Annexes

METHODS AND RESOURCES FOR COLLABORATIVE WATERSHED MANAGEMENT: HINTS AND TIPS FOR PRACTITIONERS

These annexes give brief descriptions of innovative methods and resources for collaborative watershed management.

The aim of these descriptions is to help the non-specialist practitioner assess the relevance, usefulness and feasibility of each method or resource for a particular watershed situation. Following an overview of the method or resource, key concepts are briefly discussed and relevant tools listed. Conditions for the successful use of the method or resource are identified and, whenever possible, rough estimates of the costs are given. Most descriptions include an example to illustrate how the method or resource has been applied in the field. References and Internet addresses are provided for readers who want to know more about the subject. A list of key Web sites on collaborative watershed management is also included.

The annexes do not provide step-by-step instructions on implementing or using these methods and resources. Instead, they enable practitioners to decide whether to seek specific professional assistance, and indicate what to expect if they do so.

WOCAT: a methodology for documenting and evaluating soil and water conservation

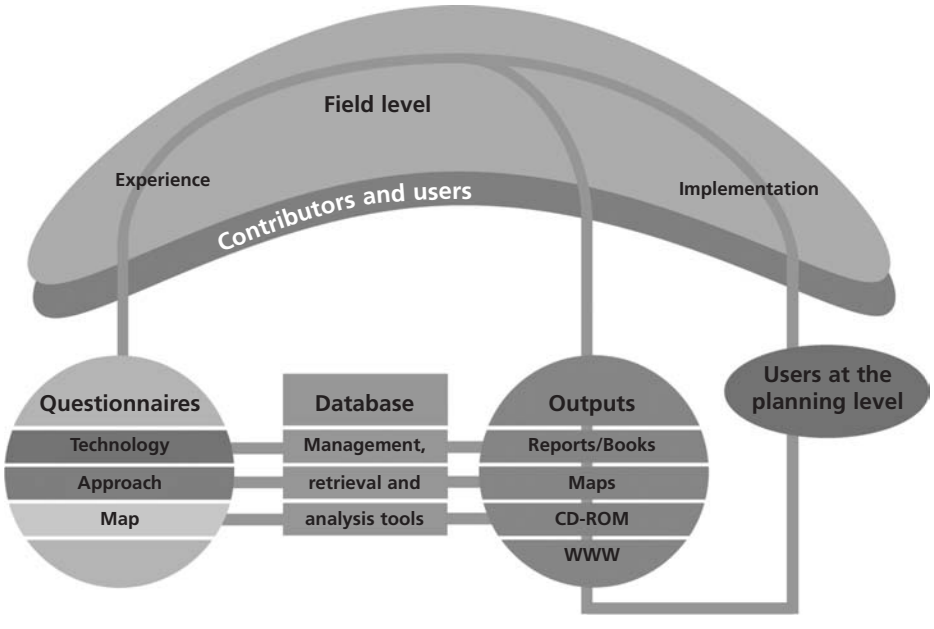
WHAT IS WOCAT?

The World Overview of Conservation Approaches and Technologies (WOCAT) is a global network of soil and water conservation specialists comprising 35 national organizations and several international and donor organizations, such as FAO, ICIMOD, the United Nations Environment Programme (UNEP), the Swiss Agency for Development Cooperation and the Danish International Development Agency (DANIDA). WOCAT's mission is to support knowledge sharing among soil and water conservation specialists, to help them identify appropriate technologies and approaches, and to support the planning and implementation of these in the field.

WHAT SERVICES DOES WOCAT PROVIDE TO FIELD PRACTITIONERS?

Knowledge about soil and watershed conservation is extensive, but scattered and not easily accessible. This is one of the reasons why soil degradation continues in many parts of the world, despite decades of efforts and large investments in soil and watershed conservation. WOCAT documents and disseminates knowledge so that practitioners can learn from each others' experiences via a source of reliable information covering many geographic and subject areas. The information gathered helps to identify research needs and suggests how ongoing practices can be improved.

FIGURE A1
Services delivered by WOCAT



WOCAT QUESTIONNAIRES

WOCAT has developed three questionnaires to capture information about soil and water conservation technologies and field-level approaches. As the questionnaires are complex, WOCAT also offers training on how to use them and the associated database.

The WOCAT methodology, questionnaires, database and outputs have been evaluated at national and regional workshops, and have been continuously revised since the first questionnaires were developed in 1994. More than 30 national training workshops since 1999 have confirmed that the current questionnaires are practical and useful, although some collaborators feel they are too complex.

The three WOCAT questionnaires cover technology, approaches and mapping; data are collected, recorded and analysed in a systematic and standardized manner. The *technologies questionnaire* investigates field activities. The *approaches questionnaire* investigates the required skills and technical knowledge, the required and available resources, socio-economic and cultural aspects, and land users' perceptions and acceptance of each approach. The *mapping questionnaire* gathers geographic information about planning issues in order to build up spatial overviews of degradation and conservation in defined areas – patterns of soil degradation vary at all levels, from the village to the global scale. Responses to the mapping questionnaire show that conservation achievements are rarely mapped; such maps should be created to identify where soil and watershed conservation measures have been effective and where they are most needed and could be implemented effectively.

WOCAT DATABASE

WOCAT's database includes more than 300 technology case studies and more than 200 approaches from 40 countries (not all of which have been validated). The database can be searched for a specific technology or approach or for specific conditions in which these are applied. It also evaluates technologies and approaches. Most of the information is presented as case studies on soil and water conservation technologies and approaches in more than 35 countries. Most information comes from Africa (60 percent) and Asia (30 percent), with a few case studies from Latin America. WOCAT has recently started to gather information from Europe. WOCAT consolidates its information by subject and area to make it more useful and accessible for planning exercises and in the field.

DISSEMINATION AND TRAINING

WOCAT disseminates information via its Web site, on CD-ROMs, in articles and at workshops. All WOCAT's tools, data and outputs can be accessed at www.wocat.net. CD-ROMs contain much of the information from the Web site, including the database, questionnaires, published reports and general information.

WOCAT held its first regional training workshop in Kenya in 1995. Since then it has trained more than 400 experts in Africa, Asia and Europe. Filling in the WOCAT questionnaires encourages practitioners to analyse their achievements.

HOW WOCAT TOOLS AND DATA CAN BE USEFUL FOR COLLABORATIVE WATERSHED MANAGEMENT

The information gathered by WOCAT provides decision-makers, such as planners and coordinating organizations, with an overview of achievements, approaches and technologies.

WOCAT promotes the use of good-quality, up-to-date information on water and soil for extension, research and education. Its tools and processes are used by government departments, project staff, scientists and extension workers from across the world to:

- monitor and evaluate individual technologies and approaches, and quantify costs and benefits;
- document, identify and transfer technologies and approaches from one area to another;
- identify key topics and knowledge gaps that need further research;
- evaluate the results of research trials, and assess the biophysical and socio-economic suitability of research-derived technologies and approaches;
- disseminate information as an educational data resource.

CONDITIONS FOR SUCCESS

One of WOCAT's main concerns is the quality of the data it collects. A study on the potential for improving data (Douglas, 2003) suggested that WOCAT should focus less on the correct filling in of questionnaires and more on transferring to practitioners the skills to evaluate the impacts and cost-effectiveness of their own activities.

Improving data quality requires respondents to be more critical about their own knowledge and to fill in questionnaires properly. In particular, respondents need to:

- review their knowledge and experience of technologies and approaches critically and systematically;
- recognize and challenge their technical preconceptions and biases, which often lead to wrong assumptions about problems and the effectiveness of technologies or approaches;
- avoid assuming that implementing a technology or approach automatically controls land degradation;
- understand fully how land degradation processes operate under specific local conditions.

When filling in questionnaires, respondents should take care to:

- complete them in close consultation with other experts;
- undertake field verification and discussions with land users;
- provide detailed descriptions specific to the technology being documented, rather than generalized descriptions that could apply to similar technologies;
- give adequate details of the technical specifications that explain how a technology performs;
- differentiate between the characteristics of the wider area in which the users of a technology operate and those of the specific sites where the technology has been adopted;
- provide detailed cost breakdowns, as omitting key cost elements leads to underestimated actual costs;
- use secondary data from project documents and technical manuals to document and check technical specifications and the costs and benefits of particular technologies and approaches.

INTERNET RESOURCES

Further information on WOCAT services, research tools and achievements can be found at www.wocat.net.

FURTHER READING

Douglas, M.G. 2003. Improving WOCAT data quality – some observations and suggestions. In *Proceedings of the Eighth International Annual Workshop and Steering Meeting (WWSM8), 4 to 8 November 2003, Kathmandu.* Berne, Switzerland, Centre for Development and Environment, Institute of Geography, University of Berne.

Liniger, H.P. & Schwilch, G. 2002. Better decision-making based on local knowledge – WOCAT method for sustainable soil and water management. *Mountain Research and Development Journal*, 22(1).

Liniger, H.P., van Lynden, G.W.J. & Schwilch, G. 2002. Documenting field knowledge for better land management decisions – experiences with WOCAT tools in local, national and global programs. In *Proceedings of ISCO Conference 2002, Vol. I*, pp. 259–167. Beijing.

Liniger, H.P., Cahill, D., Thomas, D.B., van Lynden, G.W.J. & Schwilch, G. 2002. Categorisation of SWC technologies and approaches – a global need? In *Proceedings of ISCO Conference 2002, Vol. III*, pp. 6–12. Beijing.

Van Lynden, G.W.J., Liniger, H.P. & Schwilch, G. 2002. The WOCAT map methodology, a standardised tool for mapping degradation and conservation. In *Proceedings of ISCO Conference 2002, Vol. IV*, pp. 11–16. Beijing.

WOCAT. 2003a. *Questionnaire on SWC technologies. A framework for the evaluation of soil and water conservation (revised).* Berne, Switzerland, Centre for Development and Environment, Institute of Geography, University of Berne.

WOCAT. 2003b. *Questionnaire on SWC approaches. A framework for the evaluation of soil and water conservation (revised).* Berne, Switzerland, Centre for Development and Environment, Institute of Geography, University of Berne.

WOCAT. 2003c. *Questionnaire on the SWC map. A framework for the evaluation of soil and water conservation.* Berne, Switzerland, Centre for Development and Environment, Institute of Geography, University of Berne.

Action research

WHAT IS ACTION RESEARCH?

Action research is a process aimed at generating and sharing the knowledge needed to understand development problems and identify socially acceptable solutions. Action research is driven by a pluralist group of participants, usually comprised of people who are directly affected by the problem (i.e., local actors), technical experts and a facilitator (often a social scientist). Local actors provide their real-life, everyday experience of the problem, including their strategies for taking advantage of opportunities and minimizing threats. Professional researchers provide scientific advice and technical expertise for possible improvements. Facilitators support communication among participants, systematize progress and disseminate action research findings and recommendations among decision-makers and the public.

THE FEATURES OF ACTION RESEARCH

The main features of action research are:

- the involvement of both lay people and professional researchers;
- a focus on identifying the best combination of experts' and lay people's views of the problem at stake;
- a functional link to a social change process, such as a collaborative watershed management programme;
- the direct feeding of research results into planning and action, with minimum time gaps between data collection, analysis and use;
- built-in awareness raising and adult education.

