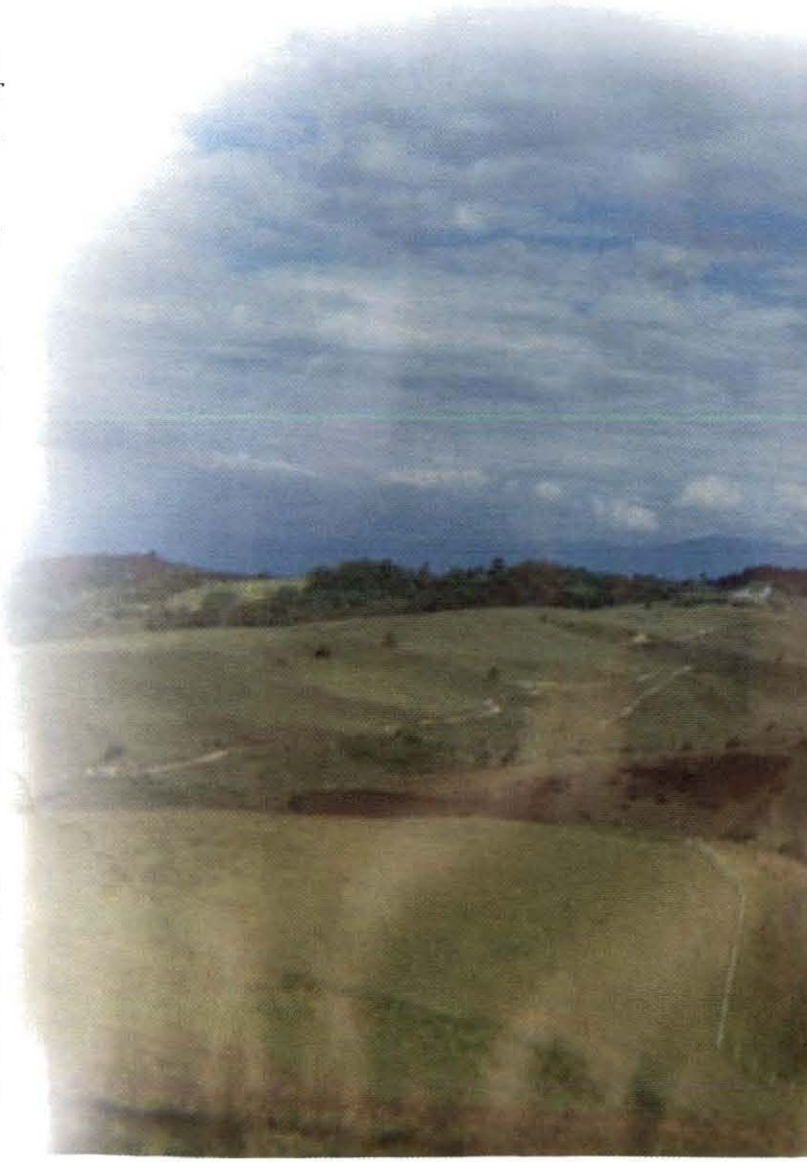

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IV GLOSSARY OF TERMS USED

Action plan:

Having received the training on how to use the methodological t participating institutions or other participants write up small pro in the form of Action Plans, in which one or more of the tools are u If approved, these plans are then carried out by the institution evaluated as part of the training scheme.

Decision support system:

This is a system of support for decision taking. It includes an oper complementary group of methodologies (which in their turn inc processes and tools) and of information tools (software and di and numerical data). These are of permanent access to people groups, allowing the support of their decisions of inversion politics about the area within their ambit of responsibility

Decision support tool/instrument:

Used in or for the support of decision taking.

Each of the nine methodological tools described in "Informed deci making for sustainable natural resource management: Nine tools help" can be a decision support tool when used towards that end.

Ecosystem:

A system of organisms occupying a habitat, together with t aspects of the physical environment with which they interact.

Thus **agro-ecosystem**: agriculture and ecosystem.

Guides:

Manuals or books of instruction on a specified subject.

The CIAT Guides are didactic materials to help train (a) traine countries interested in technology transfer to distinct types of u and (b) those same users.

The nine tools produced to date contain the essential components of each decision support tool and materials to accompany the training (e.g., questionnaires, objectives, and exercises). The learning model used by the Guides sustains that practice is the most important aspect of learning in helping develop the abilities and attitudes needed for decision taking.

Methodological tool:

A tool for application of a method in a particular field.
In developing the CIAT Guides, the term methodological tool has been used with the same meaning as methodological instrument. When it is incorporated in a decision-making system, it takes on the character of "decision support tool".

Stakeholder:

A person or a group with an interest or concern in the process of watershed management including farmers, researchers, planners, technical experts, community development workers, different agency professionals or others involved in the use and management of natural resources. In the process of planning and implementing this approach: The researchers, planners, technical experts, community development workers or other agency professionals or those involved in the use of natural resources.

Sustainable:

Able to be maintained at a certain rate or level.

Sustainable development:

Is a permanent process, a perpetual search for a balance between the demands generated to satisfy human needs and the capacity of Nature to cover these demands without irreversible degradation. Because human demands change with time, this balance is not static, but has to be redefined constantly.

