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PREPARING FOR THE NEXT GENERATION OF WATERSHED MANAGEMENT PROGRAMMES AND PROJECTS

WATER RESOURCES FOR THE FUTURE

Conference Proceedings

Porto Cervo,
Sassari, Sardinia, Italy
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PROVINCIA DI SASSARI

FAO FIAT PANIS

PREPARING FOR THE NEXT GENERATION OF WATERSHED MANAGEMENT PROGRAMMES AND PROJECTS

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Proceedings of the International Conference
organized in collaboration with the
Italian Ministry for the Environment and Territory

Porto Cervo,
Sassari, Sardinia, Italy
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Edited by
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PREFACE

On the occasion of the International Year of Mountains, and in response to the clear consensus reached by the international community regarding the need to ensure harmonious and sustainable development of mountainous areas and watersheds, the Food and Agriculture Organization of the United Nations (FAO) and its partners undertook a large-scale assessment and global review of the current status and future trends regarding knowledge about and techniques for integrated watershed management.

The objectives were to promote the exchange and dissemination of experiences of integrated watershed management techniques, identify constraints to the implementation and development of those techniques during the decade from 1990 to 2000 and capture relevant new paradigms and approaches. The lessons learned from diverse experiences are being used to define a new generation of integrated watershed management projects.

Experts from four continents contributed to the assessment, which yielded four main outputs: 1) a review of experiences in watershed management, based on questionnaires that were sent to active partners in the field; 2) substantive reports from four regional workshops held in Nairobi (Kenya), Kathmandu (Nepal), Arequipa (Peru) and Megève (France); 3) four case studies from the Mediterranean basin, Nepal, Bolivia and Burundi; and 4) an international conference in Porto Cervo, Sassari Province, Sardinia, Italy.

Watershed management concepts and approaches were reviewed, and different experiences assessed. The results of this exercise are presented in several documents, including the proceedings of workshops and reports on the four case studies.

The conservation, use and sustainable management of watershed resources in order to meet the demands of growing populations have been a high priority for many countries over the past several decades. In this respect, integrated watershed management through people's participation has become widely accepted as the approach that ensures sound sustainable natural resources management and a better economy for upland inhabitants, as well as people living in downstream areas.

The International Watershed Management Conference on Water Resources for the Future was held from 22 to 24 October 2003, in Sardinia (Italy) at Porto Cervo, Province of Sassari. This location offered a very appropriate venue for the conference, because water scarcity, soil erosion, low forest cover and opportunities for tourism development in Sardinia offer issues to discuss and share that are very relevant to approaches related to watershed management in

many other areas of the world. The international conference was the culmination of the series of regional workshops described above. The conference, which brought together about 67 participants representing 19 countries, provided a forum for inter-regional exchange on watershed management and water-related issues.

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ACKNOWLEDGEMENTS

The International Conference on Watershed Management: Water Resources for the Future, held in Porto Cervo, Sassari, Italy from 22 to 24 October 2003, was a milestone in global-level collaboration. A sincere thank you is extended to the people and institutions from various disciplines, countries and regions that participated in and contributed to the success of the conference.

Special thanks to Tage Michaelsen (FAO retiree), who inspired and emphasized the role of forests in watershed management. Appreciation is extended to: Sebastiano Sannitu, elected official in charge of the environment and Vice-President of the Province of Sassari, Italy; Maria Antonietta Accolli and Francesca Caria, Administrative Officers of the Province of Sassari, Italy; Larry Tennyson, FAO Consultant; Moujahed Achouri, FAO Officer; Aline Faucher, FAO Volunteer; and Pier Carlo Zingari, Director of the European Observatory of Mountain Forest (EOMF).

FAO is grateful to the Italian Ministry of Environment that supported the process, and to all conference personnel who provided invaluable assistance.

These proceedings have been prepared thanks to collaboration among Maria Antonietta Accolli, Francesca Caria and Aline Faucher. FAO is also grateful to the co-editors: Larry Tennyson and Pier Carlo Zingari.

ACRONYMS

APAT	Agenzia per l'Ambiente e il Territorio (Italy)
BMPs	Best Management Practices
BUWAL	Bundesamt für Umwelt, Wald und Landschaft (Switzerland)
CGIAR	Consultative Group on International Agricultural Research
CLUWRR	Centre for Land Use and Water Resources Research (United Kingdom)
DSS	Decision Support System
EAPI	Environment and Policy Institute (East-West Centre)
EFCWP	European Forestry Commission Working Party
EOMF	European Observatory of Mountain Forest
EPA	Environmental Protection Agency (United States)
FAO	Food and Agriculture Organization of the United Nations
FORC/FAO	Forest Conservation Service/FAO
GEF	Global Environment Facility
GIS	Geographic Information System
GPS	global positioning system
GTZ	German Agency for Technical Cooperation
HR	human resources
ICARDA	International Centre for Agricultural Research in the Dry Areas
ICIMOD	International Centre for Integrated Mountain Development
ICRAF	International Centre for Research in Agroforestry/World Agroforestry Centre
IIED	International Institute for Environment and Development
IMFN	International Model Forest Network
INRM	Integrated Natural Resources Management
IRBM	Integrated River Basin Management
IUFRO	International Union of Forest Resources Organizations
IWM	integrated water management
IWRM	integrated water resources management
IWSM	integrated watershed management
IYM	International Year of Mountains
M&E	monitoring and evaluation
MIS	Management Information System
MRI	Mountain Research Initiative
NGO	Non-Governmental Organization
OIEAU	Office International de l'Eau
PES	payment for environmental services
REDLACH	Latin American Network for Technical Cooperation in Watershed Management
UN	United Nations
UNCED	United Nations Conference on Environment and Development (the Earth Summit)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WM	watershed management

INTRODUCTION

The conservation, use and sustainable management of watershed resources to meet the demands of growing populations have been a high priority of many countries for several decades.

In this respect, integrated watershed management through people's participation has become widely accepted as the approach that ensures sound sustainable management of water and other natural resources and a better agriculture economy for upland inhabitants, as well as benefits for people living in downstream areas.

Integrated watershed management has been recognized as a suitable approach to addressing poverty and the need for food security of upland populations, as well as of people living downstream. The watershed management approach integrates various aspects of forestry, agriculture, hydrology, ecology, soils, physical climatology and other sciences, thus providing a comprehensive information base for choosing acceptable management alternatives within the social and economic context.

Chapter 13 of UNCED Agenda 21, for which FAO is the UN Task Manager, stresses that "Promoting integrated watershed development programmes through effective participation of local people is a key to preventing further ecological imbalance. An integrated approach is needed for conserving, upgrading and using the natural resource base of land, water, plant, animal and human resources".

Although much progress has been achieved in watershed management, no clear picture has been drawn of what has been successful and what needs to be done to improve future watershed management programmes. Therefore, an in-depth analysis of watershed management achievements and existing gaps was identified by FAO as a prerequisite to further development of watershed management programmes.

In this respect, FAO initiated a review and assessment of watershed management development strategies and approaches with a goal of providing reliable information to concerned stakeholders regarding lessons learned, existing gaps and guidelines for the next generation of watershed management programmes. The following major steps were taken:

- stocktaking exercise;
- case studies;
- regional workshops;
- international conference;
- dissemination of results.

The International Conference on Watershed Management: Water Resources for the Future, at Porto Cervo, Sassari, Sardinia, Italy from 22 to 24 October 2003, was the culmination of a series of regional workshops (in Africa, Asia, Europe and Latin America and the Caribbean), which were convened as part of the FAO review. During 2002, the Forest Conservation Service

of the Food and Agriculture Organization of the United Nations (FORC/FAO) initiated a global-level review and assessment of watershed management development strategies and approaches with a goal of providing state-of-the-art information to concerned stakeholders regarding lessons learned, existing gaps and guidelines for the next generation of watershed management programmes.

The objectives of the conference were twofold: 1) to provide a forum for inter-regional exchange of information and discussion of watershed management and water-related issues; and 2) to present results of the global FAO watershed management review initiative for discussion and direction regarding future watershed management programmes.

The conference was attended by 67 participants (Annex D) from a variety of disciplines, representing 19 countries. Several presentations were made during the course of the conference. Presentations made available for publication have been grouped in this volume under four main headings: FAO watershed management review; ongoing networking experiences, watershed and area studies, and water and land in Sardinia.

Minutes of group discussions held during the conference are presented in Annex B. Some of the key points identified by working groups are summarized in the following.

Watershed management

- *Appropriateness:* Need to consider carefully if and how watershed strategies from one area are appropriate to other areas: e.g. context, setting, culture, religion and other considerations will affect uptake and success.
- *Best and most modern technology,* although often demanded, is not always the most appropriate. Some criteria to consider when selecting interventions are scale, target stakeholders, local expertise and site conditions.
- *Awareness and engagement*: A major problem in some countries is that people are not interested in water *per se,* but rather in improving their own material well-being. It is necessary to find a way to interest them and involve them in the processes for change.

Mountain forest management

- Indigenous knowledge and culture are important. However, there is a lack of knowledge on how to use this information as a necessary complement to scientific and technical expertise and data.
- The lack of data (indicators providing assessment, valuation and monitoring) is a constraint to improving the knowledge base.
- Sorting myths and facts about water, soil and climate interactions and influences, i.e. to what extent forests and forest-related ecosystems can benefit water quality and quantity and risk control.
- Capacity building (human resources [HR] and institutional) is needed at all levels. Integrated watershed management is implemented and supported by everyday people, not solely by exclusive expertise.

Integrated water resources management: upland–lowland linkages and interactions

- Need to rethink scale issues within upstream–downstream issues: across temporal and spatial scales; biophysical and socio-economic linkages; consider transboundary issues.
- Embed economic valuation in multisectoral watershed management (WM): management and policies that take account of all multisectoral supply, demand and environmental costs and benefits; incorporate viable and appropriate downstream–upstream or upstream–downstream payment for environmental services (PES) schemes; consider return of investment in WM projects; appropriate time scales for investment; include equity issues and right of access to water – the "human and ecological reserve".
- More inclusive approach to WM required: technology alone does not provide the solution; need to live with uncertainty; move from coercive to non-coercive policies; develop multistakeholder process; move from management to adaptive management.

A committee consisting of participants from various disciplines and countries prepared a synthesis of the findings of the conference. The "Sassari Declaration", which was presented at the final plenary session and accepted by the participants, is presented below.

SASSARI DECLARATION

The province of Sassari, Sardinia, Italy hosted this conference co-organized by the Food and Agriculture Organization of the United Nations (FAO) and the European Observatory of Mountain Forest (EOMF) with the aim to exchange experiences on issues of vital importance for environmental conservation and sustainable development. Sardinia is representative of the Mediterranean environment and of island conditions. Water scarcity, erosion, low forest cover and tourism are major challenges shared by many areas worldwide. Sardinia can be considered a pilot area where studies, analyses, evaluations and methodologies are available to combat degradation and desertification processes.

The FAO initiative "Review and assessment of watershed management approaches – preparing the next generation of watershed management programmes" was launched in early 2002 within the framework of the International Year of Mountains, and continued into the International Year of Freshwater, 2003. These and other global events highlighted the magnitude and urgency of watershed management problems around the world. The FAO initiative was carried out in collaboration with several key actors in watershed management and with the contributions of several institutions and concerned parties and the financial support of several countries, such as the Government of the Netherlands, the Government of France and the Government of Italy.