ACTION RESEARCH AND PRA

Action research has been applied to deal with a variety of educational and social service problems worldwide since the 1930s. In the 1990s, the participatory rural appraisal (PRA) movement made action research popular with development organizations, which have used it in many natural resource and watershed management projects over the last 15 years. Although PRA and action research have much in common, action research is a deeper and more analytical approach, based on merging local and scientific knowledge into a social learning process. Unlike much current "quick-and-dirty" PRA practice, action research is generally a relatively in-depth and long-term process.

HOW CAN ACTION RESEARCH BE USEFUL FOR COLLABORATIVE WATERSHED MANAGEMENT?

Action research can support collaborative watershed management by providing relevant and ready-to-use information for decision-making, and by contributing to process and impact monitoring. Compared with other approaches – conventional research, participatory appraisal, on-farm research, environmental monitoring, etc. – action research has the added value of providing socially validated information that is meaningful to both local stakeholders and scientists.

Common uses for action research in collaborative watershed management include:

- needs assessments and diagnostic studies;
- field testing and validation of improved technology and practices;
- social and environmental impact assessment;
- landscaping;
- design of hydraulic works;
- education and awareness raising processes.

TECHNIQUES AND TOOLS

Action research is based on qualitative social research methods, including participant observation, interviews and facilitated group discussions. Within this framework, action research facilitators use PRA group work tools, such as transect walks, participatory mapping, ranking exercises and life histories, to elicit local actors' views and opinions and to generate working hypotheses.

Quantitative research techniques such as questionnaire surveys, GIS-based analysis, erosion and runoff measurements and economic valuations are used in the action research process to validate working group hypotheses. Many of the methods for collaborative watershed management that are presented in this annex can be incorporated into action research.

In order to involve lay people in the interpretation of research findings, interactive analytical tools (e.g., problem and objective trees, future scenario imaging, and strengths, weaknesses, opportunities and threats [SWOT] analysis) are used in group work to facilitate the formulation of conclusions and recommendations.

CONDITIONS FOR SUCCESS

Action research is a sensitive social process. Its success depends on local authorities and stakeholders accepting an action research initiative. Preparatory work should aim to build rapport and trust. Local stakeholders' timing and pace should be respected and "managerial" behaviour avoided. In-kind incentives, such as transport, meals, hosting and personalized technical assistance, can be offered to local action research participants as a (partial) compensation for their time and commitment.

Action research needs very good facilitation to succeed. Facilitators should be (and be perceived to be) relatively neutral actors with no vested interest in the issues at stake. This is easier to achieve when facilitation is entrusted to an external professional, but a good facilitator must also be sensitive to local culture and society. Many applied social scientists with experience in PRA and other participatory research methods have the basic skills needed to manage an action research process to support collaborative watershed management.

COSTS AND TIMING

The costs of action research include the salaries of facilitators and scientific advisers, incentives for local stakeholders, and transport and logistic costs. The total cost depends on the objective of the action research exercise and the time needed to achieve it; small, focused action research exercises can be completed in six weeks. As shown in the following example, an action research needs assessment at the sub-watershed level can be completed in four months. Action research is best used as a long-term process, however, paralleling collaborative watershed management initiatives on a continued basis.

A PRACTICAL EXAMPLE: DIAGNOSTIC ACTION RESEARCH IN SAN CARLOS SUB-WATERSHED, BOLIVIA

The following description of watershed planning in Bolivia in 2000 illustrates how action research can contribute to collaborative watershed management. The project was carried out within the framework of FAO's Inter-Regional Project for Participatory Upland Conservation and Development (PUCD).

The San Carlos sub-watershed covers 31 km^2 of the Piraí River basin. It lies in the municipality of El Torno, about 30 km from Santa Cruz de la Sierra, one of Bolivia's most dynamic towns. It has a population of 800 people, half of whom are subsistence farmers. Colonists and the beneficiaries of agrarian reform have been settling in this rural area since the 1950s. Land clearing for crops and rangeland caused forest cover to decrease from 72 percent in 1967 to 39 percent in 1997. The impact of this on runoff

has been exacerbated by the construction of roads and trails and by oil exploration and exploitation (which is also a major source of pollution). Since the late 1980s, the San Carlos torrent has been unpredictable. Every year, sudden spates and landslides during the rainy season damage downstream infrastructure and property, while local farmers experience increasingly severe drought during the dry season.

In 1999, the territorial management plan of El Torno municipality made controlling the San Carlos torrent's hydrological regime a priority. The mayor requested technical assistance from the Piraí River Watershed Service and the PUCD project. A field visit to the area suggested that local farming and forestry practices were the causes of hydrological imbalances in the watershed. Conversations with farmers, however, suggested that these practices should be viewed in the context of evolving local livelihood strategies and external interests in watershed resources – oil, speculation on peri-urban lands and trends in the Santa Cruz food market.

A three-month action research process was launched to study the linkages among these factors. This exercise involved the PUCD project facilitation team, senior municipal staff and selected representatives of village-level grassroots organizations. Experts in forestry, land and soil science, and agriculture from the International Centre for Tropical Agriculture (CIAT) and the University René Gabriel Moreno (Santa Cruz) were also involved.

The action research team focused on five complementary subjects:

- population dynamics, with particular attention to in- and out-migration flows;
- land cover, i.e., the spatial distribution of natural and human-made vegetal formations (forests, rangeland, agricultural land, etc.) and how it changes over time;
- livelihood strategies, i.e., the way in which people from different social strata gain a living (including on-farm, off-farm and non-farm activities);
- social stratification, i.e., differences in wealth, status and ethnicity among local social groups;
- political linkages, i.e., the relationships among farmers, village-level organizations, the municipality and departmental/national institutions.

Analysis of the historical interplays among these factors identified the socio-economic factors that underlie environmental degradation in San Carlos and the issues on which the new watershed management plan should focus.

The following research activities were conducted:

- analysis of demographic trends, based on available census data;
- multi-stakeholder discussions of watershed land cover and soil use maps (generated by GIS) for 1967, 1987 and 1997;
- individual life history interviews with key informants, focusing on the evolution of land use in San Carlos over the last 30 years;
- group interviews with members of grassroots organizations to elicit their perceptions of differences in social conditions and livelihood strategies in San Carlos;
- in-depth analysis of a small sample of households, selected as examples of the major livelihood strategies identified in group interviews.

The following were the main findings of the action research:

- The immediate cause of torrents and landslides in San Carlos is the deforestation of critical areas such as hilltops, very steep slopes and river shores (7 percent of the total area). As these areas have marginal importance to local livelihoods, the action research group agreed that a stricter forest conservation regime must be established by the municipality and enforced through legal and social fencing means.
- Earth movements related to oil operations and the construction of large houses and access roads on the hillside were confirmed as additional (but relatively self-contained and localized) causes of the watershed's hydrological imbalance. It was recommended that the municipality's territorial management plan include a soil movement monitoring and supervision service, capable of preventing abuses.

- The most important cause of hydrological imbalance was found to be removal of the forest, agroforestry and sugar cane cover that had survived on medium-steep hillsides until the 1980s. This change occurred between 1987 and 1997 and was driven by several demographic and livelihood trends, including: pest and disease epidemics affecting fruit trees; a drop in the sugar cane price on Santa Cruz market; the loss of household labour as young people out-migrated to town; the subsequent conversion of many farms to extensive cattle ranches; and the parallel shift of landless workers from agricultural wage labour to charcoal production (promoted by farmers who wanted to convert forest and agroforestry land to rangeland).

The action research team concluded that the best way of addressing the environmental situation in San Carlos was to create new sustainable livelihood opportunities for farmers and local landless workers. Fruit and vegetable production, medium-scale poultry raising, the introduction of milk cow breeds and the development of a cooperative dairy were identified as the most promising alternatives for raising farmers' incomes and creating job opportunities for the landless. Refrigerator plants and the industrial three-phase power these require were identified as the basic infrastructure needed to implement these changes.

The action research team recommended that the municipality of El Torno address the problem of torrent spates from a multi-sectoral perspective. The municipality environmental office should issue clear regulations to protect critical areas and decrease the environmental impact of roads, buildings and oil infrastructure. The local police should be trained to monitor major earth movements and motivated to report and fine abuses. The rural development office should promote linkages between local farmers and organizations that offer technical assistance and credit for agroforestry, milk livestock rearing, poultry and greenhouse vegetable production. The infrastructure office should negotiate with the power supply company for an extension of the three-phase power line. The financial office should commit the municipality's share of government royalties from oil extraction to supporting these and other collaborative management activities in the watershed.

INTERNET RESOURCES

Participatory Action Research Network
www.bath.ac.uk/carpp

Action Research on the Web
www.beta.open.k12.or.us/dennis/arowhelp/index.htlm

Community Action Research Network (University of New Anglia, United Kingdom)
www.uea.ac.uk/care/carm

FURTHER READING

Stringer, E.T. 1999. *Action research.* (Second Edition). London and New Delhi, Sage Publications.
A comprehensive step-by-step handbook for designing action research exercises.

Barton. T., Borrini-Feyerabend, G., de Sherbinin, A. & Warren, P. 1997. *Our people, our resources. Supporting rural communities in participatory action research on population dynamics and the local environment.* Issues in Social Policy Series, Gland, Switzerland, IUCN, Social Policy Service.
A field handbook for non-specialists, focusing on the interplay between population dynamics and natural resources.

Warren, P. 2000. *Ordenamiento territorial municipal. Una experiencia en el Departamento de Santa Cruz, Bolivia.* Field Report No. 6. In collaboration with P. Groppo, R. Roca Steverlyinck, J. Escobedo Urquizo and A. Rojas Guzmán. Rome, FAO, GCP/INT/542/ITA Coordination Unit.
The case study from which the example in this note was taken.

Livelihoods analysis

SUSTAINABLE LIVELIHOOD APPROACHES AND LIVELIHOODS ANALYSIS

Sustainable livelihood approaches (SLAs) put people at the centre of the development process and its objectives, scope and priorities. Livelihoods thinking started in the mid-1980s, since when a number of development agencies have adopted SLAs in their poverty reduction policies and programmes.

Over the last decade, the word "livelihood" has been used in many different ways. According to Chambers and Conway (1991) "a livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living". Livelihoods analysis is therefore primarily for understanding how people make a living in a particular context. In most societies, households are the basic productive (and reproductive) social units, so the structure, functioning and change of household economics are the primary subjects of livelihoods analysis.