Watershed:

The whole gathering ground of a major river system. At national level, a "watershed" can be referred to as a third-level agro-ecosystem, after nation and region (Muller 1995). For the purpose of research for sustainable development, the watershed offers a more complex system that represents the realities in which an ample variety of factors are at work causing conflicts of interest that require a collective management of decisions.

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ACRONYMS AND ABBREVIATIONS USED

AOP Annual Operative Plan

AROs Advanced Research Organizations

ASIAVA Asociación de Ingenieros Agrónomos del Valle del Cauca, Colombia

BMZ Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (*Federal Ministry for Economic Cooperation and Development*), Germany

CARE Cooperative for American Remittances Everywhere

CATIE Centro Agronómico Tropical de Investigación y Enseñanza (*Tropical Agricultural Center for Research and Training*), Costa Rica

CGIAR Consultative Group on International Agricultural Research

CIALs Comités de Investigación Agrícola Local (*Committees for Local Agricultural Research*)

CIAT Centro Internacional de Agricultura Tropical (*International Center for Tropical Agriculture*), Colombia

CIMMYT Centro Internacional de Mejoramiento de Maíz y Trigo (*International Maize and Wheat Improvement Center*), Mexico

CIP Centro Internacional de la Papa (*International Center for Potato*), Peru

CIPASLA Consorcio Interinstitucional para una Agricultura Sostenible en Laderas (*Interinstitutional Consortia for Sustainable Agriculture in Hillsides*), Colombia

CIRAD Centre de coopération internationale en recherche agronomique pour le développement (*Center for International Cooperation in Agricultural Development Research*), France

CLODEST Comité Local para el Desarrollo Sostenible de la Cuenca del Río Tascalapa (*Local Committee for the Sustainable Development of the Tascalapa River Watershed*), Honduras

CMDR Consejo Municipal de Desarrollo Rural (*Municipal Office for Rural Development*), Colombia

COMVALLE Consorcio Interinstitutional para el Manejo de los Recursos Naturales del Norte y Centro del Valle del Cauca,

	(*Interinstitutional Consortium for the Management of Natural Resources in Northern and Central Cauca Valley*) Colombia
CORPO CUENCAS	Corporación Vallecaucana de las Cuencas Hidrograficas y el Medio Ambiente (Corporation of the Valle del Cauca of Hydrographic Watersheds and the Environment), Colombia
DICTA	Dirección de Investigación Ciencia y Tecnología Agropecuaria (*Management of Agricultural Science and Technology Research*), Honduras
DS	Decision Support
DSS	Decision Support System
FAO	Food and Agriculture Organization of the United Nations
GIS	Geographic Information Systems
Gos	Government Organizations
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (*German Agency for Technical Cooperation*)
IARCs	International Agricultural Research Centers
IICA	Instituto Interamericano de Cooperación para la Agricultura
INTA	International Institute for Environment and Development, UK
IIED	Instituto Nacional de Tecnología Agropecuaria (*National Institute of Agricultural Technology*), Nicaragua
IPRA	Investigación Participativa en Agricultura (*Participatory Research in Agriculture*) of CIAT
IT/DSS	Intelligent Team/Decision Support System local soil quality indicators
MAGFOR	Ministerio Agropecuario y Forestal (*Ministry of Agriculture and Forestry*), Nicaragua
M&E	Monitoring and Evaluation
NARS	National Agricultural Research Systems
NGOs	Nongovernment organizations
NRM	Natural Resource Management
PCAC	Proyecto Campesino a Campesino, Nicaragua
PNUD	Programa de las Naciones Unidas para el Desarrollo (*United Nations Program for Development*)
PROCIAN DINO	Programa Cooperativo de Investigación y Transferencia de

	Tecnología Agropecuaria para la subregión Andina (*Cooperative Research and Agricultural Technology Transfer Program for the Andean subregion*)
PRODESSA	Proyecto de Desarrollo de San Dionisio (*Project for the Development of San Dionisio*), Nicaragua
PROFRIJOL	Proyecto Regional de Frijol para el Centro América, México y el Caribe (*Regional Bean Project for Central America, Mexico, and the Caribbean*)
SERTEDESO	Servicios Técnicos para el Desarrollo Sostenido (*Technological Services for Sustainable Development*), Honduras
SOL	Supermercado de Opciones para Ladera (*Hillsides Options Supermarket*)
SQIs	Soil Quality Indicators
SWBM	Soil-Water Budget Model
TAC	Technical Advisory Committee of the CGIAR
UCOSD	Union de Campesinos Organizados de San Dionisio (*Union of Organized Small Farmers of San Dionisio*), Nicaragua
UICN	World Conservation Union, formerly Union Internacional para la Conservación de la Naturaleza, Switzerland
UNA	Universidad Nacional Agraria (*National University of Agriculture*), Nicaragua
UNDP	United Nations Development Program, Geneva
USAID	United States Agency for International Development, WA
ZOPP	Zielorientierte Projekt Plannung, IDM-GTZ, Germany