Objectives

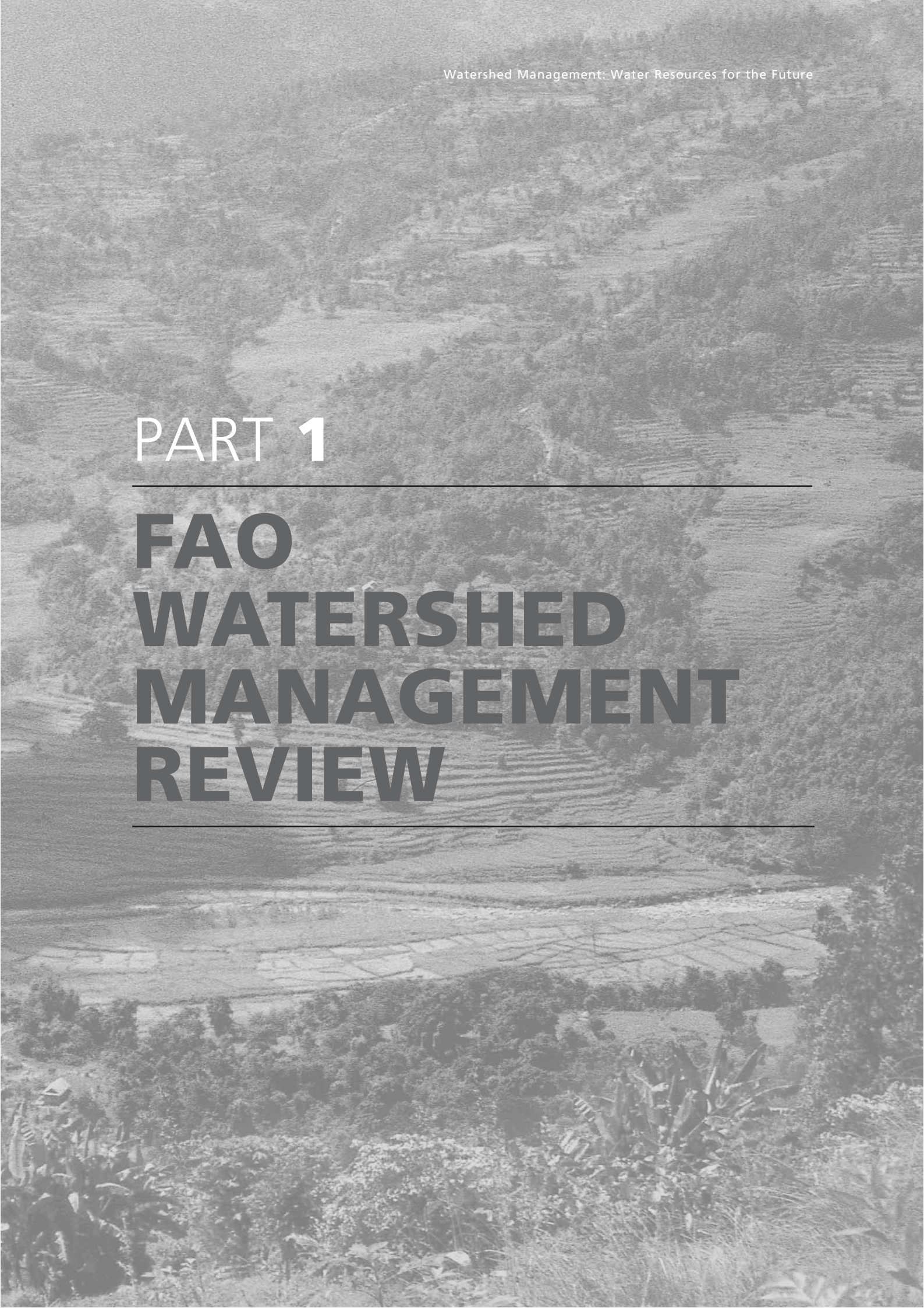
Within the context of the Millennium Development Goals and with the intent of preparing for the next generation of watershed management, the objectives of this conference were to: 1) provide an adequate opportunity/platform to all concerned parties to share information and contribute to a better understanding of the current status of watershed management; and

2) provide advocacy and support for the implementation of effective watershed management at different levels.

Recommendations

1. There is a need to focus increased global and regional attention on watershed management because watersheds integrate resources, environmental services, uses and users; watersheds connect people who may never meet and may vary greatly in terms of wealth, livelihoods and culture; good planning requires good understanding of linkages between upstream and downstream hydrologic and land-use systems; investments are long-term and generate benefits and costs across large distances; and interventions that are good for individuals or communities may be detrimental to wider societal interests.
2. Outputs from the Sassari conference and the associated regional workshops should be used to develop a set of guidelines for the next generation of watershed management programmes that can be applied to the design and screening of new projects.
3. Some of the key elements of the guidelines for the next generation of watershed management programmes include: a multisectoral approach; a combination of bottom-up and top-down planning, monitoring and evaluation; clear procedures for environmental impact assessment of interventions, including dams and reservoirs; networking among key stakeholders; consideration of socio-economic and cultural aspects and natural processes; gender balance in decision-making; embracing new approaches for sharing knowledge and learning; sustainable finance; compensation mechanisms; capacity building at all levels; reforming governance, linking surface, groundwater and coastal water sources; shift from looking at supply to looking at demand for water; efficiency of water use; coping with hydrologic extremes and natural hazards; and the integrated management of water, vegetation, soils and sediments.
4. Guidelines for the next generation of watershed management programmes should be tested and demonstrated in pilot cases, with planning and implementation from local, national and transnational scales. These pilot cases should include institutionalization of watershed approaches into national systems.
5. Considering the need for integrated approaches to watershed management, it is recommended that donor agencies, financial institutions, government departments, civil society organizations and the private sector commit to long-term intersectoral and innovative planning, finance and execution of watershed management.
6. Because watersheds often span political boundaries, watershed management should be seen as an integrative approach that has value in understanding and resolving conflicts between upstream and downstream communities and countries.
7. Because rural and urban poverty is a significant contributing factor to watershed development and degradation, it is recommended that the multiple linkages between poverty and watershed management be better understood and considered in the planning of both watershed management and poverty alleviation programmes.
8. It is recognized that there is an urgent need to build capacity of all stakeholders (including watershed inhabitants and professionals at the local and national levels) to understand and manage the multisectoral processes and approaches necessary for effective watershed management.

9. At present, land and water governance institutions and policies are often inadequate to support the integrative and multisectoral approach needed to implement watershed management. It is therefore recommended that: 1) institutions for integrated basin management be established and strengthened with appropriate legal status, resources and financing; 2) there be more effective and equitable communication among local communities, managers and policy-makers; and 3) policies be based on clear evidence and tested principles.
10. Access to a minimum amount of safe water should be recognized as a fundamental human right of all people.
11. Considering that the management over land and water resources is highly fragmented at all levels, it is recommended that consideration be given to establishing an international forum that focuses on integrated watershed management, including land-use and human activities that have an impact on water.



PART 1

FAO WATERSHED MANAGEMENT REVIEW

CHAPTER 1
PREPARING THE NEXT GENERATION OF WATERSHED MANAGEMENT PROGRAMMES

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It is clear that much progress has been achieved in watershed management, especially during the 1990 to 2000 period when new approaches and methodologies were developed to promote participatory integrated watershed management. However, no clear picture has been drawn as to what has really been working and what can be done to improve future watershed management programmes. In fact, there has been no systematic effort to review and assess watershed management strategies and approaches at a global scale since FAO did so at the expert meeting held in Kathmandu, Nepal from 25 February to 1 March 1985. Hence, in-depth analysis of watershed management achievements and existing gaps, with particular emphasis on the experiences of 1990 to 2002, is a prerequisite to further development of watershed management programmes.

This paper has been prepared in response to the raising of key issues of major concern to the development of watershed management. It reviews and assesses watershed management activities and provides reliable information on lessons learned and existing gaps. Such information is needed to justify investment in watershed management activities and to focus such activities on the areas where they are most needed. The assessment concept and approaches were designed to respond to the needs and characteristics of different audiences involved in watershed management.

BACKGROUND

Interest in and awareness of the multiple environmental, economic and social benefits provided by watershed management and development have greatly increased in recent decades. This may be particularly true in developing countries where the economy depends predominately on agriculture, but there are also fast-growing urban populations that depend on water and food supplies on an unprecedented scale.

Degradation of natural resources is considered to be the greatest constraint to sustainable agricultural development in most developing countries. It is generally accepted that sustainable use and management of land resources will only be achieved by adopting a system of improved land, water and vegetation management and use based on an integrated approach to land resources development with the direct involvement and participation of the different actors.

Given that watershed management is the implementation of management systems that ensure the preservation, conservation and sustainable use of all land resources, the development of watershed management is recognized as a prerequisite for the sustainable management of land resources and the improvement of upland inhabitants' living conditions. In fact, watershed management integrates various aspects of forestry, agriculture, hydrology, ecology, soils, physical climatology and other sciences to provide guidelines for choosing acceptable management alternatives within the specific social and economic context.

Integrated watershed management through people's participation has become widely accepted as the approach that ensures sound sustainable natural resources management and a better agriculture economy for upland inhabitants, as well as the people living in downstream areas.

As a consequence of the attention paid to and the important investments secured for the development of watershed management, much progress has been achieved in this field. However, several issues of major concern, which were raised many years ago, still require in-depth analysis and consultation among all concerned parties for better understanding and implementation of effective watershed management.

The expert meeting on strategies, approaches and systems for integrated watershed management held in Kathmandu, Nepal in 1985 highlighted the threats that watershed degradation represents for the livelihood of millions of people, and the related constraints to the development of a healthy agricultural and natural resources base. This meeting, which was organized jointly by FAO, the International Centre for Integrated Mountain Development (ICIMOD) and the East-West Centre, Environment and Policy Institute (EAPI), also identified and recommended relevant action for urgent implementation.

The main actions it recommended can be summarized as follows:
- develop significant policy and programme responses;
- develop national conservation strategies and frameworks to achieve appropriate and comprehensive management of mountain watersheds;
- develop relevant training, efficient applied research and demonstration projects required to achieve effective watershed management.

In spite of the progress achieved in developing watershed management approaches and application, most of the actions identified 17 years ago are still in urgent need of implementation, even though some of them were proposed with time deadlines; for example, the development of relevant policies and programme responses was projected to be achieved by 2000.

In addition, issues such as people's participation, in which watershed management scientists and practitioners feel that major progress has been achieved, are now being raised by many as requiring further analysis and clarification. Questions that still require satisfactory responses include: What kind of participation are we using? Are we achieving what was expected? and What is missing for the institutionalization of participatory approaches?

Another important issue that many consider to be a major gap in the evolving watershed management concept is the still very limited dissemination and exchange of information on achievements and lessons learned. Owing to various reasons – mainly a lack of adequate

institutional and organizational arrangements – project experiences and lessons learned are sometimes not even shared among concerned institutions of the same country.

In this connection, the World Bank carried out a review of its own watershed management projects in May 2000. The findings of this review of 42 projects, which had a total budget of US$2.37 billion and were implemented between 1990 and 1999, also call for in-depth analysis to identify what has been achieved and what can be done to improve future watershed management programmes.

In view of these issues, an assessment and review of results and lessons learned in watershed management are considered prerequisites not only for providing answers and clarifications of the issues raised but also, and mainly, as an important preparatory stage for the next generation of watershed management projects and development programmes.

ACHIEVEMENTS AND EXISTING GAPS

During the last few decades, watershed degradation has been seen as a serious threat to environmental conditions and to the well-being and survival of millions of people living in watershed and downstream areas. Many countries recognize the importance of upper catchment conditions, and have made reversing watershed degradation a priority.

However, many watershed management programmes have failed to achieve their objectives, mainly owing to the following reasons:

- They focused too much on natural resources conservation.
- They were designed with little attention to human activities and the priorities and needs of people.
- They neglected beneficiaries' involvement and contribution to the planning and implementation of watershed management interventions.
- They were frequently limited in span and scope, and lacked the long-term commitments needed to address underlying causes and long-term management issues in a satisfactory way.

Consequently, new concepts and approaches were developed to reverse watershed degradation and establish an improved agricultural and rural economy. In order to achieve such objectives, social and economic aspects were given particular attention in watershed management programme/project formulation and implementation. In addition, *people's participation* was recognized as being key to the success of watershed management programmes.

Recognizing that the management and conservation of land resources through physical structures, reforestation and other conservation measures would not be sustainable and replicable unless people's concerns were taken into account, the *integrated concept* was developed as a process in which community problems and needs can be considered as an important component of development programmes. People's participation was also recognized as a principal component in all phases of the development of watershed management programmes.

The *participatory integrated watershed management* approach introduced and developed over the last decade includes, in addition to the technical aspects, the economic, social, political and cultural dimensions of natural resources conservation and management. Watershed management has become a multi-disciplinary activity in which appropriate institutional and organizational mechanisms are required for the coordination/implementation of watershed management activities.

The development of concepts and approaches, and the watershed management experiences from many parts of the world now call for further investigation, analysis and consultation among watershed management stakeholders for greater consensus on what has been achieved and on how things could be done better. Stakeholders are stressing the need for a clearer overview of several key issues of major concern to watershed management development.

Although it is generally agreed that integrated watershed management can play an important role in natural resources conservation and improvement of the conditions of upland people, conflicting views on the approaches and methods of watershed management continue to be the subject of concern and controversy.

A quick overview of the last decade's findings and recommendations on watershed management activities outlines a number of key questions.

Are we sharing experiences and lessons learned? It is recognized that significant progress on watershed management approaches and methodologies has been achieved in different parts of the world. However, sharing these results and identifying appropriate mechanisms for disseminating such information are important issues that require urgent action in order to benefit watershed management users/new projects from experiences learned and to avoid the duplication of efforts.