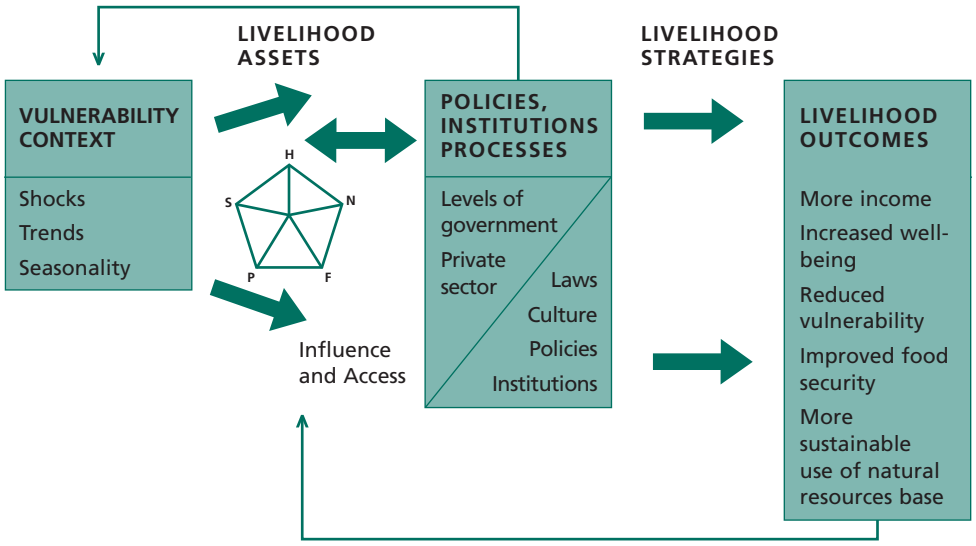
THE LIVELIHOOD ANALYTICAL FRAMEWORK

Many livelihoods analysis exercises address household economics through the analytical framework presented in Figure A2.

The following are the main components of the livelihood framework:

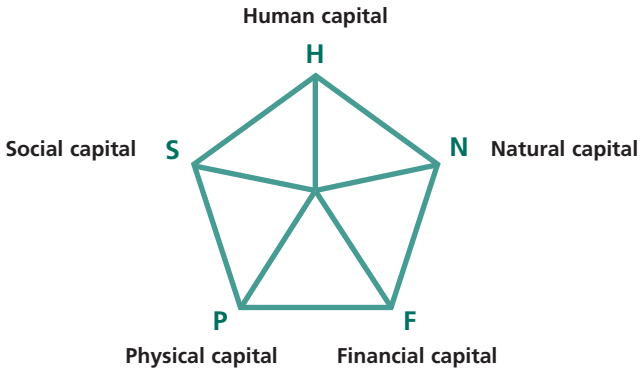
- *Capital (or livelihood) assets* (the pentagon on the left side of the framework; see also Figure A3) are the mix of endowments on which a household relies for its living. Capital assets can be *natural* (land, planting materials, water availability, etc.), *physical* (housing, agricultural equipment and tools, infrastructure, etc.), *human* (the working capability of household members, education, agricultural expertise, access to extension and technical assistance, etc.), *social* (interhousehold cooperation and safety networks, cooperatives, associations, etc.) or *financial* (income, credit, subsidies, etc.).
- *The vulnerability context* (the rectangle on the extreme left of Figure A2) consists of the natural and social factors that influence the ways in which households obtain and use their assets. These include exposure to natural, economic and political risk factors and shocks (loss of soil fertility, drought, floods, disease, inflation, wars, etc.).
- *Policies, institutions and processes* (the central rectangle in Figure A2) include all the socio-political factors and actors that aim to offer the household better opportunities to make a living.
- *Livelihood strategies* (the linking arrow between the left and right blocks of Figure A2) are the mix of productive (and reproductive) activities that household members undertake to make a living. Livelihood strategies tend to optimize the use of household capital assets, in the light of risks and constraints posed by the vulnerability context, and opportunities made available by policies, institutions and processes.
- *Livelihood outcomes* (the block on the right of Figure A2) are both the productive and reproductive objectives a household aims at, and the actual results it achieves via its livelihood strategy. Livelihood outcomes can be secure (when immediate household needs are satisfied) or insecure (when the household is affected by poverty, disease or misfortune). They can also be sustainable (when current outcomes do not decrease household endowments) or unsustainable (when making a living in the present is at the expenses of future performance and outcomes).

FIGURE A2
Sustainable livelihood analytical framework



KEY: H = human capital, N = natural capital, F = financial capital, P = physical capital, S = social capital

FIGURE A3
The capital (or livelihood) assets pentagon



HOW CAN LIVELIHOODS ANALYSIS BE USED IN COLLABORATIVE WATERSHED MANAGEMENT?

Livelihoods analysis can help to clarify the role of local livelihoods in the human ecology of a watershed. For instance, findings from livelihoods analysis can help watershed managers to:

- identify and assess (*ex-ante* and *ex-post*) the impact of watershed management measures on local livelihoods;
- identify interventions and physical works that may promote more secure and sustainable livelihood strategies and outcomes, and include them in watershed plans;
- identify and address those environmental risks and trends that are particularly critical for local livelihoods;
- promote more sustainable use of household natural capital endowments and other watershed natural resources.

Livelihoods analysis can be useful at all stages of the collaborative watershed management process. At the beginning, it can help ensure that local people's points of view, needs, problems, expectations and capabilities (including their knowledge of natural resource management) are considered in the identification and design of collaborative watershed management activities. During implementation or at the end of a particular phase of the process, livelihoods analysis can help to assess the changes that collaborative watershed management are promoting in household economies, society and culture.

METHODS, TECHNIQUES AND TOOLS

Livelihoods analysis is usually undertaken as an action research exercise (see previous section), in which members of the concerned group collaborate with technical experts (agronomists, soil and water scientists, foresters, economists, social scientists, etc.) with the support of a facilitator. In some regional studies, an "extractive" version of livelihoods analysis forms part of a research exercise aimed primarily at providing information for decision-makers; this approach, however, does not fit very well with the inspiration and philosophy of collaborative watershed management and SLAs.

Most livelihoods analysis exercises are fed by information obtained from a mix of quantitative and qualitative research methods, including:

- reviews of secondary (already existing) data;
- analysis of selected environmental and social indicators;
- sample surveys;
- in-depth interviews;
- interactive PRA exercises;
- benefit–cost analysis of the livelihood strategies or activities at stake;
- market research;
- analysis of the policy and institutional context.

The particular mix of research methods to be adopted in a livelihoods analysis exercise is identified during the initial design stage, according to the objectives, scope and focus of the exercise.

CONDITIONS FOR SUCCESS

Livelihoods are complex and multidimensional, so livelihoods analysis should be carried out by an interdisciplinary team including a social scientist, an economist, an expert in natural resource management and, depending on the focus and scope of the exercise, other experts. For instance, if education or health are key vulnerability factors in the local context, an expert in adult education or public health should also be incorporated in the team.

As it is expensive to hire a full team of livelihood analysts, a social scientist is often contracted as the full-time coordinator and facilitator, while other team members are involved on a part-time basis, taking maximum advantage of the human resources already available within the programme area. The ideal coordinator/facilitator for livelihoods analysis in collaborative watershed management processes is an applied sociologist or anthropologist, with previous experience of the local socio-cultural setting and a threefold background in livelihoods analysis, human ecology and action research facilitation.

COSTS AND TIMING

A comprehensive and detailed livelihoods analysis can be expensive and time-consuming. Narrowing the scope of the exercise to critical social groups and issues of special relevance to the collaborative watershed management process makes it possible to conduct a "fairly quick and fairly clean" livelihoods analysis in a relatively short time, at a relatively low cost. For instance, in 2004, FAO's Special Programme for Food Security analysed the livelihood impacts of project-promoted best practices in four weeks, with US$15 000 (including remuneration and travel for an international consultant).

A REAL-LIFE EXAMPLE: THE LIVELIHOOD IMPACTS OF INDIAN WATERSHED MANAGEMENT PROGRAMMES

A study of the livelihood impacts of watershed development (WSD) programmes carried out in India during the 1990s (Turton, 2000) provides examples of the information generated by livelihoods analysis, and its relevance to watershed management.

During the 1990s, Indian rural development policies increasingly decentralized the responsibility for natural resources management to the community level. At the end of the 1990s, micro-watershed development was attracting more than US$450 million of central government funding a year, for numerous projects implemented by NGOs.

Watershed management in India has evolved since the 1970s and early 1980s, when it was based on biophysical criteria. In the late 1980s, this changed to an emphasis on WSD. The Ministry of Rural Areas and Employment issued WSD guidelines, which covered productive, social, ecological/environmental and equity objectives.

In the late 1990s, livelihoods analysis was used to study the impact of WSD on rural livelihoods, focusing on the extent to which WSD activities result in new livelihood opportunities and the degrees to which these opportunities are equitably distributed and sustainable.

The study found that WSD's potential impact on household *assets* had increased as WSD approaches evolved from externally imposed biophysical interventions towards greater participation and a broader range of activities. This affected all five asset types in the sustainable livelihood framework, but benefits were not always evenly distributed. For example, WSD-promoted soil and water management works (physical assets) benefited better-off landholders disproportionately, because they were able to take advantage of the enhanced availability of natural capital assets.

A particular concern of the study was poorer groups' access to common pool resources (CPRs). WSD projects established rules of access to CPRs and collaborative agreements for their community management, but the study questioned the extent to which the poor retained access to CPRs after these interventions, and the extent to which short-term losses of access to CPRs were outweighed by longer-term gains.

In terms of *livelihood strategies,* WSD initiatives opened up new opportunities by supporting agricultural intensification processes. New labour opportunities were created by increased crop intensity and, particularly, changes in the livestock sector, where restricted access to CPRs encouraged more stall-feeding of both large and small ruminants. The intensification strategies also had important intrahousehold implications, however: while men usually appropriated the gains from increased production of cash crops such as sugar cane and cotton, women bore most of the increased workload.

WSD initiatives also provided new opportunities for households to diversify their livelihood strategies. NGO projects promoted diversification through self-help groups for women, the landless and other marginal groups, with activities ranging from traditional crafts (leaf plate making, weaving, basket making, etc.) to mushroom cultivation and forestry activities. These products generally have inelastic demand, however, so their scope for increasing incomes was limited.

The study also assessed the compatibility of WSD with existing livelihood strategies. In India, migration is one of the most important means of diversifying rural livelihoods for the poor. WSD initiatives that involved new institutions such as watershed committees therefore ended up excluding many of the poorest people, who had migrated and were absent from their villages.

Overall, the study concluded that watershed-based approaches have led to improvements in rural livelihoods. They should not be considered as a panacea, however: the productivity gains of pilot projects have been less extensive at the wider scale, and links between productivity gains and livelihoods are complex and poorly

understood. Of most concern was the fact that productivity gains can work against the livelihood strategies of certain groups, particularly the poor. The greatest challenge seems to be in achieving distributional equity between the poor and the better-off and between men and women. This requires careful and continuous vigilance.

From a methodological point of view, the study demonstrated that a livelihoods perspective can promote more explicit analysis of the ways in which watershed management directly and indirectly affects people's lives. It encourages broader and more structured assessment of the impacts relevant to local people. This can help practitioners and decision-makers to adjust their approaches and enhance the socio-economic impacts of watershed management activities, although these may be incremental and subject to other sectoral goals.

INTERNET RESOURCES ON SLAs AND LIVELIHOODS ANALYSIS

A comprehensive site with a research engine dedicated to livelihood approaches and many downloadable papers and materials is at: www.livelihoods.org.

The following FAO/DFID Livelihoods Support Programme (LSP) working papers and briefing notes on livelihoods and natural resource management are downloadable from: www.fao.org/sd/dim_pe4/pe4_040501a_en.htm.

Baumann, P. 2002. *Improving access to natural resources for the rural poor: a critical analysis of central concepts and emerging trends from a sustainable livelihoods perspective.* FAO, LSP WP 1, Access to Natural Resources Sub-Programme. Rome, FAO.

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System-Wide Programme for Collective Action and Property Rights (CAPRi)

WHAT IS CAPRi?

The System-Wide Programme for Collective Action and Property Rights (CAPRi) is one of several inter-centre initiatives of the Consultative Group on International Agricultural Research (CGIAR). CAPRi examines the formation and effectiveness of voluntary, community-level organizations and property institutions as they relate to natural resource management, particularly the linkages among collective action, property rights, technological change, natural resource management and poverty alleviation. CAPRi addresses these through an interdisciplinary approach that combines insights and methodologies from social and physical scientists, technical experts and practitioners. Through collaboration among CGIAR centres, national research institutions and NGOs, the programme integrates a wide range of knowledge from both academics and practitioners, bringing together the diverse range of researchers necessary to examine the environmental impact of institutional change.

Watersheds are a main focus of CGIAR and CAPRi research. Watersheds connect land units through lateral flows of water, nutrients and sediment, linking farmers, fishers and urban dwellers in intricate cause and effect relationships. Externalities among the people who share a watershed depend on both the biophysical attributes of the watershed and the institutions that shape people's interactions within the watershed.

CAPRi RESEARCH ON COLLECTIVE ACTION AND PROPERTY RIGHTS IN WATERSHED MANAGEMENT

According to the CAPRi approach, many of the critical challenges confronting watershed management – organizing local communities, internalizing environmental externalities, negotiating use rights over resources, and resolving conflicts among stakeholders – are captured by the concepts of collective action and property rights.

Collective action is action that is taken voluntarily by a group, either directly or by an organization acting on its behalf, in pursuit of group members' shared interests. Although it may not be needed when individual, farm-level technologies are being adopted, collective action becomes more necessary when natural resource management addresses larger spatial units, such as watersheds. Collective action involves designing rules and undertaking action, participating in processes and enforcing rules that are perceived as beneficial to the group. Many of its benefits are non-material, but material benefits also influence the emergence of collective action.

CAPRi defines collective action as "the capacity to call on the collective to stand behind one's claim to a benefit stream" (Bromley, 1991). Property rights require institutions or rules to back claims, but these need not be government-backed legal institutions. Entitlements can be defined by cultural norms or customary rights. Property rights need not constitute ownership of a resource, but can instead be a bundle of rights, including access to a resource (e.g., the right to enter a farmer's field) or withdrawal of benefits from a particular resource (e.g., water from a stream or fruit from trees). There are also rights to control, exclude and manage a resource, part of

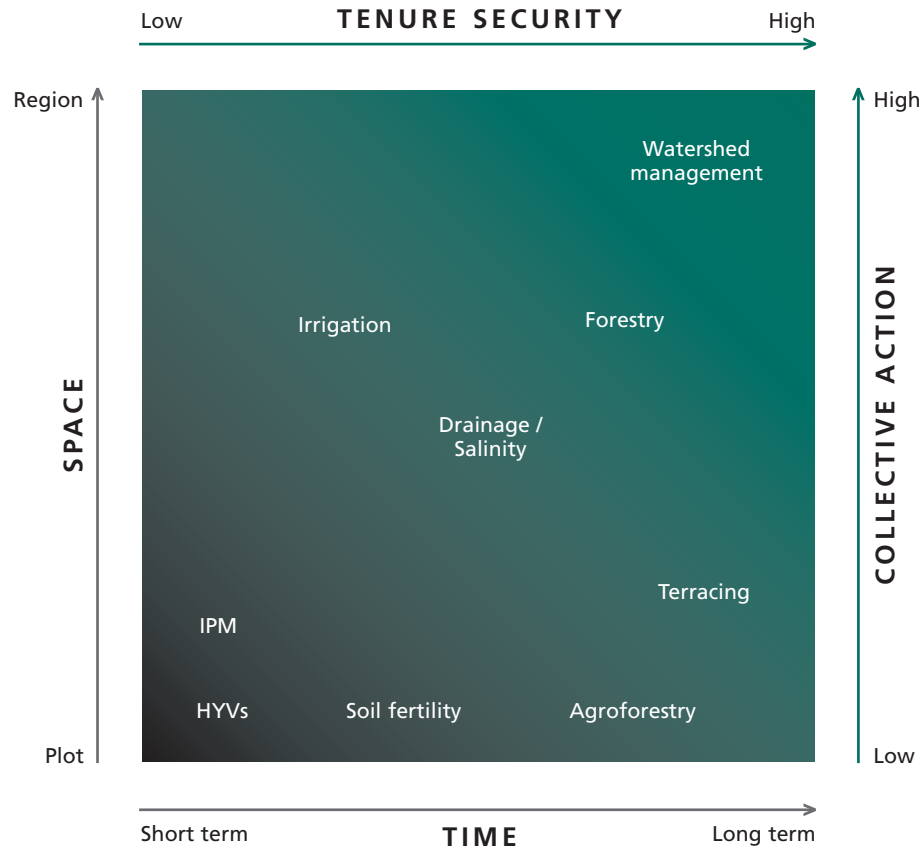
a resource or multiple resources (Schlager and Ostrom, 1992). As well as their spatial characteristics, natural resources also embody temporal features that affect production and management. Whereas some economic activities involving natural resources produce returns in a short period, others do so over a long period. Property rights that offer security of tenure are important incentives for investing in natural resource management technologies that generate returns over a longer period. Many watershed management activities fall into this category (Figure A4).

GOAL AND OBJECTIVES OF THE CAPRi PROGRAMME

The CAPRi programme contributes to policies and practices that alleviate rural poverty by analysing and disseminating knowledge on the ways that collective action and property rights institutions influence the efficiency, equity and sustainability of natural resource use. Its specific objectives include:

- increasing knowledge of the emergence and performance of voluntary, self-governing and self-adapting community organizations and property institutions for natural resource management;
- identifying the positive and negative features of different types of institution in different resource and socio-economic conditions, and comparing the effects of different property institutions across different resources and regions;

FIGURE A4
Collective action and tenure security in watershed management



- identifying concrete policy instruments to facilitate and encourage the formation, improved functioning, resilience and spontaneous evolution of users' organizations and property institutions that assure optimal resource use;
- promoting partnerships among local organizations, States, civil society and private entities, to limit the duplication of efforts to achieve these goals;
- strengthening the capacity of national and international research centres, NGOs, universities and local organizations to carry out research on collective action and property rights issues, and forging and strengthening linkages in order to capitalize on the synergies created through collaborative effort.

CAPRi SERVICES FOR NATURAL RESOURCE AND WATERSHED MANAGEMENT PRACTITIONERS

The CAPRi programme sponsors research on collective action and property rights by associated centres and national partners, develops broad conceptual frameworks, sponsors workshops, training and panels on priority research themes, directs face-to-face meetings with researchers and experts, edits books and working papers presenting members' research on collective action and property rights, coordinates an e-mail network for information exchange, and supplies literature reviews, an annotated bibliography and publications.

CAPRi offers research grants and Ph.D. field research fellowships to build the capacities of associated centres to undertake research on collective action and property rights issues, and to strengthen or establish collaboration between CGIAR and a range of partners. Research grants fund innovative empirical research on property rights and collective action issues by associated centres and national partners, while Ph.D. field research fellowships provide students who already have a solid academic background in collective action and property rights theory and methodology with the opportunity of undertaking research in collaboration with a CGIAR project.

Researchers can exchange ideas and feedback on topics of mutual interest via the CAPRi e-mail network, which facilitates greater interaction between academics and practitioners. Discussion topics concern priority themes, and information such as upcoming conferences and relevant literature is posted frequently.

HOW TO JOIN THE CAPRi PROGRAMME

CAPRi services are available to member institutions. Membership includes all the researchers at CGIAR centres and collaborating institutions who are involved in property rights and/or collective action research. All members and other interested researchers or policy-makers can join the CAPRi e-mail list by sending a request to: capri@cgiar.org.

INTERNET RESOURCES

Most CAPRi materials can be downloaded from: www.capri.cgiar.org.

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Negotiation and mediation techniques for natural resource conflict management

THE FAO/DFID GUIDE TO NATURAL RESOURCE CONFLICT MANAGEMENT

Negotiation and consensus building on natural resource issues is a key element of collaborative watershed management. The FAO/DFID Livelihoods Support Programme (LSP) has recently issued a guide that provides step-by-step advice on working with many different stakeholders to reach mutually satisfactory agreements in collaborative natural resources management. It offers practical guidance on how to establish and manage a process of consensual negotiation in collaborative natural resource management and other livelihood projects involving multiple stakeholders.

NEGOTIATION AND CONSENSUS

The guide focuses on two key concepts: negotiation and consensus. When people talk with one another in an effort to resolve their opposing interests, they are *negotiating.* Some negotiations are simple and some complex. Those who are involved in a negotiation are called the parties; a negotiation can involve two parties (e.g., two individuals or groups negotiating land use, control over woodland or devices used for fishing) negotiating for themselves or representing others, or it can involve multiple parties. In some negotiations, the parties in dispute are so entangled in their differences that they are no longer able to find any constructive solution by themselves. In such cases, a third party facilitator or mediator might be able to help. The role of the facilitator/mediator is to assist individuals and groups in negotiating and reaching agreement successfully.

The other key concept is *consensus.* Consensus does not mean that everyone gets what they want or that there is a unanimous decision about an agreement, nor does it imply voting to obtain a majority. Consensus means that all parties feel that their interests have been addressed and that they can live with the agreement – they may have wanted a bit more here or a bit less there, but they can accept the outcome of the negotiation. The purpose of consensual negotiations is to achieve the best possible outcome for the most people, or at least an outcome that everyone can accept. Consensus building is a critical characteristic of collaborative natural resource management when many different stakeholders, such as the State, communities, NGOs and the private sector, have to negotiate how best to share the management, entitlements and responsibilities arising from particular natural resources, such as a forest, a river, the sea coast or grazing land.

CONFLICT AND CONFLICT MANAGEMENT

Many successful collaborative arrangements have developed from consensus solutions to long-standing conflicts over natural resources. Such conflicts originate in differing interests concerning the use of natural resources and/or power imbalances among stakeholders. Most natural resource conflicts are rooted in competition among individuals and groups over material goods, economic benefits, property and power. When conflicting parties feel that their needs cannot be met, or perceive that their values, needs or interests are being threatened, it may become necessary to intervene; some form of conflict management may be needed to avoid escalation into destructive and violent conflict. Anticipating and managing conflict are therefore critical ingredients

of collaborative natural resources management. The challenge is to manage conflicts so that the advantages they bring can be maintained (e.g., opportunities to understand other people's views, expand livelihood options or create change and development), while the disadvantages are reduced or mitigated (e.g., extreme disruption, lack of development or even violence). The aims of conflict management are to:

- identify latent conflict and address it constructively;
- prevent existing conflict from escalating;
- make use of conflict in promoting positive social change.