Are we using the appropriate participatory processes? The experience of participatory approaches during the last decade has raised several issues: What kind of participation is taking place? To what extent can participatory approaches be used? Are we overestimating what can be achieved through participatory approaches?

Participatory processes are recognized as primordial in watershed management at all stages, from project identification to the appraisal and implementation of activities. Experiences have shown that one-sided bottom-up or top-down approaches do not work. This leads to the conclusion that no single approach or method can be considered as the most appropriate one, but rather a variety of approaches and methods should be pragmatically used and adjusted according to specific circumstances.

Are the technologies developed producing the desired results? Greater emphasis is being put on the services and benefits that watershed management can provide. Watershed management is increasingly seen as an appropriate vehicle not only for environmental conservation but also for the improvement of rural livelihoods. In this regard, there is demand for the development of appropriate technologies that can ensure sustainable development and natural resources management. Specific issues are also raised regarding watershed management scale problems, upstream–downstream relationships and the technologies and methodologies needed.

Are project activities sustainable and replicable? There is uncertainty about the sustainability and replicability of the technologies that projects implement. The World Bank (2000) review of watershed management projects raised this concern, stating that "many Bank projects, while able to achieve considerable gains in the short term as a result of an intensive injection of funds and expertise, are neither replicable nor sustainable following project completion".

To what extent have the institutional/organizational and legislative arrangements been developed? Institution building for watershed management has been mentioned as one of the most neglected parts of watershed projects. It is recognized that there is a need for improved understanding and identification of the institutional and organizational arrangements required for effective watershed management. An appropriate legislative framework to support watershed management policies is an important tool that needs particular attention.

Are the expected policies/strategies in place? Recent assessments have shown that although broad environmental policies are in place in many countries, generally no attention has been given to the development of watershed management policies. Lacking or inadequate national policies, strategies and action plans are recognized as principal constraints to implementing sustainable watershed management programmes.

These are some of the relevant controversies and watershed management issues that have emerged from watershed management experiences all over the world, especially those carried out during the 1990 to 2000 period.

In order to achieve effective watershed management, it is necessary to examine state-of-the-art watershed management programmes and concepts. In this context, the review and assessment intends to address the key watershed management issues raised, in preparation for future watershed management projects/programmes.

ASSESSMENT: LESSONS LEARNED AND FUTURE PROGRAMME DEVELOPMENT

The assessment and review of watershed management activities is being conducted with the broad objective of promoting, disseminating and exchanging information on watershed management achievements and existing gaps and providing support for the development of effective watershed management through relevant projects and programmes. It aims to provide an adequate opportunity for all concerned parties to share information and contribute to a better understanding of the current status of watershed management, and to provide awareness raising and the required advocacy and support for the implementation of effective watershed management at the local, national and regional levels.

Based on the in-depth analysis of watershed management activities carried out over the last few decades, with emphasis on the last decade (1990 to 2000), and in view of important events such as the International Year of Mountains (IYM), the assessment/review initiative was developed with the main objectives of:

- assessing and identifying the nature and extent of achievements and existing gaps in state-of-the-art watershed management programmes and concepts;
- identifying lessons learned and principal issues emerging from the experiences of FAO and other relevant organizations, with particular focus on the 1990 to 2000 period;

- identifying guidelines for the formulation and implementation of the next generation of watershed management projects/programmes;
- contributing to implementation of Agenda 21, Chapter 13 (Sustainable Mountain Development) and to the outcome and follow-up of the IYM and the International Year of Freshwater.

The assessment's approach was carefully developed in order to respond to several needs while considering the characteristics of the different audiences involved in watershed management at the global, regional and national levels. It includes:
- stakeholder identification, participation and contribution;
- steps in the assessment development process that allow relevant parties to contribute;
- output that responds to the issues raised by stakeholders.

The following steps were identified as necessary for the proposed watershed management review and assessment.

Consultation: The review/assessment concepts and approaches were discussed in-house. Comments and suggestions were sought from technical divisions involved in watershed management activities.

Investigation: In-depth investigation was conducted to identify whether FAO and/or others had conducted other reviews and assessments on issues related to watershed management activities.

Stocktaking: FAO experiences of watershed management were emphasized, with particular attention on the period 1990 to 2000. Project formulation documents, evaluations and findings, recommendation reports and the outcomes of watershed management events such as seminars, conferences and workshops represent a principal source of information for the assessment. To be in line with the assessment objectives, experiences and information from other relevant organizations were taken into account during this phase of the assessment.

Case studies: Selected case studies treating watershed management issues were identified for in-depth analysis to provide reliable information on state-of-the-art watershed management. By highlighting what does or does not work, the case study analysis can also orient the formulation and implementation of the next generation of watershed management projects. Ongoing work on sustainable mountain development case studies could be a good source of information for the watershed management activities assessment.

Workshops: In order to learn from regional experiences, regional workshops were conducted. Watershed management experts who had been involved in watershed management shared experiences and lessons learned. Workshop participants commented on the outcome of the assessment steps, and contributed to the exercise's findings and recommendations.

International conference: An international conference was planned where key partners in watershed management could discuss the findings/recommendations of the review and guidelines for the next generation of watershed management programmes for dissemination at the global scale.

Dissemination of results: The review and assessment results will be disseminated through reports and relevant Web sites. An FAO Conservation Guide on future watershed management programmes is an outcome of this exercise.

The potential users of the watershed management activities review and assessment include FAO and other relevant international organizations, national institutions/decision-makers dealing with watershed management activities, and watershed management specialists, including researchers involved in watershed management development activities.

Potential uses include: sharing/promoting lessons learned from past experiences; greater streamlining and consensus on the issues raised; raised awareness on the role of watershed management in rural development/poverty alleviation programmes; development of future watershed management plans and strategies; guidance for policy development and formulation of relevant projects/programmes; and orienting research action to identified key issues for the development of watershed management programmes.

The findings and recommendations of the watershed management activities review and assessment will be presented in an FAO Conservation Guide. The results are also available through relevant Web sites.

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CHAPTER 2
REVIEW AND ASSESSMENT OF WATERSHED MANAGEMENT STRATEGIES AND APPROACHES

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The importance of multiple economic, social and environmental benefits derived from land-based resources has increased in recent years. Sound management of these resources is therefore prerequisite to sustainable resource-based production systems. Watershed management, which in essence is the application of land resource management systems, is considered by many to be the most appropriate approach to ensuring the preservation, conservation and sustainability of all land-based resources and improving the living conditions of people in the uplands and lowlands. Integrated watershed management with participation of all the relevant key actors has become widely accepted as the approach best suited for sustainable management of renewable and non-renewable natural resources in upland areas.

WATERSHED MANAGEMENT – A HISTORIC VIEW

Large-scale removal of forest lands by humans in the nineteenth and early part of the twentieth centuries created significant changes in the hydrologic function of watersheds. Downstream flooding occurred more frequently, with subsequent increases in loss of life and damage to infrastructure. Accelerated erosion, produced by changes in the biotic and hydrologic components of natural drainages (watersheds), created unprecedented large-scale siltation of developed lowlands. At the time, the general consensus was that the removal of forest was causing these undesirable impacts. However, the mechanisms for reversing the process through sound scientific management had not been developed.

During the second quarter of the twentieth century, the discipline of forest hydrology evolved from the need for scientific management of the soil and water resources of headwater catchments in order to minimize the flooding and siltation of productive lands and infrastructure in the valleys and plains inhabited by humans. As the importance of rangelands and cultivated lands in the hydrologic cycle and the erosion–sedimentation processes of catchments became known, forest hydrology gave way to the more comprehensive, present-day watershed management.

Over time and in response to changing needs, the scope of watershed management has broadened from the initial concept of technical management of the water resource to an integrated discipline that applies biological, technical, social and economic principles to maintain the productivity of headwater and lowland areas through the scientific management of soil, plant and water resources.

Watershed management in its truest form is the conservation management of the soil, plant and water resources of a catchment to benefit humanity. It involves managing the land and human resources of the drainage in a manner that sustains adequate levels of water, soil, food and fibre production. This form of management requires a participatory integrated approach that includes the various physical, vegetative and human components of areas that range from a few hectares to large river basins.

The watershed part of watershed management implies management of these resources, to the extent possible, within a defined physiographic boundary. From a conceptual perspective, when the boundaries of a management system are defined it is easier to identify and monitor the components (e.g. inputs, storage and outflows) of that system – e.g. the hydrologic cycle. However, from a land management perspective, these physical boundaries are considered to be simply topographic demarcations within political and administrative boundaries that usually overlay a series of watersheds.

The theoretical concept of participatory integrated management of natural resources is difficult to apply. The myriad uses, ownerships, political and social constraints and biophysical systems in large watersheds limit application of the idealistic integrated approach. In practice, large catchments are usually managed according to economic, social and political considerations.

Management of the natural resources in headwater watersheds has the greatest potential for application of the participatory integrated concept. Agricultural, forest and rangelands often represent a potentially significant production resource for local inhabitants. However, the natural physical and biological constraints of uplands often limit productivity compared with lower elevations where major production and population centres are located.

WATERSHED MANAGEMENT REVIEW AND ASSESSMENT OF STRATEGIES AND APPROACHES

Degradation of the natural resources of upland areas has been occurring on the global scale for several decades. In an attempt to reverse this trend, concerned governments and development assistance organizations have been employing watershed management principles since the 1960s. Through these years of development, strategies and approaches for implementing watershed management interventions have changed as the discipline moves forward along the learning curve. By responding to research results, lessons learned, failures and successes, periodic reviews and evaluations, the discipline continues to be dynamic, with adjustment and modification as required to meet changing needs.

During the past decade, the social and economic aspects of watershed management have been given high priority. In addition, people's participation has been recognized as one of the keys to successful management of natural resources (Bendtsen and Sthapit, 1999; Petersen, 1999). The integrated concept has expanded to include community needs and problems as part of a holistic watershed management development scheme.

The last review and assessment of watershed management development strategies and approaches by FAO was held in 1985–1986 (FAO, 1986b). In view of the development changes that have occurred during the past decade, and the period of 17 years since this review, it was

decided to conduct a stocktaking exercise to determine the present status of watershed management development, identify any gaps and formulate guidelines for future development projects/programmes.

Objectives

The overall aim of the assessment was to promote, on the global scale, the dissemination and exchange of information regarding achievements and gaps in watershed management, and to provide future support for effective watershed management projects and programmes. Specific objectives included:

- to conduct a study, on the global scale, of the nature and extent of accomplishments in watershed management;
- to identify major gaps in watershed management strategies and approaches, with focus on the 1990 to 2000 period;
- to formulate guidelines for the next generation of watershed management development projects and programmes.

Procedures

A five-pronged approach was followed to collect information. The first step was to identify key actors involved in watershed management development during the study period. A set of questions designed to provide information relevant to the study was prepared and sent to the key actors. The responses were reviewed and summarized.

The second step was to conduct stocktaking of FAO experience of watershed management development projects/programmes during the 1990 to 2000 period. This process included reviewing project terminal and evaluation reports, proceedings of seminars, conferences and workshops, personal and group consultations, and other information sources.

The third step was selection and review of case studies on completed watershed management projects or programmes. The selected case studies are summarized in this paper.

The fourth step was to convene a series of regional workshops to provide a forum for regional, national and local actors in watershed management.

The fifth and final step was to prepare a summary of the results of the first four steps and to formulate guidelines and strategies for future watershed management development programmes, with subsequent distribution on the global scale.

RESULTS

Initial findings of the watershed management review are presented in the following sections.

Key actors survey

The survey questionnaire was sent to 30 key actors (organizations, agencies and institutions). A total of 18 responses were received: 14 of these provided answers to the questions, and four provided information on contacts and publications (see Table 1).

TABLE 1

Key actor survey: organizations and names of respondents to FAO review questionnaire

CGIAR, Consultative Group on International Agricultural Research.
Ruth Meinzen-Dick, Senior Research Fellow, International Food Policy Research Institute.

CIAT, International Center for Tropical Agriculture.
Joachim Voss, Director-General.

CIFOR, Center for International Forestry Research.
Mike Spilsbury.

CONDESAN, Consortium for the Sustainable Development of the Andean Ecoregion.
Roberto Quiroz.

DANIDA, Danish International Development Agency.
Poul Richardt Jensen, TSA.

DFID, Department for International Development, United Kingdom.
Professor Ian R. Calder, Director, Centre for Land Use and Water Resources Research.

EU, European Union.
Helmut Bloch, M.Sc., Ph.D., Director-General Environment.

FAO, Food and Agriculture Organization of the United Nations.
Kumar Upadhyay, CTA, and Prem N. Sharma, Consultant.