HOW THE FAO/DFID GUIDE CAN BE USEFUL FOR COLLABORATIVE WATERSHED MANAGEMENT

The FAO/DFID guide focuses on conflict situations where a third party (mediator) assists so that consensual negotiations can take place and work effectively. This is a common situation in collaborative watershed management. As it is important to choose an appropriate strategy for addressing a particular conflict, the guide introduces and discusses some of the advantages and disadvantages of a range of conflict management approaches (legal, customary, etc.), to help watershed managers and other practitioners assess which may best suit the specific situation. In particular, it makes suggestions and recommendations for:

- facilitating negotiations and agreement among individuals, groups or institutions that believe they have incompatible objectives;
- broadening people's understanding of their own and others' interests and needs;
- encouraging people to think beyond their own often entrenched and emotional positions.

Table A1 presents a number of tools that may aid stakeholders in conflict analysis.

HOW TO USE THE GUIDE

The guide explains how to establish and manage a negotiation process. The suggested *process map* is subdivided into ten steps, and is not a rigid blueprint; the actual process is not linear, but moves forwards and backwards as needs and capacities change. This requires flexible handling of the steps according to how the process develops. Conflict management is a shared learning process. Users of the guide are encouraged to adopt a learning approach by testing and adapting different techniques and strategies. Managing conflict is a process of analysis, action and – above all – reflection.

TABLE A1
Conflict analysis tools from the FAO/DFID guide

Tool	Purpose
Root cause analysis	To help stakeholders examine the origin and underlying causes of conflict
Issue analysis	To examine the issues that contribute to conflict, focusing on five categories: problems with information, conflicting interests, difficult relationships, structural inequalities, and conflicting values
Stakeholder identification and analysis	To identify and assess the dependency and power of different stakeholders in a conflict
Analysis of the "4Rs": rights, responsibilities, returns and relationships	To examine the rights, responsibilities and benefits of different stakeholders in relation to natural resources, as part of improving understanding of a conflict To examine the relationships among or within different stakeholder groups
Conflict time line	To assist stakeholders in examining the history of a conflict and to improve their understanding of the sequence of events that led to the conflict
Mapping conflict over resource use	To show geographically where land or resource use conflicts exist or may exist in the future To determine the primary issues of conflict

CONDITIONS FOR SUCCESSFUL USE

Consensual negotiations are more effective in addressing some types of conflicts than others. For example, conflicts arising from differing interests concerning resource use are negotiable, whereas basic needs, such as identity, security, recognition or equal participation within the society, are usually non-negotiable. Negotiation techniques are therefore less useful in resolving underlying structural tensions and identity conflicts than they are in resolving disputes over declining resource availability. Because underlying structural tensions often operate at the regional or national level (competing or overlapping legal orders, real or perceived inequalities inherent in the wider socio-economic or political system, etc.), managing them tends to involve measures such as policy reform, structural adjustments, democratization and/or international conventions or protocols.

The successful use of consensual negotiation is limited by two additional factors:

- the intractable nature of some environmental conflicts (nothing that anyone does seems to improve the situation); for example, in some instances, conflicts cannot be resolved in win–win ways – resource availability may be limited, and increasing the resource use of one party may mean less resource being available for another;
- major differences in power among the people, groups and agencies involved, e.g., a local community, local NGOs, government agencies, a multinational company; consensus building is based on the premise that power imbalances among the different parties are not so substantial that a third party cannot bridge them in the negotiation process.

NEGOTIATION AND MEDIATION TECHNIQUES IN ACTION: THE DIVERSION OF BOSOKE RIVER IN THE AMANSURI WETLAND, GHANA

The local context

The Amansuri wetland lies on the western coastline of Ghana, within the eastern and western Nzema traditional areas and the East Nzema and Jomoro districts. It is about 360 km west of Accra, and its closest large urban centres are Axim and Half-Assini. It has an equatorial monsoon climate, and lies within the wet evergreen forest zone. The wetland and its catchments cover more than 1 000 km² and consist of ten sub-catchments ranging from 18 to more than 140 km² each. The region forms the watershed for Amansuri Lake and includes the drainage areas for several rivers and the coastal floodplain north of Beyin. The wetland itself covers more than 100 km², including small areas of open water (Amansuri Lake). The region's coastal lagoon is a Ramsar Wetland of International Importance.

The original inhabitants of the conflict area are Nzemas, but Fantes and Ewes fishers have settled in some coastal communities. In the western Nzema traditional area, family heads own the lands under several different landholding systems, but the paramount chief has final authority on land issues. The 18 communities bordering the wetland depend heavily on its resources for their livelihoods (fishing, palm wine, farming, agroprocessing and general trading).

The Ghana Wildlife Society (GWS), an NGO, is implementing the Amansuri Conservation Integrated Development (ACID) Project, in partnership with the Western Nzema Traditional Council, in the western Nzema traditional area's portion of the Amansuri wetland. The project's ultimate aim is to conserve the wetland system so that ecological functions and scenery are maintained, alongside low-impact resource use based on the principles of sustainable management.

The conflict

Two major and three minor rivers drain into Amansuri Lake. The Bosoke is the largest of these and serves as the shortest access route from Old Nzulezo to communities within the wetland such as Gyamozo and New Nzulezo. The people of Old Nzulezo

use the river as a route to their farms and palm wine tapping and alcohol distilling areas. Between late 2001 and early 2002, the people of Gyamozo diverted part of the Bosoke river through a natural channel so as to avoid having to wade through the swamps. This drastically reduced the volume of water flowing into Amansuri Lake.

In March 2002, the people of Nzulezo, who were the most affected by the river diversion, informed the people of Gyamozo of its effects and asked them to restore the river to its original course. Nothing was done, so the elders of Nzulezo reported the case to the ACID Project Management Committee (PMC), which did not take action either. The people of Nzulezo then issued threats and ultimatums to the people of Gyamozo, insisting that they redivert the Bosoke. In August 2002, the PMC reported the case to Jomoro District Assembly (JDA), in whose administration the conflict area falls. Existing by-laws prevent the diversion of natural watercourses without authorization, but even after several attempts, JDA could not resolve the issue. In January 2003, quarrels and violence between people from the two villages started to break out over the most minor issues. Some people from Old Nzulezo said that "if the assembly cannot solve the problem, we will solve it in our own way" (meaning by force).

Stakeholder analysis

It was at this point that an ACID staff member suggested using a collaborative approach to resolve the conflict. ACID staff members assumed the role of mediators in an internal meeting to assess the current situation in the area. They determined who the stakeholders were (Table A2) and planned a strategy for entering the conflict setting, including whom to contact first.

Root cause analysis

Subsequently, the mediators invited people to conduct a root cause analysis in Old Nzulezo. Two opinions emerged as potential reasons for people in Gyamozo to divert the river: (1) to secure access in times of flooding; and (2) to destroy the palm wine that some people from Old Nzulezo obtained from nearby forests. To make sense of these views, the mediators conducted an analysis of the effects of diversion on stakeholder livelihoods and interests (Table A3).

Negotiation of a win–win solution

The mediators presented their preliminary findings at a public meeting in Old Nzulezo. The initial response from villagers was that Gyamozo should redivert the river and should be punished for having diverted it in the first place. After the analysis, the villagers realized that sticking to this position would not help them. At the end of the meeting, the people of Nzulezo softened their position and suggested that the only way of moving forward to resolve the conflict was to ask the elders of New Nzulezo (who had good relations with Gyamozo) to convince Gyamozo villagers to attend a negotiation meeting.

TABLE A2
Stakeholders involved in the conflict

Primary stakeholders	Secondary stakeholders	Interested parties
Old Nzulezo	GWS	Miegyinla
New Nzulezo	JDA	Ngelekazo
Gyamozo		Ekebaku
Beyin		Ebonloa

The people of Gyamozo had already refused several times to become involved with the mediators, however. The family head of New Nzulezo sent a linguist to the community to invite its members to meet on common ground. Traditionally such an invitation has very strong implications, and three men from Gyamozo attended a meeting. They explained that they wanted access to the road. They presented their case in a moderate way, arguing that access to their village was extremely difficult during the rainy season.

The mediators asked them whether they were aware of the effects that the river diversion had had on the other communities, and showed them the effects analysis. The people from Gyamozo had not been aware of the severity of these effects. At the following negotiation meeting, the mediators allowed each party to make its statement. Different and sometimes diverging views were expressed, and the mediators invited the parties to consider a solution that was acceptable to both.

People from New Nzulezo argued that the river should be rediverted One person from Gyamozo said: "We have done more harm than good. We did not understand the seriousness of the effects, and we should redivert the water. If there is a funeral in Old Nzulezo, we cannot go because of this issue". This was a turning point in the negotiation process, and other people from Gyamozo agreed. Once general agreement had been reached that rediversion was essential, the family head suggested that the three communities should work together to restore their relationships.

At a subsequent meeting in New Nzulezo, the parties agreed on the procedure to follow – first a footbridge would be constructed so that Gyamozo would remain accessible during the rainy season, and then the water would be redirected. The negotiators acknowledged that the agreement involved costs for materials, a chainsaw operator, fuel and labour, and asked JDA and the ACID project to provide funds for the bridge construction. The agreement is now being drafted, but no development funds have yet been raised, so the parties cannot implement it. In the meantime, the negative effects continue.

TABLE A3
Effects of the river diversion on stakeholders

Stakeholder	Effects
Old Nzulezo	Reduced freshwater fish catches for fishers. Low levels of water in the waterway, affecting transport by boat to farms, palm wine tapping and local gin distilling areas during the dry season. Changed composition of plant species downstream, resulting in fears that the raffia palm for palm wine tapping and building will be displaced.
New Nzulezo	Destruction of some farms. Effects on boat travel from New Nzulezo to Old Nzulezo.
Gyamozo	Creation of water channel to provide easy access to farms, palm wine tapping and local gin distilling areas, and to make it easier to transport produce to the main local markets.
Beyin	Reduced freshwater fish catches in the floodplain.
GWS	Difficult tour guiding within the wetland during the dry season because of low water levels in the Beyin–Amansuri Lake waterway.
JDA	Reduced income from tourism during the dry season.
Interested parties	Reduced fish supply and reduced income from tourism during the dry season.

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Valuation of environmental services of watershed management

WHAT ARE THE ENVIRONMENTAL SERVICES OF WATERSHEDS?

Watersheds provide human societies with many goods and services, including provision of clean water, erosion control, carbon sequestration, conservation of biodiversity and maintenance of landscape beauty. The value of these is rarely expressed in monetary terms, however, and there are no markets where they can be bought or sold. As the providers of these environmental goods and services do not receive any compensation for providing them, they do not take them into account when making land-use decisions, which may endanger continued provision in the future.

HOW CAN VALUATION BE USEFUL FOR COLLABORATIVE WATERSHED MANAGEMENT?

The economic valuation of environmental services from watersheds makes the value of the services transparent by expressing it in monetary terms that can easily be compared with other values. Both the production and the use of a service can be valued.

The economic valuation of environmental goods and services can be useful in raising awareness about public goods whose supply people generally take for granted. It can help set priorities for the activities of watershed management programmes. Valuation is an important basis for establishing payment schemes for environmental services in watersheds, which may improve the distribution of benefits and costs among upstream and downstream water users in a watershed context.

There are numerous ways of deriving the monetary values of environmental services. The following paragraphs give a brief overview of common methods for estimating the supply of and demand for environmental services.

VALUATION OF THE SUPPLY OF ENVIRONMENTAL SERVICES

Many valuation studies are based on *opportunity cost* estimations. The opportunity cost refers to the income that a service provider could earn from productive activities that are to be avoided or transformed in order to provide environmental services. This value indicates the approximate amount of compensation required to provide an effective incentive for changing or maintaining a soil use. The opportunity cost can be estimated through surveys among local producers.

Models that estimate the marginal change in service provision associated with a land-use change are also useful for estimating the actual supply of environmental services.

VALUATION OF THE DEMAND OF ENVIRONMENTAL SERVICES

Most valuation studies use the *contingent valuation method*. This analyses beneficiaries' willingness to pay for a given service, and their perception of the values of the environmental services they use. The availability of information, and other social and economic factors such as strategic bias among participants, may influence the results of this method.

Another common direct method is the *cost avoided method*, which compares the cost of maintaining the flow of an environmental service with the cost of an alternative engineering solution, such as a water treatment plant.

Indirect methods estimate the economic value of an environmental service as an input to local economic processes. The *travel cost method* determines the investment that people make to use a particular resource, for example, the time and resources spent to visit a national park. The *hedonic price method* determines the value of an environmental service by comparing the prices of other goods with varying degrees of access to that service. For example, the value of water resources can be determined by comparing the prices of landholdings as a function of their access to water resources. Comparing the prices of properties in a scenic environment with those of properties in less attractive settings determines the value of a landscape.

CONDITIONS FOR SUCCESS

Valuation techniques should only be used when service users and providers are used to attaching monetary values to goods and services. When this is not the case, it may be possible to use valuation techniques, provided that the values are expressed in units that people can relate to, for example, as an equivalent of days worked.

For valuation techniques to work, it is important to have a sound understanding of the biophysical linkages between land use and water resources in the watershed, in order to be clear that a change or preservation of a specific land and water use in the upstream part of a watershed will be beneficial to downstream water users in terms of water availability or quality. As discussed in Chapter 2, the links between land use and water resources are often not well understood. Such understanding is crucial when valuing the supply of water-related services.

In order to achieve realistic results, economists with experience in valuation should conduct the study, design the interviews, etc. It is also important to document the assumptions on which a valuation is based, for example, assumptions about land–water linkages and the costs of inputs and labour.

The following are some of the most common errors in the economic valuation of water-related services:

- The use of secondary sources to provide market values. For instance, using values from contingent valuation studies of other locations.
- Valuating a total environmental service in an area (e.g., establishing the total value of a water supply to the watershed's population), instead of valuating the *marginal* effect of a given land-use change on that environmental service (e.g., water availability).
- Failure to valuate alternative ways of guaranteeing the service in demand, such as through the treatment or transfer of water resources. Such valuations are important because they help to assess the cost-efficiency of the different options (e.g., changes in upstream land use compared with an engineering solution).
- Attributing water scarcity – actual or perceived – to changes in land use upstream, when it is rather the result of an inefficient system for water provision and sewage treatment downstream.
- Valuating the expected benefits of land-use changes, but not the costs associated with such changes, e.g., production losses.

COSTS AND TIMING

It is necessary to hire qualified personnel to carry out the valuation study. The valuation team should have a background in economics and social sciences, and experience in quantitative surveys. It is very helpful to have an environmental expert to analyse the linkages between land use and water-related environmental services, particularly when valuating the supply of a service.

The time frame for a valuation study should consider the following stages: appraisal of the specific case; adaptation of methodology and survey design; data gathering; data analysis; and presentation of results.

Costs and timing depend to a great extent on: the availability of data; the size of the sample population; and the complexity of the case, for example, the number of alternative land uses to be considered. Demand-side studies are generally more straightforward and require less time than supply-side studies. A contingent valuation survey to determine the demand for water in a small rural community may take two months, while studies assessing the supply of water-related services in a watershed with complex land-use patterns may take more than a year to complete.

INTERNET RESOURCES

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www.fao.org/landandwater/watershed/watershed/papers/papercas/paperen/costa1.pdf
Case study valuating the impacts of livestock production and forest regeneration on water yield for hydroelectric production in the Rio Chiquito watershed of the Lake Arenal area in Costa Rica.

Barbier, E.M., Acreman, M. & Knowles, D. 1997. *Economic valuation of wetlands: a guide for policy makers and planners.* www.ramsar.org/lib/lib_valuation_e.htm
Practical guidelines for the application of valuation methods for wetlands, which can also by applied in the wider watershed context. Case studies illustrate the application of different methods in Africa, Europe and North America.

Bassi, L. 2002. *Valuation of land use and management impacts on water resources in the Lajeado São José micro-watershed, Santa Catarina, Brazil*.
www.fao.org/landandwater/watershed/watershed/papers/papercas/paperen/brazil.pdf
Case study on the off-site benefits of changed land management practices – zero and minimum tillage, contour tillage, crop rotation, cover crops, green and organic manure, level terracing and forestation, etc. – in a watershed area in terms of water quality and reduced water treatment costs for downstream users.

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Final report: www.rlc.fao.org/foro/psa/pdf/report.pdf
Complete proceedings and case studies: www.rlc.fao.org/foro/psa
Proceedings of the forum, including case studies on the application of valuation techniques in a watershed context in Latin America.

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Case studies: www.rlc.fao.org/prior/recnat/foro.htm
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Payment for environmental services (PES) in watersheds

WHAT ARE PES IN WATERSHEDS?

As the positive externalities, or environmental services, provided by watershed systems become increasingly scarce, the beneficiaries of these services are beginning to recognize their value and are willing to invest in their continued provision. Four main services can be distinguished: watershed protection, carbon sequestration, biodiversity conservation, and landscape. In the watershed context, water-related services are of particular importance.

Payment for environmental services (PES) schemes are flexible, direct compensation mechanisms by which service providers are paid by service users for the provision of a given service. PES schemes in watersheds usually involve the implementation of market mechanisms to compensate upstream landowners for maintaining or modifying a particular land use that affects the availability and/or quality of downstream water resources.

Table A4 gives an overview of the services, beneficiaries and users in a watershed context.

WHAT ARE THE MAIN FEATURES OF PES IN WATERSHEDS?

In the watershed context, a typical PES scheme has the following features: one or more upstream service *providers* supply a well-defined water-related environmental service to downstream *beneficiaries*, who *compensate* the providers for the service provision through the payment scheme, either directly or through an *intermediary*.

TABLE A4
Watershed services, beneficiaries and users

Services	Beneficiaries	Providers	Land uses
Watershed protection			
Regulation of water flow in rivers Maintenance of water quality Control of sediment yield Reduction of flood risks	Drinking-water suppliers Irrigation schemes Hydroelectric producers Beverage industry	Upstream landholders: farmers, forest owners, administrations of protected areas	Reforestation, forest management, conservation agriculture
Carbon sequestration			
Climate regulation through assimilation of atmospheric CO_2 in biomass	Governments Private companies	Landholders in general	Reforestation Agroforestry
Biodiversity conservation			
Existence value of species Bioprospecting Ecosystem resilience	Conservation organizations Private companies (e.g., pharmaceuticals)	Landholders, administrations of protected areas	Habitat protection (use restrictions) Habitat restoration
Landscape beauty			
Maintenance of typical landscapes Maintenance of landscape features such as wildlife	Tourism operators Tourists	Administrations of protected areas	Landscape protection and use restrictions (e.g., hunting bans)

Because the direct assessment of water-related environmental services is technically difficult and costly, compensation is usually based on the area covered by a land use that is assumed to provide the desired service, and is calculated on a per-hectare basis. The land uses vary according to the services provided, but typically include:

- forest conservation;
- reforestation;
- conservation of natural grassland;
- soil- and water-conserving agricultural practices, such as maintenance of permanent soil cover, mulching, no-burning;
- reduction of water pollution, such as treatment of coffee pulp residues, no grazing near watercourses (Kiersch, Hermans and Van Halsema, 2005).

Other forms of compensation include covering the administrative costs for protected areas.

The amount of compensation is generally decided through negotiation among the participants. At a minimum, the compensation needs to cover the opportunity cost to service providers of switching to a more profitable land use. The maximum depends on the beneficiaries' willingness to pay.

The institutional set-up of PES schemes typically consists of several entities:

- the beneficiaries, and possibly an organization that represents them, such as a municipal water supply company;
- the service providers, and possibly an organization that represents them;
- an intermediary organization whose tasks may include making payments to providers, making contracts with individual providers on the scheme's behalf, and monitoring compliance with PES contracts;
- the fund that collects fees from beneficiaries and administers payments to providers, overseen by a committee that may comprise representatives of beneficiaries and the local authorities.

Depending on the scale and size of the scheme, not all of these entities are necessary for the functioning of a PES scheme: in some cases, the beneficiary organization itself administers the fund, for example. When there are very few beneficiaries and providers – there may be as few as one of each – there may be no intermediary.

Mechanisms for monitoring and compliance control are important aspects of PES schemes. Clear rules must be established for the monitoring of compliance with obligations under the PES scheme, for example, to ensure that service providers use the land according to the requirements of the contract. Mechanisms also need to be established to regulate sanctions in case of non-compliance and for conflict resolution among participants.

HOW CAN PES BE USEFUL FOR COLLABORATIVE WATERSHED MANAGEMENT?

PES schemes have many positive features that make them an option for watershed managers to consider:

- PES schemes are a tool for internalizing the positive externalities provided by upstream land users to downstream stakeholders in a watershed context. They can therefore help to make resource allocation more efficient, and can tap into resources for beneficiaries that were previously underutilized by watershed management programmes.
- As initiatives that are tailored to the specific situation in the watershed and financed by local funds, PES schemes may have greater local acceptance than large watershed programmes funded from outside.
- PES schemes can help raise watershed residents' awareness about interactions at the watershed scale.
- By establishing links between upstream and downstream stakeholders, PES schemes may serve as a platform for resolving conflicts about resource allocation at the watershed scale.

TECHNIQUES AND TOOLS

The heterogeneous nature of watersheds and the different constellations of service providers and beneficiaries make it difficult to draw up simple guidelines or blueprints for the establishment and operation of a PES scheme in watersheds. Watershed managers willing to adapt a PES strategy should consult the case studies available (see the resource section at the end of this annex).

Answers to the following questions can help to structure the complex issues and determine the feasibility of a PES scheme in a watershed.

- What is/are the environmental service(s) in demand?
- Who are the users of the environmental services?
- How many are there?
- How much are the users willing to pay for the service?
- How is each service generated, and in what quantity?
- Who is generating the service?
- What are the costs to the providers of generating the service in demand?
- What payment mechanism is used?
- How do users pay?
- How do providers receive payments?
- For how long?
- What are feasible mechanisms for compliance control?
- What is the institutional and legal framework?
- Which institutions and legal instruments facilitate the establishment of a PES scheme?
- Which political and economic issues should be considered?
- How effective is the PES scheme in ensuring the continued supply of environmental services compared with other alternatives, such as engineering solutions?
- How efficient is the system in terms of the costs for establishing and operating the scheme?
- What are the likely environmental impacts?
- What are the likely social impacts?