IADB, Inter-American Development Bank.
Roberto E. Quiroga, Senior Economist.

ICIMOD, International Centre for Integrated Mountain Development.
Roger White.

IWMI, International Water Management Institute.
Frits Penning de Vries.

NUS, National University Singapore.
Professor Roy E. Sidle, Department of Geography.

PROMIC, Programa Manejo Integral de Cuencas.
Roberto Mendez and **Ana V. Heredia**.

TMI, The Mountain Institute.
D. Jane Pratt, President.

UNESCO, United Nations Educational, Scientific and Cultural Organization.
Dr Mike Bonell, Chief of Section, Division of Water Sciences.

UNU, United Nations University.
Libor Jansky, Ph.D., Senior Academic Programme Officer, Environment and Sustainable Development.

World Bank.
Norman B. Piccioni, Sr. Agric. Economist LCSES.

The results of the survey were summarized according to three main topics: 1) major issues that require further investigation and in-depth analysis; 2) major constraints – past and future; and 3) challenges, needs and opportunities for future effective watershed management. A summary of the responses is presented in the following.

Major issues that require further investigation and in-depth analysis include: pathways of water, sediment and nutrients in response to land management; appropriate sustainable natural resources management options; cross-scale biophysical and socio-economic issues; the dynamics of natural resource use intensification; multi-institutional approaches to acting together in watershed management projects.

The above suggests that there is a need to establish linkages among central governments, local governments and civil organizations, together with a more coordinated and effective international aid effort. It is also necessary to find ways of: appraising the ecosystem services of catchments and the damage to on- and off-site environments from the viewpoints of farmers and society; creating options for catchment development in which all stakeholders gain (including through intersectoral or downstream–upstream transfers); and dealing with trade-offs and conflict. Staff require careful on-the-job training, particularly in dealing with people, and the role of youth in watershed management should be investigated in greater depth.

In its response, the World Bank stresses that "…finding the right way to address the policy framework and the sets of incentives that affect natural resources in watersheds (water, land, forests, etc.) is key. Also, issues of governance (local vs. central; upstream users vs. downstream users; community organization; mechanisms for water allocation and property rights) are central themes. The challenge is not a conceptual investigation of these issues, but rather the political will to move in the right direction."

Major constraints for the present include reconciling the needs of resource-based planning with "people-first" objectives, the weak national research systems in developing countries, and the need to develop central and/or local government/community commitment and the political will to allocate appropriate staff. Watershed management is about managing conflicts. Thus, lack of governance is a major constraint.

In addition, process-based concepts and models are lacking across many spatial scales. There is insufficient understanding of the reasons why some major catchment development programmes are working well while others are not – in other words there is an inability to replicate successes. Lack of sustainable financial and institutional mechanisms was identified as an additional "Achilles heel" of watershed management projects.

Major constraints for the future include the present-day constraints continuing. Additional constraints for the future are related to limited access to freshwater, with worsening of the environmental situation as water quality and flooding become more important in highly settled areas; upstream–downstream issues are most important where water supply limits productive land use.

There is also a need to improve project design and management in order to increase the participation and commitment of key actors. A major constraint for catchment development is often the willingness/capacity of national governments to act, e.g. with respect to land tenure and payments for ecological services of catchments, including that of water supply.

Challenges include adapting decision support tools for different biophysical and socio-economic conditions, and documenting experiences and lessons learned in order to become the leading organization in this field.

Needs include a specific focus on water and sustainability as they apply to protection of human health and the environment, capacity building of youth through training and rural school curricula appropriate to their environments, and demonstrations of the usefulness of methodologies for science-based project design and monitoring and evaluation.

Opportunities include recognition of watershed management's role as one of the most important mechanisms to address global climate change and the high negative impact of desertification in a sustainable way. There is also increasing public understanding of the importance of managing watersheds. Information collected during the 1990s will make it possible to assess performance more effectively and compare methodologies and approaches based on actual results.

FAO experiences

The second step of the study was to conduct stocktaking of FAO experiences with watershed management development projects/programmes during the 1990 to 2000 period. The process included review of project terminal and evaluation reports, proceedings of seminars, conferences and workshops, personal and group consultations, and other information sources. The results of the stocktaking exercise are presented in the following according to major topics.

Evolution of watershed management methodologies/approaches over the past decade, 1990 to 2000

The top-down approach, which was prevalent during the 1970s and 1980s, has given way to the grassroots, bottom-up approach. However, it appears that neither of the extremes is the recipe for success. The correct, sustainable approach is somewhere in between. The proper mix would include factors such as biophysical, social, cultural, financial and political considerations for all concerned stakeholders.

The emphasis of watershed management has changed from development of upland water and soil resources to all-encompassing management of upland natural resources, communities and associated infrastructure, with diffusion of the focus and prioritization of objectives. Community development has become a part of many integrated watershed management projects, with subsequent lower priority being set for management of soil and water resources. Technology for soil and water conservation on sloping lands has changed from mostly physical methods to emphasis on biological and biophysical treatments.

To some extent, the transfer of technology has shifted from a major emphasis on training professionals to training the local inhabitants who are directly involved in implementing development activities. Some of the more recently developed technologies are being used for planning and decision-making; e.g. Geographic Information Systems (GIS), global positioning systems (GPS), satellite imagery, management decision-making tools, advanced monitoring and evaluation, and participatory models.

FAO's role in sharing experiences and lessons learned in watershed management

Owing to the significant decrease in FAO field projects and the associated decrease in FAO field personnel, national meetings and technical backstopping, the sharing of technology and experiences at the national and local levels has decreased. At present, the sharing of experiences and lessons learned consists primarily of attendance, and sometimes presentations, at high-level conferences.

There is a need for networking of watershed management technology on the global scale. FAO is lagging behind as other organizations set up their own systems. This is an excellent opportunity and time for FAO to take the lead role in fulfilling this gap.

The International Year of Mountains, 2002 provided FAO with a forum to share its experiences in upland watershed development. Regional and national conferences and workshops have also provided fora for information exchange between FAO and national-level professionals. The regional participatory watershed management training project in Asia (1996 to 1999) provided a forum for information exchange between FAO and participating countries. Implementation of the second phase of this project could provide the mechanisms for a sustainable network in Asia, with links on the global scale.

The existing FAO conservation guides are being formatted on CD-ROM for distribution. However, some of these documents were prepared several years ago and may need revision to reflect the current trends and status of technology development and transfer in watershed management. The most recent FAO conservation guide that specifically addressed watershed management was prepared in 1996. Periodic articles on state-of-the-art watershed management topics in journals such as *Unasylva* have provided a mechanism for disseminating information on the global scale.

Decentralization seems to have created a technology transfer gap between FAO headquarters and regional offices. With respect to forestry and watershed management, the flow of technical information between the regions and the relevant central office is lacking. This particular initiative has shed some light on this issue. The causes are most likely multiple and the solutions complex. A detailed problem analysis with subsequent solutions is warranted.

Participatory processes in the planning and implementation of watershed management activities

Global experience has shown that there is no universal model for participatory planning and implementation of watershed management activities. There is a process that would, in most cases, have similar steps. However, this process – which should include all levels and steps of

the participatory process, e.g. planning, design and implementation with all concerned stakeholders – has not been well defined. Bits and pieces of the process have been identified by various projects. The complete participatory process for watershed management needs to be mapped out in a logical manner, tested and refined.

Experience has shown that empowerment of the main stakeholders in watershed management projects/programmes to plan and implement appropriate activities is essential if the project/programme is to have any chance of sustainability. For example, regardless of good intentions, it is not enough for a project to form a community conservation committee at the grassroots level – in isolation from local governments – plan and start interventions, provide technical, financial and other required inputs to the end of the project and then expect the government to make the project sustainable by providing the required inputs into the future. This is a recipe for failure.

Participatory research methods such as participatory rural appraisal, which have been developed and employed on a wide scale in watershed management projects, have sometimes been a good instrument for initiating the participatory process. However, owing in part to the inherent nature of rapid data collection, subjective questions and answers and limitations on statistical analyses and the subsequent extrapolation of findings, the data generated by these rapid survey methods have limitations for use as baseline data for future assessment of project success. In addition, these participatory appraisal methods are only one part of the participatory process. Participatory appraisal methods, if used, should be conducted in proper sequence as part of the overall participatory process.

Participatory approaches and institutional considerations

The pendulum is swinging in support of empowering people with regards to the conservation of natural resources. There are several reasons for this, one being that past endeavours by governments to solve natural resources degradation problems on their own have for the most part been unsuccessful in terms of sustainability. Second, most national governments do not have the human or financial resources for the countrywide mitigation of natural resource degradation. Throughout the world there are examples of successful, sustainable resource conservation being carried out by local communities that have been empowered to manage their land-based resources.

Change is also occurring, albeit slowly, in governments. New policies are being implemented that permit and encourage people's management of their natural resources; e.g. land tenure, user rights, water rights, crop tenure, formal recognition of community groups and committees, privatization of communal lands, rights to the income generated from these conservation activities, etc.

The participatory process requires an active, well-trained field-level extension service in sufficient numbers to carry out watershed management activities on a large scale. The extension component is usually a weak link in the development process.

Gender issues

Review of past FAO projects revealed that gender issues have been a part of watershed management projects. However, the extent to which these issues were addressed has varied and the recommended changes have not always been made. FAO has promoted the involvement of men and women in implementing watershed management activities since the early 1970s. Through time, the importance of directly involving women in these activities has grown. The degree of success of women's involvement has varied for many reasons, including the following:

- *Inadequate project design:* All of the projects reviewed from the 1990 to 2000 period included component(s) for women. However, most of the inputs provided for these activities were minimal compared with other interventions. In addition, the designs addressed only parts of the gender issues in rural environments. Consequently, most of these activities were inadequate in terms of addressing key gender issues.

- *Cultural and social constraints:* Experience has shown that cultural and social constraints are limiting factors regarding rural women's involvement in project activities. Regardless of the level of inputs, these issues have to be considered and project activities designed to fit the norms for a particular rural setting.

- *Policy and legal constraints:* If there is no supporting policy and legislation, the involvement of women in watershed management projects will continue to be limited.

As the empowerment of people movement moves forward, the inclusion of women in the decision-making process is a prerequisite to sustainable development in rural environments.

Impacts of watershed management technologies

Watershed management technologies have proven to be effective for mitigating erosion on sloping land, stabilizing landscapes, providing clean water, and stabilizing – and in some instances improving – agrarian production systems on the small to medium scale. With modification, these existing technologies can be used successfully in most terrestrial environments inhabited by humans. The degree of success of watershed management interventions is primarily a matter of the will of the people and the scale of the activities.

Regarding the *upstream* effects, examples exist throughout the world where upland resource conservation activities have been successful on the micro and macro scales; e.g. micro- to meso-scale activities in Honduras, the Philippines, China, Thailand, Burundi, Nepal, Pakistan, Sri Lanka, India, Bolivia, Peru and other countries, and the macro-project in Santa Catarina, Brazil.

Regarding the effects *downstream*, the impact of upland watershed management activities on downstream water quantity, quality and siltation remains a controversial issue, partly because of economies of scale, and partly because of difficulties in predicting with reasonable accuracy the results of these activities. Until the magnitudes of natural and human-induced erosion and subsequent sedimentation can be quantified with reliability in a watershed, the controversy will remain regarding upstream effects on downstream infrastructures. The same applies to the quantifiable affects of land use on the hydrologic cycle and water supply and quality.

In the meantime, downstream infrastructures such as hydroelectric and/or irrigation dams are being constructed for hundreds of millions of dollars. However, in the past, when watershed management activities were to be carried out to mitigate downstream siltation of these structures, at best a few million dollars were provided to treat all of the contributing upland areas. In many catchments, the upland areas are in degraded condition before the dam is constructed, so implementing small-scale watershed management interventions is like putting a band aid on gangrene; furthermore, the results of poverty-level inputs are poverty-level outputs.

Sustainability and replicability of watershed management technology

The interpretation of *sustainable* in the context of watershed management interventions is a matter of perspective. Many interventions at the community, household and farm levels have continued after the project terminated. For example, woodlots were still being managed years after projects ended in Pakistan, Nepal, Myanmar, Thailand, India and the Philippines. The same applies to terracing works that have stabilized hillsides and improved agriculture production in China, Nepal, Thailand and Honduras; biophysical gully erosion control treatments that have stabilized gully cutting on sloping lands – structures that were built 15 to 20 years ago are in place and functioning as an energy modifier on the landscape, which was the original intention; and simple low-tech water supply interventions that continue after projects finish. The development process has provided many examples of low-tech and low-cost upland interventions being more sustainable than high-tech, high-cost ones.

Two key factors regarding the sustainability of watershed management interventions are financial and institutional stability/instability. As stated by some of the contributors to this assessment exercise, the "tragedy of the commons" continues to be a problem. Experience has shown that the political, social and user rights issues must be solved on common lands before interventions are sustainable.

The technical solutions available for managing soil and water resources are *replicable*, with modification to fit most landscapes inhabited by humans. These techniques are being used throughout the world. The degree of replication depends to some extent on the degree of technical skills and investment required to implement a technique. For example, high-tech, high-cost torrent/landslide control is replicable to most sites. However, the scale of these interventions is limited by the technical and financial resources available. Whereas low-tech, low-cost interventions at the community and farm levels have potential for replication on the large scale if local technical skills are available and people are willing to implement the activities.

Important scale factors for upscaling from site, to watershed, to basin, to region include institutions, finances, and cooperation and coordination of all concerned parties. Important factors for out-scaling from plot or demonstration site to local farms and communities include biophysical considerations, finances, and the capacity of local institutions.

Development status of institutional/organizational arrangements, policy and legislative mechanisms

Watershed management is an integral part of natural resources management in many countries; more so today than ten years ago. Some countries give it more attention than others. In Asia and the Pacific and in Latin America it has been institutionalized into existing forestry and agriculture line agencies. The degree of institutionalization varies, from one or more professionals in watershed management such as in Bhutan or the Lao People's Democratic Republic, to watershed management units or divisions such as in Myanmar, Nepal, Honduras and the Philippines. Institutionalization of watershed management in Africa has been slow to develop. The reasons for this lag are beyond the scope of this exercise.

Policy and legislation that support participatory watershed management remain major issues. Governments have been slow to respond to the need for changes in existing and new policies and legislation that enhance upland inhabitants' opportunities for sustainable participation in natural resource conservation interventions. However, some progress has been made, for example: 1) the granting of user rights for communities and households on government lands in Asia, Africa and the Americas; 2) many countries' enactment of tree crop tenure rights that permit individuals or groups to harvest and market products from trees that they themselves have planted (Nepal, Bhutan, Pakistan and other countries); and 3) formal recognition of local watershed resource conservation development groups/committees.

Training and education

Watershed management training and education programmes have progressed significantly during the past decade. The results of a study by Brooks (FAO, 1992) of the Asia and Pacific region indicate that there are many talented professionals. The study also pointed out that there are excellent education institutions in the region. None of the respondents to the global survey stated that there was a dearth of well-trained professionals. The Brooks study pointed out the need for training/education of all the key actors, from policy- and decision-makers to field-level technicians and villagers who are implementing watershed management activities.

The regional FAO watershed management training in Asia project (FAO, 2000) indicated the need for training in participatory methods and interpersonal skills at all administrative, professional and technician levels.

The major training constraint that surfaces in all the study reviews is the need for more emphasis on well-designed training programmes for local government staff and for the villagers who are directly involved in implementing field-level activities (FAO, 1996; Dent, 1996; FAO, 1999).

Evaluation of FAO projects

Eight FAO projects with a watershed management theme that were implemented during the 1990 to 2000 study period were evaluated in the context of the stocktaking part of this study. Terminal and evaluation reports were reviewed and evaluated according to the following criteria:

- scale of operation;
- participatory approach;
- project design;
- major constraints;
- sustainability indicators;
- training;
- technology;
- government capacity.

A summary of the project evaluation is presented in the FAO project evaluation matrix, Appendix 3.3. The results indicate that all of the projects had a community- or group-level participatory component. Project design was unsatisfactory in two projects, with satisfactory performance for the others. None of the projects were rated highly satisfactory. The major constraints varied, but were common to the constraints that have been identified in this overall assessment exercise. Evaluation of project training components indicated a trend towards more emphasis on the training of local-level technicians and villagers. All of the projects had social and biophysical technical components. However, indicators of the performance of these technologies were insufficient for evaluation. Government capacity ranged from unsatisfactory to satisfactory. In some projects, government performance was not clearly defined. Sustainability indicators were not clearly defined in most of the projects. In addition, these indicators were not of sufficient scope and detail in any of the projects to provide clear evidence of sustainability.

Analysis of the results of the FAO project evaluation identified some points that may need attention for the improvement of future projects. These points are the following:

- Project design is lacking: e.g. overdesign in terms of expected outputs; unclear objectives; less than comprehensive design (i.e. a design that includes the required inputs for all of the key actors in the project [FAO, 1991]).
- Performance indicators need to be comprehensive and clearly defined.
- There is a need for monitoring and evaluation procedures at the project and agency levels that clearly link performance with objectives.
- There is a need for sustainability indicators that are clearly defined and linked to project objectives.

Comparison of major watershed management development issues: 1986 and 2002

During 1985–1986, FAO conducted a study on the problems of watershed management in Asia and the Pacific (FAO, 1986a). One of the outputs of this study was identification of major issues and constraints with respect to implementing watershed management development projects and programmes. These major issues and constraints were used as a baseline for comparison with the major issues and constraints that were identified in the current study. The results of the comparison are presented in Table 2.

TABLE 2

Comparison of major issues and constraints, 1986/2002

	1986	2002
Policy, legislation and regulations	The concept of watershed management (WM) had not been introduced into upland strategies or national development policies	WM has become an integral part of upland strategies in many countries
	Coherent policies to promote good WM were inadequate	Some improvements in policy, but it remains a major issue
	Inadequate coordination policies	Coordination remains a key issue
	Legislative and regulatory measures emphasized policing for enforcement	In some countries, enforcement is now being given less importance than empowerment
Institutions and organizations	WM activities were implemented through forest and agriculture departments promoting the formation of separate WM units within government technical sectors	Experience indicates that this approach is preferable to multi-agency responsibility; separate WM departments are not necessary to achieve success; and well-trained WM staff are needed at all levels
Problem identification, programme planning and project implementation	Diagnostic methods were needed for rapid assessment of biophysical and social parameters	Rapid rural appraisal method developed and used globally
	Scope of WM activities was often not clearly defined	Failure to define scope of WM activities remains an issue although further diffusion of objectives and activities has occurred, with inclusion of integrated rural development
	WM planning methods overemphasized biophysical elements and inadequately considered social and cultural issues	Social and cultural issues have become an integral part of WM planning
	Inadequate economic analysis of WM programmes	Economic analysis models remain inadequate
	Absence of operational guidelines to overcome conflicts between project objectives and administrative organizations	Little progress on making operational guidelines
Monitoring and evaluation	Monitoring often started after, rather than before, projects started	Pre-project monitoring is still rarely carried out
	Monitoring was often inadequate to evaluate achievements and outputs	The advent of verifiable indicators in project design has improved monitoring and evaluation
	Social and cultural factors not covered	Project design considers social and cultural factors
Training and education	Professionals and technicians in WM lacked broad perspective	Good progress, but they still lack people skills
	Curricula copied from external sources, with limited application to local conditions	Many institutions have modified curricula to fit local conditions
	Emphasis on university training, with lack of training for field workers	Emphasis now on training field workers, but training of local people is lacking
	WM is mostly ignored in primary and secondary education	Conservation of natural resources is taught in many elementary and secondary schools throughout the world
	Hardly any planning for development of technical personnel in most countries	Still inadequate technical personnel planning

TABLE 2 - continued

	1986	2002
Research and demonstration	Relationships between technical and social benefits of WM were not clearly understood	Remains an issue
	Causes and effects of watershed degradation in highly populated watersheds were not fully understood	Remains an important issue
	Scarcity of well-designed demonstration watersheds	Demonstration watersheds established, but of little use because of unreplicable levels of inputs and other factors
	Need for linkages among research, demonstration, extension and educational organizations	Remains an important issue
Awareness raising	Inadequate public awareness campaigns	Public awareness campaigns are an integral part of conservation education worldwide
	NGOs are not being used effectively for awareness raising	NGOs are involved in all aspects of WM
Extension	Extension networks were one of the weakest links in WM	Still an issue, although there is more resource conservation and WM extension in many countries
	Majority of extension workers had inadequate training in conservation extension	Training of extension workers is common in many countries
	Weak linkages among extension, research and training	Remains an issue
People's participation	Large deficiencies in methods used to ensure participation	Participatory processes widely used. However, the total process, including all stakeholders, has yet to be well defined
	Unsatisfactory legal, institutional and organizational approaches to involving local residents in project planning and implementation	Remains an issue, and is a key topic being considered by development practitioners
	Land tenure was a major constraint to community and farmer participation	Significant progress, as rural people have gained more user rights, land tenure and crop rights
	Community-owned land was rarely well managed	Remains a key issue in most of Asia. Reasons for poor management of community land have been documented, but little implementation progress
Investments	WM is a long-term process needing long term investments	Donors and governments are aware of the need for long-term commitments
	It was seen as unfair to expect upland communities to bear costs of WM when most benefits were enjoyed by lowland people	Remains controversial, but note recent movement towards payment to upland dwellers for environmental services provided to lowlanders

Source: 1986 issues paraphrased from FAO, 1986b, Chapter 6 – Issues and constraints.

Some of the issues and constraints identified in 1986 remain important today. Some of the institutional, administrative, project planning and research issues listed in the 1986 study have been identified in this current study (Table 2). Progress has been made on several issues and constraints. For example, policy and legislative reform is occurring. Improvements have been made in training and education, awareness, extension, people's participation, and monitoring and evaluation (Table 2).

CASE STUDIES

A literature search was conducted for case studies that had been prepared for projects with watershed management as a major component. Several case studies were reviewed (Dachanee, Lakhaviwattanakul and Kalyawongso, 1996; Hoang and Nguyen, 1996; Lim Suan and Rosario, 1996; Rice, 2000; and Warren, 1998). The following two case studies were selected for presentation in this paper: the Begnas Tal and Rupas Tal Watershed Management Project (BTRT), Nepal (Bogati, 1996) and the Project Land Management II in Santa Catarina, Brazil.

BTRT, Nepal

The Begnas Tal (lake) and Rupa Tal (BTRT) watershed management project was funded and implemented from 1985 to 1994 by the international NGO, CARE. A case study of the project was conducted as part of the FAO regional project on participatory watershed management training in Asia.

The BTRT watershed area comprises about 173 km^2 of land area that includes two main lakes and three minor lakes. The area is about 10 km east of Pokhara in western Nepal. The population is about 31 000. The terrain is hilly with gentle to steep slopes. The area is rural with an agrarian economy. The nearby town of Pokhara is the major population centre of the area.

In the project area, seven village development committees (VDCs) were established and used as the primary mechanism for implementing participatory methods. The local people were involved in planning, implementation, follow-up and maintenance of individual and community watershed resource activities. Watershed management technicians who were part of the external support served as technical facilitators. Community development conservation committees (CDCCs) were organized to ensure people's participation in interventions that were relevant to their particular needs. Every household in the community was represented on the CDCC. The participatory process began with formation of a CDCC, which in turn identified its problems, prioritized its conservation needs and presented these to the VDC and the project office for consideration. At the end of 1994, 100 CDCCs were in operational status. As the project progressed, the need was recognized for a third level of communication and decision-making at the community level. Consequently, a community development board (CDB) was formed at the village level to facilitate communication between the VDC and the CDCC. All members of the VDC and the chairperson of the CDCC are members of the CDB. The end result of this process was a participatory communication pathway of CDCC to CDB to VDC to facilitating agency.

Agricultural diversification interventions have minimized the risk of crop failure and enabled farmers to earn income throughout the year. The average farmer now grows about six kinds of fruits, five different fodder crops, and cereal crops.

Following initial education and implementation by the project, with people's participation, management of natural forests was handed over to the local users. The end result is denser forest lands.

Several conservation farmers adopted improved agriculture practices, which they share with their neighbours. They have set up demonstrations on their farms, and have converted many followers. Homestead agroforestry plots and kitchen gardens provide sources of income. Cash crops such as coffee, pineapples, oranges, cardamom, broom grass, vegetables and other fruits are sold at local markets.

Local women are active in forest management and conservation farming activities, and are fully involved in the decision-making process. Three major factors that facilitated active participation of women were: a clear prospect of benefit sharing; support from their families; and the small size of the CDCC.

Overall, the project was considered a success. The participatory model developed in the BTRT area was used by other development projects in Nepal; e.g. the FAO Shivapuri watershed management and fuelwood project. According to Bogati, the participatory model and many of the activities that were implemented during the life of the project have continued after the end of international assistance.