CONDITIONS FOR SUCCESS

Although there are many possible applications for PES schemes in watersheds, the schemes should not be seen as a panacea for financing natural resources management. The successful implementation of a PES scheme depends on several conditions.

- ***Sufficient demand.*** There needs to be sufficient demand, i.e., at least one beneficiary in the watershed is willing to pay for the continued provision of one or more clearly defined environmental services. If there is no demand for environmental services, or beneficiaries are unable or unwilling to pay, the implementation of a PES scheme will be difficult. For a PES scheme to be viable, the estimated users' demand must be higher than the amount needed to compensate service providers effectively for the intended change in land use. The absence of demand for environmental services in a watershed does not mean that the area should not be conserved, only that PES is not a useful tool for this case.
- ***Clear understanding of land–water linkages.*** As discussed in Chapter 2, the links between land use and water-related environmental services depend on many site-specific factors, and are often poorly understood. Particularly regarding forest–water linkages, there are many generalizations that do not hold true in all situations, for example, that forests regulate stream flow. It is therefore crucial to identify which land uses providers should adopt to secure delivery of the environmental services demanded by beneficiaries. If the services are not delivered, the scheme will collapse.
- ***Sustainable financing arrangements.*** The development of a PES scheme comes at a price. The institutional framework has to be established, monitoring and

enforcement arrangements implemented, and providers and beneficiaries have to bear the costs of participating in the scheme, such as travel to the scheme's office, the drawing up of legal contracts, and design of land-use plans. These *transaction costs* may be considerable. The funding sources for transferring payments under the scheme must be sustainable in the long term. Many functioning PES schemes have been established within the framework of technical cooperation projects. Although external funds from donors may play a crucial role in covering the initial costs of establishing a scheme, they must not be used to cover any recurrent administrative costs or incentive payments, as this will undermine the financial sustainability of the scheme.

- ***Land tenure security***. Land tenure needs to be reasonably secure. When there are conflicts over land tenure, PES schemes can aggravate them as landholders struggle to gain control over land that is eligible for incentives under the scheme (Wunder, 2005). In frontier areas where deforestation is occurring, PES programmes may actually increase the pressure on land as new settlers move in to benefit from incentives paid by the scheme. Land titles are not a necessary prerequisite for PES schemes, however (Pagiola, Bishop and Landell-Mills, 2002). When land tenure is secure, landholders may see PES contracts as a welcome recognition of their claim to the land.
- ***Cultural acceptance of PES***. There must be consensus that it is reasonable for beneficiaries to pay providers for the continued provision of environmental services. This can be problematic in situations where it is considered unacceptable to pay for water-related services, or where cultural or religious values are at stake, for example, in the preservation of a mountain or lake that is considered sacred by local people.
- ***Legal issues***. A legal framework specifically tailored to PES is not a prerequisite for the functioning of a PES scheme. It helps, however, if the scheme is recognized by local legislation, as this generally raises credibility among participants. An existing legal framework for PES and functioning PES scheme at the national level may stimulate the formation of private PES agreements, by providing a blueprint for establishing the schemes and by reducing the transaction costs for service providers and buyers, who may choose to link into the national scheme instead of setting up a separate institutional framework. Both effects can be observed in Costa Rica (Boxes 17 and 20 in Chapter 2).

SOCIO-ECONOMIC IMPACTS OF PES SCHEMES

Whether and how PES schemes can alleviate poverty in upland watersheds depends on many factors. Although the objective of PES is not poverty alleviation but improving the flows of environmental services, PES schemes may in principle improve equity in watersheds by transferring revenues from richer lowlands to poorer upland areas (Pagiola, Bishop and Landell-Mills, 2002). Empirical evidence of the impact on the rural poor is sketchy, however, and the results are mixed. In some cases (e.g., Pimampiro in Ecuador: Box 18), incentive payments are reported to make up a significant share of the food, education and medical expenses of participating poor households (Echavarría, 2002). There are, however, several factors that make it difficult for the poor to benefit from PES programmes: (1) the transaction costs involved in joining the scheme – preparing the necessary documentation, travel time to the office, legal costs, etc. – are comparatively higher for poor small farmers than for richer landholders; (2) small farmers may lack the funds to invest in the activities required by the PES scheme, such as reforestation; (3) small farmers may be determined to commit to the long-term conservation of their property owing to risk aversion; and (4) the transaction costs of a PES scheme are higher if the scheme has to deal with many dispersed smallholders

than when there are only a few large landholders, so schemes may restrict access for smallholders. In the FONAFIFO programme in Costa Rica (Box 20), for example, areas of as little as 1 ha may qualify for PES payments, but in practice the scheme adopts a minimum threshold of 10 ha, thus excluding small farmers.

PES schemes do not automatically improve equity in the watershed context. In fact, there may be trade-offs between reaching the environmental goals of the scheme in an economically efficient manner and contributing to poverty alleviation. It may be more cost-effective for schemes to target large landholdings in order to reduce transaction costs, but this reduces the potential impact on equity and the possibilities of including the poorer strata of a watershed population. If the PES scheme is to achieve social objectives, its design must be carefully tailored to include poor and small landholders, and this may reduce the attractiveness of a PES scheme as an efficient tool for environmental sustainability (Kiersch, Hermans and Van Halsema, 2005). Paying a large part of the incentive up-front, or improving participants' access to credit schemes, may improve poor households' chances of participating (Pagiola, Bishop and Landell-Mills, 2002), but funding sources would need to be identified to cover the additional costs arising from such a policy.

Costs and timing

The following establishment and operating costs of a PES scheme need to be considered:

- ***establishment costs***, including: initial feasibility studies (land–water linkages, valuation of demand and supply); definition of rules and regulations; set-up of the institutional framework; training of staff in administration, monitoring and compliance control;
- ***operating costs***, including: administration of the fund; collection of payments from service users; disbursement of funds to service providers; establishment of contracts with service providers; compliance monitoring;
- ***costs to providers for formalizing contracts***, including: legal expenses; travel time and expenses; establishment of land-use plans.

Drawing up a PES scheme in a watershed context is an interdisciplinary effort. Experts in economics, hydrology, forestry, agronomy and social sciences have to be consulted during the planning process and operation of the scheme.

The PES scheme should be conceived as a long-term programme. Contracts with providers may initially be drawn up for three to five years, but should be renewable to ensure continued provision of the services and to allow the scheme to adjust payments and land-use requirements as new findings on land–water linkages emerge. Financial sustainability is a key aspect of this. Care must be taken to design the scheme so that the transfer payments and the operational costs are covered by the contributions of service beneficiaries. External funding sources should only be used to cover recurrent costs if they can be transformed into a sustainable funding mechanism, such as an endowment fund.

INTERNET RESOURCES

Ecosystem Marketplace

www.ecosystemmarketplace.com/

Features news, tools and case studies on market development for ecosystem services worldwide.

FAO Latin American Regional Electronic Forum on Payment for Environmental Services in Watersheds (April/May 2004.)

Final report: www.rlc.fao.org/foro/psa/pdf/report.pdf

Complete proceedings and case studies: www.rlc.fao.org/foro/psa

Proceedings of the forum, including lessons from ongoing PES experiences in a watershed context in Latin America and case studies.

Regional Forum for Payment for Environmental Services in Watersheds Arequipa, Peru, 9-12 June 2003

Final report: www.fao.org/documents/show_cdr.asp?url_file=/docrep/004/y3618e/y3618e00.htm

Case studies: www.rlc.fao.org/prior/recnat/foro.htm

The proceedings include various case studies of PES schemes in watersheds in Latin America.

FAO Land–water linkages in rural watersheds

www.fao.org/landandwater/watershed

Resources on:

- impacts of land-use systems and practices on hydrological regime and water quality;
- instruments for valuating water-related environmental services;
- case studies on PES schemes in watersheds.

International Institute for Environment and Development (IIED) Forestry and Land Use Programme

www.iied.org/nr/forestry/index.html

Includes background material and publications on PES.

Rewarding Upland Poor for Environmental Services (RUPES)

www.worldagroforestry.org/sea/networks/rupes/

A programme for developing mechanisms to reward the upland poor in Asia for the environmental services they provide. Contains background information on PES programmes and case studies in Asia with a livelihoods focus.

World Bank Environmental Economics Programme

www.worldbank.org/environmentaleconomics

Includes a useful section on PES.

FURTHER READING

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Watershed management on the Web

FAO, FORESTRY DEPARTMENT
www.fao.org/forestry/index.jsp

The FAO Forestry Department helps nations to manage their forests in a sustainable way. The Organization's approach balances social, economic and environmental objectives so that present generations can reap the benefits of the earth's forest resources while preserving them to meet the needs of future generations. In helping member countries to conserve and utilize their forest and tree resources sustainably, FAO works in partnership with governments, international organizations and agencies, NGOs, the private sector, communities and individuals. FAO helps countries to develop economically viable approaches to the sustainable use of forest products and services and to account for the economic and environmental benefits that forests provide. FAO assists member countries with national forest policy formulation and the strengthening of forest-related institutions, including support for extension and community forestry.

FAO, LAND AND WATER DEVELOPMENT DIVISION
www.fao.org/ag/agl/watershed/watershed/en/mainen/index.stm

FAO's Land and Water Development Division is concerned with the development of technology, strategy and policy, and the provision of advisory and technical services to FAO members to ensure more productive and efficient use of land and water resources and plant nutrients in order to meet present and future food and agriculture demands sustainably. FAO's programme on hydrological services in watershed management explores the extent to which different land-use systems and practices affect hydrological regime and water quality, the scales and contexts where impacts are of importance, instruments to valuate the resulting benefits and costs to resource users, and institutional, economic, regulatory and social mechanisms that can be applied to achieve an equitable sharing of these benefits and costs by upstream and downstream resource users in a watershed context.

INTERNATIONAL CENTRE FOR INTEGRATED MOUNTAIN DEVELOPMENT (ICIMOD)
www.icimod.org/index.htm

ICIMOD is an international organization committed to improving the living conditions of mountain inhabitants in a sustainable way. It was established in 1981 based on an agreement between the Government of Nepal and the United Nations Educational, Scientific and Cultural Organization (UNESCO). The centre is multidisciplinary, area-focused and mountain-based; it concentrates mainly on the Hindu Kush-Himalayan region. ICIMOD offers much to this region and to other mountain regions facing similar problems. In cooperation with regional and international partners, the centre develops and provides integrated and innovative solutions that foster action and change to overcome mountain people's economic, social and physical vulnerability.

EUROPEAN OBSERVATORY ON MOUNTAIN FORESTS (EOMF)
www.eomf.org/

EOMF has the task of developing a policy for mountain forests in Europe with the cooperation of all stakeholders. It was established in 1996 as an outcome of the first International Workshop of the European Project for Mountain Forests (Saint Jean d'Arvey, Savoie, France, 11 to 13 September).

The observatory's main mission is to unite different specialists in mountain forests in supporting resource conservation, sustainable economic and employment development, and the integration of national and international principles and recommendations.

WORLD AGROFORESTRY CENTRE (ICRAF)
www.worldagroforestry.org

ICRAF's mission is to advance the science and practice of agroforestry in order to transform them throughout the developing world. The centre has been working with smallholder farmers in Africa, Asia and Latin America for three decades.