The major reasons for success of the project included:
- clear and transparent decision-making procedures by project management;
- clear and simple guidelines and flexible operational procedures to facilitate people's participation in watershed management;
- well-defined programmes, budgets, plans, implementation procedures and benefit sharing mechanisms;
- integration of a wide range of diversified watershed management activities, and guarantee of benefits;
- strong motivation among project staff.

The main lessons learned by the project are as follows:
- Interest groups for women should be formed for income-generating activities.
- Indigenous technology for the conservation of watershed resources should be evaluated before external technology is imposed.
- Training of leadership skills for local users is needed.
- Training of local users on maintenance of activities is needed.
- Mid-level field technicians should be oriented in project goals, and receive refresher training in watershed management subjects.

Santa Catarina, Brazil

The Land Management project in Santa Catarina was implemented from 1995 to 1999 with World Bank funding. The project objective was to safeguard farmers' incomes and natural resources by increasing agricultural production and income for about 81 000 mostly small-scale farmers, by promoting the adoption of sustainable, modern forms of land management and soil and water conservation, and mitigating existing upland land degradation.

Project interventions centred on the introduction of land management methods that would improve soil and water conservation and the disposal of animal, human and pesticide wastes in

520 of Santa Catarina's 1 700 micro-catchments. The major components included agriculture extension, research, incentives to share the costs for implementing new methods with farmers, support for reforestation of critical parts of the landscape, rural access road improvement, land-use planning and mapping, environmental monitoring, training assistance to state parks and biological reserves, and project administration.

The overall project performance was rated as successful. Owing to the good performance of the project and the apparent sustainability of activities, a second project is being considered, which incorporates the successful components and lessons learned from the original project.

A case study was conducted on the Lajeada Sao Jose micro-watershed (FAO, 2002), which was one of 520 micro-catchments included in the project. This micro-watershed was chosen for study to illustrate the positive effects of improved land management on land degradation, agricultural production, water quality, and upstream and downstream beneficiaries. The watershed is about 7 744 ha in size, with elevation of about 659 m and slopes ranging from 0 to 20 percent. Total population of the watershed is estimated at 28 375, with a distribution of about 1 057 people in the upland rural area and 27 300 in the downstream urban area.

Improved land use and management (zero and minimum tillage, crop rotation, cover crops, green and organic manure, level terracing and forestation) produced on-site benefits such as reduced soil erosion. Crop production increased (maize by 40 percent, soybean by 21 percent, beans by 3 percent and tobacco by 32 percent) with subsequent increases in farm income. Owing to the downstream environmental monitoring of stream flow, the project was able to determine some of the offsite benefits of the land management interventions. One important benefit was the reduction in suspended sediment levels by 69 percent. This reduction represented a savings in water treatment costs for domestic supply of about US$2 445 per month. This study illustrates that investment in upland watershed management-related interventions can produce downstream economic return.

Some of the important lessons learned during implementation of the project at the study watershed are as follows:

- Active participation and organization of land users are essential factors for success.
- Participatory methods need to be promoted at the micro-watershed level.
- Formal extension to and education of farmers is necessary.
- Existing farmers' organizations need to be strengthened.
- Farmers are most interested in activities that improve farm-level production.
- Environmental education of upstream and downstream inhabitants is essential.
- Decentralization of research and extension is needed.

CONCLUSIONS

Watershed management projects and programmes are being implemented throughout the world. It is considered by many to be one of the important development sectors now, and will continue to be so in the future.

As the trend continues towards empowerment of rural people to manage their natural resources, the integrated, multiple use concepts of watershed management at the community and farm levels with linkages to local and State governments will become more viable.

The watershed management development approach is not perfect in any sense. It continues to evolve with time, with ever-changing development needs. As described here, some of the major constraints that were identified in 1986 are still prevalent today. However, some of those earlier constraints have been removed, or are being given attention by the key actors in development. New approaches such as payment for environmental services are being implemented and tested. The role of national and local NGOs is becoming more important as the participatory approach is being expanded at the community and farm levels. However, the effectiveness of NGOs in implementing sustainable watershed management activities has yet to be determined.

According to Sayer and Campbell (2001), the integrated management of natural resources requires three key elements:

- Management needs to be adaptive.
- Movement along the research–management continuum is essential.
- There must be provision for negotiation among all stakeholders, with interventions that are based on (an outcome) of this process.

Sustained improvement of the well-being of poor people in developing countries, such as farmers, will require natural resource management research that gives more emphasis to: 1) management risks; 2) reduction of dependence on external inputs; 3) avoidance of long-term depletion of production potential; and 4) more careful control of environmental externalities (Sayer and Campbell, 2001).

In the 1990s, the watershed management development sector became, to some extent, ambiguous in context. The basic principles of multiple use management of renewable and non-renewable natural resources, with emphasis on soil and water resources, gave way in some projects to a more holistic, integrated rural development and agriculture production systems approach, with less importance to upland conservation of soil and water resources.

RECOMMENDATIONS

Analysis of the results of this review and assessment study suggests that a paradigm shift is warranted to refocus the watershed management development sector and improve the performance of future projects and programmes. Some of the important paradigm components and recommended changes are listed in Table 3.

TABLE 3

Preliminary recommendations of the FAO stocktaking exercise

Present scenario	Future scenario
1. Treating the symptoms of watershed degradation (i.e. deforestation, soil erosion, siltation, decreasing production) (WRDP-WMIC, 1998).	Identifying and treating the underlying causes of watershed degradation (i.e. lack of knowledge, poverty, population increase, demand for resources, improper land use). More focus on prevention rather than cure.
2. Priority focus on off-site/downstream costs and benefits of watershed management (i.e. downstream infrastructure risk, decrease in floods and sedimentation, increase in water quantity and quality for downstream users).	At minimum, equal priority to on-site costs and benefits of watershed management (i.e. improving and maintaining upland agriculture, forest, rangeland productivity, and water quantity and quality).
3. Inadequate project designs that often overestimate government capacity and assume policy changes will occur.	Project design that provides for adequate government capacity and assures policy changes.
4. Top-down research and development, and transfer of technology to local stakeholders that is driven by donors and education and research institutions.	Emphasis on stakeholder participatory learning and technology development process that builds on indigenous technologies and addresses local research needs.
5. Diffuse focus of watershed management, which often maximizes production of resources/commodities other than water and soil.	Sustainable multiple-use management of watersheds that combines water resources development with compatible economic land-based production systems (i.e. trees, crops, livestock, fish, recreation).
6. Encroachment of integrated rural development approach with multisectoral steering committees and line agencies (which, for the most part, has been a failure) into the integrated watershed management concept.	Multiple-use management of natural resources (renewable and non-renewable), with emphasis on water and soil resources in upland watersheds and with development responsibility given to the relevant line agency.

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CHAPTER 3
OUTCOME OF THE AFRICAN REGIONAL WORKSHOP ON PREPARING THE NEXT GENERATION OF WATERSHED MANAGEMENT PROGRAMMES

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The workshop was co-hosted by FAO and the World Agroforestry Centre (ICRAF), Nairobi, Kenya, from 8 to 10 October 2003.

SUMMARY OF KEY ISSUES

What is special about watershed management compared with other resource management?

- Watersheds are integrators of people, resources and sectors.
- Watersheds link people who may never see each other and who may have vastly different wealth, livelihoods and socio-economic status.
- Watersheds include multiple resources – forests, wetlands, fisheries, agricultural land, grazing land, water.
- Good planning needs to be based on clear understanding of land use – hydrologic systems and interactions.
- Investments are long-term and generate benefits and costs that extend across large distances.
- Interventions that make good sense for individuals or communities may not be good for the total society that depends on the watershed.
- There is a large range of watershed management situations across the African continent in terms of hydrology, policy, culture, governance, investment and the spatial distribution of poverty within watersheds.

What is special about watersheds in Africa?

- In general, levels of poverty are higher in Africa than in other regions of the world, and many African countries are experiencing increasing poverty. This poverty has multiple impacts on watershed management – both resource users and governments have short time perspectives, there are fewer resources available for investment by resource users and governments, public investments are heavily dependent on donor priorities, and donors put priority on poverty reduction and are tending to underinvest in natural resource management.
- Most countries share important river basins with other countries.
- Most important water resources are shared among two or more countries.

- There is a heavy dependence on the priorities and programmes of multilateral finance organizations and donor agencies.
- Most countries have declining water storage in catchments, wetlands and lakes.
- Some countries have extremely low levels of investment in constructed water storage (water pans, dams, reservoirs).
- There is a wide range of situations regarding water availability, forest cover and water quality.
- There is generally low and variable capacity of national and regional institutions involved in watershed management.

Watershed governance

- Many countries have recently enacted new policies for water and environmental management. However, there is a need to harmonize policies across countries and to include other sectoral policies. More important, there is a need to develop the institutional capacity, financing mechanisms and enforcement mechanisms to implement these policies fully.
- There are new commitments to regional harmonization in some parts of the region.
- There is a need for nested management regimes, linking local organizations to sub-catchment, catchment and basin authorities and agencies.
- Africa faces fundamental and special challenges of dealing with the consequences of transnational watersheds and river basins. Fortunately, there have been a number of early efforts to get better transnational water resource management (e.g. the Niger River basin, the Lake Victoria Development Programme of EAC, the Nile Basin Initiative, the Fauta Djallon, etc.).

Experiences with watershed management

- There are some cases of successful case studies in improved catchment management at the local level (e.g. Morocco) and examples of land-use practices that have beneficial effects on watershed properties (e.g. agroforestry practices in Kenya).
- There is good evidence that the poor can benefit greatly from even small additional amounts of water during the dry season.
- There has been relatively little upscaling of successful watershed management to the national and regional levels. Institutional arrangements and financing mechanisms need to be put in place to scale these up to much larger areas.
- There generally is poor coordination and harmonization of organizations and agencies involved in watershed management.

Upstream–downstream linkages

- Smallholder water harvesting has good potential for increasing the availability of water for domestic and small-scale productive uses.
- There are weak controls on water abstraction and forest conversion in the headwater areas of many catchments.
- Deforestation and soil degradation in headwater areas is increasing the severity of peak flows in many rivers.

- Policy-makers and farmers in many semi-arid areas have major concerns about the impacts of invasive trees on river flows and groundwater reserves.
- Many water and watershed management interventions are put in place without due regard to the downstream impacts of those interventions.
- Water quality is underemphasized.
- Groundwater is underemphasized.

Knowledge and information

- There are large knowledge gaps among technicians, the general public and policy-makers about cause and effect relations in watersheds.
- There is a strong need to build the capacity of key institutions in Africa, with emphasis on developing tools in Africa that are appropriate for Africa.
- There is very little effective monitoring and evaluation of water quantity and quality.
- Improved information and information management systems can assist in the resolution of conflicts over water and watershed management (e.g. Ghana).
- Good economic and social planning must be based on good understanding of hydrological relations and good data on demand and supply of water.
- There are a number of important misunderstandings of the relations among trees, forests and key hydrologic properties (especially on the major phenomena of landslides and floods).
- There are unexploited opportunities for sharing concepts and lessons learned across the African continent – among scientists of different disciplines, among scientists, policy-makers and resource users, and among countries at different stages of institutional development.
- Some advances have been made in the state of science of watersheds (summarized by Calder and Mungai).
- There is little sustained experimentation and monitoring.
- There is a need for greater awareness raising among the public and policy-makers.
- There is a need for more open sharing and more consistent collection of data.
- There is a need for more training and institutional capacity building.
- There is limited capacity in Africa in knowledge generation and research.
- We need success stories from Africa, no matter how site-specific, in order to make the case for watershed management with policy-makers and donors. Especially valuable will be success stories in which science and knowledge make a difference in watershed management; and where watershed management makes a difference in people's lives.

Land, forest and water rights

- Africa's legacy is of close interaction between land and water rights, with water rights largely following land rights.
- Water has recently been declared a national resource in South Africa and Ghana, implying the need to transfer water from locations of relative plenty to areas of relative scarcity. In South Africa, this is part of a complicated system of inter-basin transfer of water resources to move water from the high-availability areas in the east of the country to high-population and low-supply areas in the central areas.

- Property rights to watershed resources are held under multiple property systems and are sanctioned by multiple sources of authority. It is important that new agencies have real power, are articulated with property rights arrangements, and are harmonized with existing, trusted and legitimate sources of power.
- Privatization of watershed resources is a default pathway of development.

New financing and benefit sharing mechanisms

- There is a need to mobilize more consistent and long-term donor financing in conservation and investment in watershed management. Donors should be urged to address long-term investments that can reduce the need for short-term relief.
- In some instances, there may be good possibility to link investments in watersheds to people's willingness to pay for reliable and good-quality water – environmental services.
- There are many unanswered questions about who should get compensation for watershed protection and how that compensation should be paid.
- Large questions remain about the potential for involvement of the private sector in watershed management and how that potential can be enhanced.

Networking

- Many groups pointed out the need for networks, although we should make sure that we do not try to reproduce networks that are already in place, such as WaterNet.
- Around catchments, community groups and civil society organizations should be linked with agencies and authorities with management responsibilities.
- There is little South-South linkage within Africa and between Africa and other developing regions.
- There is a need for cross-country sharing of lessons and experiences.
- There is a need for networks among social and biophysical scientists.
- There is a strong need to emphasize the need for linkages between policy and science, based on good accepted science, receptive policy-makers and networks between them

TABLE 1

Summary of working groups

	ACHIEVEMENTS	GAPS	RECOMMENDATIONS
Priority given to watershed management in Africa	Policy-makers are giving more attention to environmental conservation and management of water resources. Some countries have established effective water resource management authorities.	There continue to be large gaps in understanding about cause and effect relations in watersheds, particularly regarding the effects of intensive agriculture and trees in upper watersheds. Little priority is being given to collection, management and use of data for improved watershed management. Almost no attention has been given to the quantity and quality of groundwater resources.	Raise awareness of policy-makers, rural residents and civil society of key interlinkages that exist in watersheds. Need to elevate watershed management issues on national policy agendas, linking it more closely with water and rural development.
Management of upland-lowland linkages in watersheds	Increased understanding of the need for watershed management programmes to be comprehensive and flexible and to involve all stakeholders.	Lack of concern for the potential negative consequences of intensive horticultural production. Little agreement on the role of trees and forests in watershed management.	Promote research in contentious issues, e.g. role of trees in watersheds. Develop appropriate networks for exchange of knowledge. Watershed management programmes should include components on communication/education of stakeholders. Raise awareness about impact of horticulture and intensive agriculture on water quality and health. Develop comprehensive strategies for water quality management in watersheds. Collection and transparent dissemination of information about watershed resources - responsibility of authorities/agencies at all levels of watershed management from sub-basin to transnational basin levels.
Managing conflicts in watersheds	Increased understanding that conflicts in watersheds can be managed in a variety of ways - negotiation, payments and regulation.		Explore, evaluate and test potential mechanisms to address conflicting interests within the watersheds.
Policies and institutions affecting integrated watershed management	Appreciation that better policies can result from effective interactions between politicians and technical specialists. Some countries provide legal protection for domestic and ecological reserves of water. Many countries have new water and environment legislation that clarifies roles for different stakeholders and provides for better regulation of watershed resources.	Lack of harmonized institutional and regulatory framework to deal with transboundary watersheds. Little enforcement of new laws and regulations. Implementation of new water and environment legislation has been limited in many countries. Poor match between sectoral policies and the multisectoral aspects of watershed management.	Link watershed management to environmental management, rural development and poverty reduction strategies. Ensure better linkages between science and policy in setting up watershed management policies. Harmonize existing policies across sectors and among countries that share river basins. Increased communication and awareness creation among stakeholders regarding policy and institutional requirements for effective watershed management.

TABLE 1 - Continued

	ACHIEVEMENTS	GAPS	RECOMMENDATIONS
Practical experiences with watershed management	Some techniques - particularly agroforestry and water harvesting - have been developed that enhance farmers' resource income while reducing sedimentation and runoff. Some countries (especially Ghana and South Africa) have implemented nested watershed management regimes, building from the sub-catchment to the river basin level.	Little is known about the downstream effects associated with improved water harvesting in upper catchments. Lack of funding and expertise in watershed management to implement plans. Some countries have water/watershed management institutions that are operational. Lack of shared understanding and vision of watershed processes, problems and solutions among stakeholders.	Encourage the use of agroforestry and water harvesting techniques, while monitoring and taking account of the potential downstream effects. Develop, test and monitor technologies appropriate for the range of local conditions in Africa. Share experiences of success and failure across countries. Watershed management programmes should include components on communication/education of stakeholders. Watershed management programmes need to be planned and implemented with a long time perspective. Develop feasible up-scaling strategies in watershed management programmes. Watershed management regimes need to be built up from local organizations to sub-watershed, watershed and basin management agencies. Watershed management councils and authorities need to go beyond water allocation to address watershed resource conservation and enhancement.
Involvement of local organizations	Most countries have new water legislation that defines roles for local organizations. Many local organizations are aware of the new legislation.	Low enforcement of new water laws. Implementation of decentralized watershed management is constrained by human and financial resources. Local participation processes are often dominated by elite groups.	Integrated planning and financing for water storage and supply, and watershed management that links local interests and concerns from water quality to conservation.
Institutional strengthening			Strengthen technical and regulatory capacity of institutions mandated to implement watershed management. Develop comprehensive training and information programmes at all levels.
Finance mechanisms			Need to design innovative finance mechanisms to support watershed management for the range of situations found across Africa. Need resources and finance committed for the long periods necessary for effective watershed management.
Networking	Some effective regional bodies are in place to support transnational basin management (e.g. NEPAD, NBI, LVDP, Niger Basin, Fouta Djallon, Inkomati Basin Agreement) Some networking efforts have been made (e.g. AMA, ROPPA, WATERNET).		Establish and strengthen watershed management networks at the national, regional and continental levels.

CHAPTER 4
REFLECTION ON TWO DECADES OF WATERSHED MANAGEMENT EXPERIENCE IN ASIA (1983 TO 2003)

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BRIEF HISTORICAL CONTEXT

Watersheds in Asia are characterized by diverse biophysical settings and socio-economic situations. A FAO study (FAO, 1986) has classified Asian watersheds into seven types using biophysical as well as socio-economic parameters. Within one river basin and over a short vertical interval, one can observe the manifestation of alpine as well as tropical watersheds. Similarly, within one river basin there exist arid, semi-arid and humid watersheds. Many watersheds in Asia are highly populated and represent home for diverse ethnic groups in a multifaceted culture. They are also home for wide varieties of flora and fauna.

Until the 1960s, watershed management as a concept and sustainable natural resource management practice was not well known in Asia. Soil and water conservation activities used to be practised as part of the agriculture extension activities at the farm household level. Watershed management as a discrete national programme started emerging after the 1960s in countries including China, India, Pakistan and the Philippines. These activities were forestry-focused and characterized by large-scale reforestation and protection of natural forests. Engineering methods to control gullies and landslides were applied in the vulnerable areas that threatened the multipurpose dams downstream.

Significant awareness about watershed management in Asia was triggered by a book in 1975 titled "*Loosing ground*" by Erick Eckholm, published by World Watch Institute. This book alarmed the countries in the region, as well as donor communities, about the massive degradation of upland areas in the Himalayas, which was leading to the formation of an island in the Bay of Bengal. The author of the book could successfully present a "doomsday" scenario and drew the attention of the world communities to the problems of watershed management that could result in dire consequences if they were not addressed urgently. A call for launching a global initiative to address the upland degradation problems received substantive support. Since then, several countries have implemented pilot watershed management initiatives.

The 1980s could be considered as the "warming up phase" for watershed management programmes in the region. This is manifested by the launching of a series of global, regional and national initiatives such as workshops and seminars, debates in the media about watershed management concepts and practices, and delineation of strategies and approaches by planners and researchers. If the number of projects launched, human resources trained, and workshops and seminars arranged and the rate of increase in investment in watershed management

activities are to be used as indicators to assess all-round support received by any development paradigm between the 1970s and the 1980s, watershed management will stand among a few leading development paradigms (maybe after only integrated rural development projects).

The 1990s could be considered as the expansion phase of watershed management initiatives in the region. For various reasons, these programmes became quite popular in national and international investment portfolios. One important factor that triggered the growth of the WM initiative was its better performance compared with integrated rural development projects (IRDPs) and core forestry development projects that concentrated primarily on forest productivity. Watershed management projects gained credibility for the reasons that these projects could present themselves as poor; i.e. they were focused on marginalized groups, environmentally friendly, rural in setting, scientific in terms of input/output analysis and "all encompassing" in terms of the basic needs of rural communities (e.g. development of crop, livestock, forestry, small infrastructure and microfinance). During this period, the investment priority of donors shifted significantly from production forestry to environmental forestry such as watershed management.

As watershed management enters into a new millennium, it is also facing criticism and challenges in terms of its concept, as well as practices. In the context of several other emerging development paradigms, development practitioners are raising many questions about its advocated strength. If these questions are not addressed in time, the concept will die a natural death in a world where resources for development are shrinking significantly every year.

THE ASIAN WATERSHED MANAGEMENT EXPERIENCE OVER TWO DECADES[1]

Despite two decades of watershed management practices, Asian countries are still faced with the following constraints at different stages of the project management cycle in their effort to launch national watershed management programmes.

Watershed management policy: Several countries do not have watershed management policy. Wherever it exists, it is characterized by blanket policy direction and lacks focus to deal with specific biophysical and socio-economic situations. Guidelines for site-specific policy problems cannot be addressed by existing policies. The policies do not encourage investment in monitoring and evaluation (M&E), which is so important in watershed management for input/output analysis and to establish upstream–downstream relationships. Policy does not encourage the drawing of master plans to assess the national problem in its totality. As a result, watershed projects proliferate on an ad hoc basis without economic, environmental and social consideration. Furthermore, once promulgated, policies are not reviewed to integrate the lessons learned from the field over time.

Watershed management legislation: The same is true of WM legislation. Several countries do not have comprehensive legislation. Watershed management is currently guided by fragmented laws, including land laws, soil and water conservation acts and forestry legislation.

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1. This section is drawn from the results of the group discussion held at a FAO/ICIMOD Regional Watershed Management Workshop on Preparing the Next Generation of Watershed Management Programmes, jointly organized by FAO and ICIMOD, 11 to 13 September 2003, at Kathmandu, Nepal.

Wherever WM legislation exists, it is characterized by one or more of the following weaknesses:

- It does not encourage or provide incentives for interdepartmental cooperation.
- It does not spell out the funding mechanism for watershed management activities because the benefits go to the lowlands while upland communities suffer.
- It is silent on the sharing of benefits accrued from the joint management of watershed resources.
- It is ambiguous on decentralization of authorities to protect and manage watersheds.
- It is not enforceable because it is top-down and restrictive, limiting beneficiaries with a list of "now allowed" activities inside the watershed. So it is out of date and not revised to encourage people's participation.

Watershed management planning: Watershed management planning is evolving very quickly in Asia, in its focus as well as in its approaches. There is a wide range of variation in contemporary WM planning approaches from the government department-driven top-down approach to a fully community-driven approach. The forestry-focused top-down approach has now been almost replaced by the integrated participatory approach. Wide ranges of planning models exist and each model is characterized by its own strengths and weakness. Several models have worked in a special environment of heavy investment in social aspects through NGOs in the context of pilot demonstration of best practices in a closed environment. None of them could be considered for wide-scale replication because the quantitative evidence that they would work in similar environments elsewhere is difficult to find. In general, the ongoing state-of-the art of WM planning is characterized by the following weaknesses:

- Watershed plans are developed without adequate understanding of the biophysical situation and socio-economic settings. National master plans guided by watershed conditions do not exist in the majority of countries.
- Watershed selection is ad hoc. Methodology for priority ranking using biophysical and socio-economic parameters is not normally used.
- Plans lack focus and try to encompass all aspects of community development, as if WM is the panacea for all problems. Plans do not follow watershed boundaries. Baselines are not adequately established during the planning phase for impact assessment.
- Blanket norms are used for projecting investment costs, irrespective of watershed conditions.
- Interdisciplinary collaboration among government departments, local governance and NGOs is a chronic problem in preparing watershed management plans. Most of the time, plans are donor-driven.

Plan implementation: In Asia, there exist wide variations in the approaches used to implement WM plans. The trend is shifting to community-driven execution with combined support from government departments for technical assistance and NGOs for social mobilization. Wherever coordination among NGOs, local leadership and government extension support have matched, plan implementation and consequent impacts have been impressive (Kerr, Pangare and Pangare, no date). In general, WM plan implementation is characterized by the following constraints:

- *Inadequate and erratic funding:* Watershed plans are long-term. Donor-funded projects in particular suffer owing to a lack of sustained funding because projects are funded for a fixed period of time and donor inputs sometimes cease at the peak of the implementation phase, when an enabling environment is created in the project area through continued dialogue with the beneficiaries.