ICRAF contributes to the protection of watershed services through agroforestry-based solutions that reward the poor for providing environmental services, improve the health and nutrition of the rural poor, build human and institutional capacity in agroforestry research and development, and conserve biodiversity through integrated conservation and development based on agroforestry technologies.

LATIN AMERICAN WATERSHED MANAGEMENT NETWORK (REDLACH)
www.fao.org/regional/lamerica/redes/redlach

REDLACH was created in 1980 with support from the FAO regional office for Latin America and the Caribbean. The network has the characteristics of both private and public institutions. Its main objectives include planning watershed management resources, promoting sustainable development concepts in Latin America and the Caribbean, increasing the technical capacity of member countries through the exchange of experience and knowledge, technical cooperation, and promoting watershed projects.

MOUNTAIN PARTNERSHIP
Water: www.mountainpartnership.org/issues/water.html
Watershed: www.mountainpartnership.org/issues/watersheds.html

The Mountain Partnership is a voluntary global alliance of partners dedicated to improving the lives of mountain people and protecting mountain environments around the world. It builds on the interest in mountain issues that has grown up since the Earth Summit of 1992. Launched at the World Summit for Sustainable Development in 2002, the partnership taps its members' diversity of resources, information, knowledge and expertise to support positive change in mountain areas. Its initiatives on the ground cover specific themes – policy and law, sustainable livelihoods, watershed management, research, gender, education, sustainable agriculture and rural development in mountains – in geographic areas that include the Andes, Central America and the Caribbean, Central Asia, East Africa, Europe and the Hindu Kush-Himalaya.

UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP)

http://freshwater.unep.net/ | www.unep.org/

UNEP's mission is to provide leadership and encourage partnership in caring for the environment by inspiring, informing and enabling nations and people to improve their quality of life without compromising that of future generations. It was established in 1972, after the UN Conference on the Human Environment. UNEP supports national governments' participation in international negotiations, helping them to fulfil their obligations under international agreements, develop institutions and formulate and enact legislation to protect the environment. UNEP promotes dialogue and cooperation among stakeholders, the exchange of best practices and success stories, and the transfer of knowledge and technology. It develops policy guidelines for addressing major environmental issues, such as the increasing scarcity of freshwater, degradation of the marine environment and pollution of the atmosphere.

WORLD MOUNTAIN PEOPLE ASSOCIATION (WMPA)

www.mountainpeople.org/en/actions/eau.php | www.mountainpeople.org/

WMPA emerged from the World Mountain Forum, held at UNESCO (Paris) and in Chambéry, France in June 2000, to provide mountain people with a platform for their opinions and desires. It is present in more than 70 countries on four continents, and is organized into regional and national bodies of local institutions, NGOs, scientists, small-scale enterprises, etc. WMPA has three major objectives: to increase the understanding of mountains internationally, regionally and nationally; to organize North–South and South–South exchange and cooperation among mountain territories and populations in sharing knowledge, means and experience; and to support and develop the local initiatives of its members and partners.

CENTRE FOR DEVELOPMENT AND ENVIRONMENT (CDE)

www.cde.unibe.ch/themes/wm_th.asp | www.cde.unibe.ch/

CDE's mission is to contribute to sustainable development through research partnerships, education and training, the development of concepts and tools, awareness raising and policy advice. It focuses on the management of natural resources, integrated regional development and interventions that mitigate the symptoms of global change. It employs disciplinary and interdisciplinary approaches, links analysis and synthesis, and combines high-end and low-end methods, such as GIS-based observations and participatory field-based approaches. CDE supports the principles of subsidiarity, empowerment and partnership, while acknowledging the importance of research, planning and decision-making at the regional, national and international levels.

MOUNTAIN FORUM

www.mtnforum.org/index.cfm

The Mountain Forum is a global network of individuals and organizations concerned with the well-being of mountain people, their environments and their cultures. It was founded in 1996 with the participation of mountain stakeholders, and is a global network of networks guided by a Board of Directors. The Mountain Forum seeks to bring the lessons and experiences of mountain people into policy discussions at the national and international levels with the aim of improving their livelihoods and promoting the conservation of mountain environments and cultures.

MOUNTAIN STUDIES INSTITUTE (MSI)

www.mountainstudies.org/databank/datalinks.asp?category=hydrology
www.mountainstudies.org

MSI is an independent, non-advocacy, non-profit mountain research and education institution and high-altitude field station established in 2002 in Silverton, Colorado, the United States. Its mission is to enhance understanding and sustainable use of the San Juan Mountains through research and education. While focusing on a distinct mountain range, MSI activities serve the global mountain community and have broader applications to the study of mountain systems – mountain environments, mountain people and their interactions. MSI serves students, educators, researchers, land and environmental managers, elected officials and the public, within the region and beyond. It uses research and education as a sustainable economic development model for mountain communities.

CONSORCIO PARA EL DESARROLLO SOSTENIBLE DE LA ECORREGION ANDINA (CONDESAN)

www.condesan.org/iniciativas.htm | www.condesan.org/

The CONDESAN initiative was born in 1992 at a meeting of academics in Lima. It is a consortium of more that 75 research institutions, universities, NGOs, businesses, producer groups and government agencies. Its main objective is to create a new form of cooperation in the Andina region to include all the actors that contribute to protecting the ecosystem. Other objectives include improving the market situation in this area, enhancing the capacity of local people and ensuring that information reaches the grassroots.

AFRICAN MOUNTAIN ASSOCIATION (AMA)

www.madagascar-mountain.org/bassins.htm | www.madagascar-mountain.org/ama.htm

AMA's main aim is to improve knowledge about mountain environments in Africa and to highlight their importance as resources that should be used carefully for posterity. It was founded in 1986 during a workshop for African and non-African researchers held in Ethiopia. It aims to establish cooperation among mountain territories for knowledge and experience sharing to benefit mountain inhabitants and to promote recognition of the problems facing mountain populations. AMA emphasizes the need for national and international development.

MILLENNIUM ECOSYSTEM ASSESSMENT (MEA)

www.maweb.org//en/index.aspx

MEA is an international programme of work designed to meet the needs of decision-makers and the public for scientific information concerning the consequences of ecosystem change on human well-being and the options for responding to such change. It was launched by the UN Secretary-General in June 2001 and completed in March 2005. MEA focuses on ecosystem services (the benefits that people obtain from ecosystems), how changes in ecosystem services have affected human well-being, how ecosystem changes may affect people in future decades, and response options that might be adopted at local, national or global scales to improve ecosystem management and thereby contribute to human well-being and poverty alleviation.

MEA is an instrument for identifying priorities for action. It helps identify options for achieving human development and sustainability goals, and has helped build individual and institutional capacity to undertake integrated ecosystem assessments and act on their findings.

CENTRE FOR INTERNATIONAL FORESTRY RESEARCH (CIFOR)
www.cifor.cgiar.org/

CIFOR is an international research and global knowledge institution committed to conserving forests and improving the livelihoods of people in the tropics, through collaborative, strategic and applied research and by promoting the transfer and adoption of appropriate new technologies and social systems for national development. CIFOR's high-impact research helps local communities and small farmers to gain their rightful shares of forest resources, while increasing the production and value of forest products. CIFOR's three research programmes address the needs of the rural poor as well as environmental concerns: the environmental services and sustainable use of forests programme oversees research on biodiversity, carbon, fires, watershed functions, and the sustainable management and harvesting of forest products; forest governance examines the process of making and implementing decisions about the management of forests by people and organizations beyond the scale of the individual household or small enterprise; and forests and livelihoods closely investigates how forest resources and their management, use and trade contribute to the livelihoods of the rural and urban poor.

CENTRE FOR LAND USE AND WATER RESOURCE RESEARCH (CLUWRR)
www.cluwrr.ncl.ac.uk/index.php

CLUWRR is the focus for integrated environmental management research at the University of Newcastle-upon-Tyne, the United Kingdom. Its mission is to develop integrating methodologies for linking ecology, hydrology and economics, taking account of sustainability, equity, socio-economics and stakeholder participation issues, and to apply technologies and methodologies that assist the development of plans, strategies, guidelines and policies for improved environmental, land use and water resources management at the local, regional, national and international scales.

WORLD CONSERVATION UNION (IUCN): WATER AND NATURE INITIATIVE
www.iucn.org/themes/wani/

The main goal of IUCN's Water and Nature Initiative is the mainstreaming of an ecosystem approach into catchment policies, planning and management. The initiative aims to develop a coherent set of activities that are innovative and directed at guiding future investment and actions in water resources management and nature conservation. The principles involved include: participation, which involves empowering all stakeholders to participate in water management; strategy, which involves having the maximum possible effect; transparency, which involves clarity in decision-making and management; catalytic, which involves influencing, facilitating and initiating action; and innovation, which involves developing knowledge within projects and sharing it with the widest audience possible.

INTERNATIONAL WATER MANAGEMENT INSTITUTE (IWMI)
www.iwmi.cgiar.org/index.htm

IWMI is a non-profit scientific research organization focusing on the sustainable use of water and land resources in agriculture and on the water needs of developing countries. The institute takes a multidisciplinary approach to water management research. It works through collaborative research with partners in the North and South to develop tools and practices to help developing countries eradicate poverty and manage their water and land resources better. IWMI's mission is to improve water and land resources management for food, livelihoods and nature.

WORLD RESOURCES INSTITUTE (WRI)
water.wri.org/index.cfm

WRI is an environmental think-tank that uses research to create practical ways of protecting the earth and improving people's lives. Its mission is to encourage human society to live in ways that protect earth's environment for current and future generations. Its programme tackles global challenges by using knowledge to catalyse public and private actions. The institute protects the capacity of ecosystems to sustain life and prosperity, expands participation in environmental decisions, promotes public and private actions to ensure a safe climate and increases prosperity while improving the environment. WRI tries to build bridges between ideas and actions, meshing the insights of scientific research, economic and institutional analyses and practical experience with the need for open and participatory decision-making.

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE (IDRC): WaDImena
www.idrc.ca/en/ev-57064-201-1-do_topic.html | www.idrc.ca/index_en.html

IDRC is a public corporation created by the Parliament of Canada in 1970 to help developing countries use science and technology to find practical, long-term solutions to the social, economic and environmental problems they face. Support is directed towards developing indigenous research capacity to sustain policies and technologies that developing countries need to build healthier, more equitable and more prosperous societies WaDImena is a five-year multi-donor-funded programme (2004 to 2009) coordinated by IDRC in partnership with the Canadian International Development Agency (CIDA) and the International Fund for Agricultural Development (IFAD). WaDImena contributes to effective water governance by enhancing water use efficiency, equity and sustainability.

CENTRE FOR WATERSHED PROTECTION
http://www.cwp.org/index.html

Founded in 1992, the Centre for Watershed Protection is a non-profit corporation that provides local governments, activists and watershed organizations with the technical tools for protecting precious natural resources: streams, lakes and rivers. The centre has developed and disseminated a multidisciplinary strategy for watershed protection that encompasses watershed planning, watershed restoration, storm water management, watershed research, better site design, education and outreach, and watershed training. As techniques for protecting small watersheds from the detrimental effects of sprawling development and the accompanying impervious cover continue to improve, the Centre for Watershed Protection has been at the heart of this newly emerging practice.