- *Lip service to empowering and strengthening local governments, women and marginalized groups.* Local governance has no or limited authority to make decisions on resource use. Either donors or government departments make critical decisions. As a result, implementation is delayed, and benefits do not reach the neediest.
- Implementation suffers from a *lack of interagency coordination* at all levels.
- Extension packages are high-tech because they are influenced by external assistance. Low-cost indigenous technology is not investigated adequately, and this issue often is ignored. As a result, the *extension packages are not replicable* and they cannot be sustained by farmers.
- Best practices are documented in special environments where implementation succeeds owing to support provided by a large number of NGO extension workers in a small project area. Such practices are indiscriminately replicated widely in situations where extension outfits are weak.
- *Lack of capacity* at the local leadership level, as well as among farmers and extension workers, regarding social engineering aspects and sustainable land management principles affects plan implementation adversely.
- Lip service to fashionable development paradigms (food security, poverty alleviation, biodiversity equity, special consideration of marginalized groups, etc.) distorts the focus of the project, while the true goals remain unattended. There is frequently a rush to invest quickly and report progress through the indiscriminate use of planned resources. Logical sequences for planning implementation are not followed or ignored in order to establish short-term good impressions on government supervisors and funding agencies.
- Each donor would like to graft its successes elsewhere in its project domain, in areas characterized by different social and biophysical environments. As a result, each receiving country is involved in testing donors' models, resulting in a proliferation of models and approaches. The evolution of a mainstream government strategy is distorted amid the pull and push of externally supported projects.[2]
- Different government agencies view the sustainable use of natural resources in different ways. They formulate legislation in their own interests. As a result, contradiction prevails, and local bodies face difficulties in implementing WM plans owing to conflicting provisions among different sets of legislation.
- Wherever coordinated legislation exists, the local authorities lack user-friendly regulations and guidelines to implement the provisions of the law.
- Implementation of plans suffers from political interference and interest.

Monitoring and evaluation: The strength of WM lies in the fact that inputs and outputs can be measured, and physical and economic impacts accounted scientifically. However, watershed management programmes in recent years are paying more attention to establishing socio-economic benchmarks, at the cost of delineating biophysical information. Symptoms of watershed degradation predominate more in M&E than causes do. As a result, convincing evidence that establishes the merits of watershed management to the people is difficult to find. The following are some of the issues associated with the M&E dimension of watershed management:[3]

2. This experience is drawn from case studies from India, Nepal, Pakistan, Sri Lanka, Indonesia, etc. presented at the regional workshop for Asia, September 2003, ICIMOD, Kathmandu, Nepal.
3. This experience is drawn from the group discussion during the regional workshop for Asia, September 2003, ICIMOD, Kathmandu, Nepal.

- Watershed programmes are investing less and less in baseline surveys to understand the hydrologic and other biophysical regimes of watersheds. Owing to overemphasis on social aspects, governments are less and less interested in establishing field networks such as weather stations, stream flow measurement stations and erosion monitoring plots.
- M&E is not normally integrated into the project management cycle. Instead of being an entry point for project formulation, M&E initiatives normally receive attention only after the projects are operational.
- Wherever M&E plans exist, they are top-down and do not match local capacities to implement plans.
- Local capacity for watershed M&E is limited, and there is no will to monitor.
- M&E is influenced by proxy indicators because the process normally starts after the project has been implemented.
- Target monitoring predominates over impact monitoring because funding agencies and government authorities are primarily interested in short-term impacts.
- M&E frameworks lack information management and transparency. Information generated through M&E is not adequately shared with all project stakeholders.

CONCLUSION

Watershed management as both a development paradigm and a development practice has survived well in the Asian region over the last two decades. Several donors have carried out global evaluations, regional studies and country-specific documentation on its appropriateness as an environmentally sustainable, economically feasible and socially acceptable development initiative. It has stood firmly against several odds. By and large, WM projects have been recognized as poor-friendly initiatives, which have been instrumental in arresting degradation of critical watersheds, creating awareness about the need to promote sustainable use of natural resources, and improving the livelihoods of deprived communities and ethnic minorities residing in hostile economic and physical environments. However, state-of-the-art WM practices are still evolving and there is a long way to go to establish them as a mainstream development concept. WM has faced several barriers in the past and is expected to face challenges in the future before it is widely adopted as a lead activity within the framework of national development programmes. Therefore, the future generation of watershed programmes should be crafted in such a way that the incumbent constraints are addressed harmoniously in a logical sequence.

The strengths of WM lie in the fact that it has wide-ranging recognition from a cross-section of development practitioners, including politicians, planners, sociologist, technical experts and beneficiaries. The WM initiative has earned credibility over the years that when properly designed and implemented it has potential to demonstrate sustainable development goals established by the world community. WM programmes can be tailored in such a way that they demonstrate environmentally sound, economically sustainable and socially acceptable community development in upland areas. Governments in the Asia region should capitalize on the credibility earned by WM projects over the last two decades.

The weaknesses of WM are that it is an interdisciplinary science involving teamwork among many technical agencies. Agencies are poorly equipped and the availability of trained human resources is a serious problem in the majority of Asian countries. This problem is further

compounded by the need for a continuing coordination mechanism to bring teams together in planning, implementation, and M&E of WM initiatives. Furthermore, several countries in the region have a legacy of central planning, and the social engineering skills to make programmes people-friendly are very weak. The last but not the least weakness is an acute shortage of funds for organizing substantive WM programmes. Upland provinces and districts are always politically weak because they are normally far from the power centres. They are generally poor and are unable to mobilize their internal resources. So far, WM initiatives are funded by donors and funds trickle down out to the poorest and ethnic minorities as a result of sympathy. Owing to the lack of a sustainable funding mechanism, consolidation and replication of WM activities have remained a major problem during recent decades.

RECOMMENDATIONS

The earlier discussion clearly reveals that despite significant achievements over a period of two decades, Asian countries are faced with several constraints in their effort to organize watershed management in their respective countries. Therefore, past experiences have to be carefully reviewed and a new road map needs to be defined for the coming years. The outstanding issues that affect watershed management during the whole project cycle from project design to M&E could be categorized as follows:

- technical;
- institutional and organizational;
- resource mobilization.

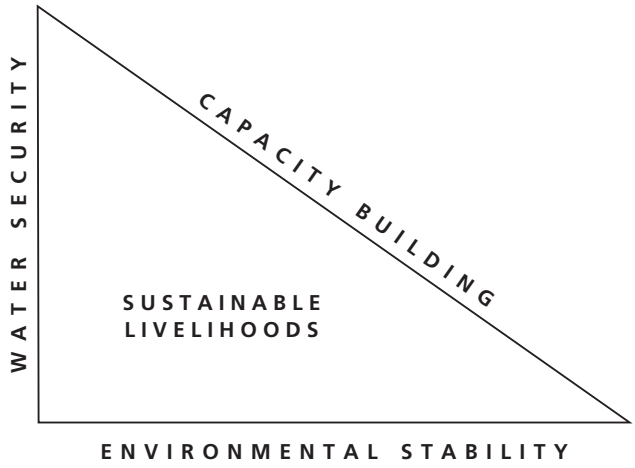
Recommendations that may be able to address each of these issues are presented in the following.

Technical issues

The social engineering aspect of watershed management is very important, but it should not ignore its technical facet, which is its strength in maintaining recognition as an accountable development programme. For this reason, future WM programmes should receive attention in the following technical areas.

Focused conceptual framework: Streamlining of the concept and practice of watershed management in its scope and design should receive priority in coming years. Watershed management is not a panacea for all mountain development problems. There are some problems that watershed management programmes cannot address. Therefore, WM's scope should revolve around water-centred sustainable land-use management practices. It should focus on three elements in the context of Asian watersheds, which are characterized by high population density: 1) food and water security; 2) environmental stability; and 3) strengthening local capacity to manage the land and allied resources. The ultimate goal of watershed management should be to provide sustainable livelihoods to communities residing both upstream and downstream (see Figure 1).

FIGURE 1
The goals of watershed management



As society graduates from one level of economic development to the other, demand for water for various purposes increases. As demand increases, in the absence of proper management, uncontrolled use of water increases, resulting in accelerated degradation of water quality. A vicious circle among demand, reduced quality and reduced availability of water is created. Therefore, activities leading to sustainable water yields and protection of the environment should be the focus of watershed management in the coming years, and this will be possible only if the community's capacity to manage its own local resources is ensured. Future generations of watershed management in the context of Asia should be designed to ensure that these three elements of community development are addressed. Such watershed management programmes would automatically contribute to sustainable livelihoods (SLs) in a given community, although its primary objective is to ensure water security.

Develop a convincing input/output model: At present, watershed management programmes are appreciated by many in Asia who are under the false impression that WM controls floods, reduces sediment deposits along rivers and reservoirs, increases the life of dams, and contributes to increased dry season flow, allowing increased availability of water during dry seasons. These upland–lowland linkages are being advocated by professionals despite the findings of some researchers. For example, one group of watershed scientists advocates that floods in Bangladesh cannot be reduced by organizing watershed management in the mountains of Nepal. Sediment in a dam in north Bengal cannot be trapped through watershed management in Bhutan's isolated mountains. These findings are supported by more and more research findings from different research institutions. Watershed management has a strong local influence in small watersheds. However, ongoing efforts to attract political support for watershed management funding through the use of myths has to change in coming years. If watershed management is to receive priority in the future, quantitative auditing techniques to establish upstream–downstream relationships have to be established. These techniques should be linked to monetary and social costs and benefits.

***Improve technical skills to distinguish between human-induced watershed degradation and natural triggers*:** Techniques to distinguish between human-induced and natural causes of watershed degradation are still not well established. As a result, it is difficult to invest the scarce resources wisely to optimize the benefits of watershed management rehabilitation by focusing more on the human-induced aspects. Equally important is enhancing the ability of watershed managers to explain to stakeholders the true dynamics that influence a given watershed and to sensitize them about how degradation is occurring. Once stakeholders are sensitized about these issues, local solutions emerge automatically, contributing to the emergence of less expensive alternatives to watershed management.

Revitalize technical infrastructure in biophysical analysis of the watershed resources, including inventory, database management and M&E skills: In those countries in Asia that are donor-dependent, technical infrastructure created in the 1980s to carry out biophysical analysis is degrading since the emphasis on social engineering aspects in problem analysis and implementation strategies started to predominate during the 1990s. Participatory appraisal tools are well developed, but the modern application of remote sensing and GIS, which have become powerful analytical tools, is less developed. Future investment in watershed management programmes should invest more in revitalizing the hardware aspects of planning.

Systematic documentation of lessons learned and best practices and their dissemination: Several field projects in Asia have succeeded in piloting economically sustainable, socially acceptable and environmentally friendly watershed management practices. Most of these lessons learned are forgotten owing to a lack of funds for documenting them and disseminating them to management practitioners and extension agents. Externally supported projects terminate abruptly. Therefore, it is highly desirable to organize a global or regional initiative to identify, document and disseminate the best practices and lessons learned from different situations.

Create awareness of the dynamics of watersheds and their values: Any development theme will not survive by maintaining myths and by continuously advocating "doomsday" scenarios. In many languages, there is no direct translation of the word "watershed". Even key decision-makers are not aware of the simple dynamics of how a watershed functions. Not many people understand watershed values and their implication on national economic development. As a result, mountain communities are neglected and become involved in the cultivation of drug-related crops or create radical movements to attract the attention of elite groups in their own countries and the world community in general. Wa region in Myanmar, and several mountain belts in Afghanistan have continuing problems of opium cultivation. Nepalese mountains are now affected by a radical Maoist campaign, which has a strong support base in mountainous districts that have been neglected for decades and living below the poverty line for generations. Therefore, it is very important to sensitize those responsible for national development about the social, economic and environmental consequences if today's issues confronting mountain development are not addressed.

Institutional and organizational issues

Policy and legislation: WM initiatives cannot survive if they have to face continuing conflict with national policies, programmes and procedures. It is recommended that the next generation of WM projects try to reconcile the requirements of WM with mainstream polices, programmes and

procedures. Principle policies and legislation to be looked into are land-use policy, land law, forest acts, land-use and land tenure polices including usufruct rights, environmental impact assessments, water users' rights and water management systems, etc. A WM programme should also try to fit itself within the comprehensive poverty alleviation and growth strategy of the country. Furthermore, WM initiatives being interdisciplinary affairs, their organizational arrangements should be consistent with the overall decentralization policy of the government concerned.

Watershed management organization: Organizational structures to carry forward national WM programmes have remained as an outstanding issue. There is no single recipe to address this issue. Different countries have their own organizational legacies and needs. However, certain requirements of WM should be followed as a guideline to designing country-specific organization. These are presented in the following:

- Watershed management programmes could be compared with the intensive care units of a hospital where watershed degradation is widespread and involves the management of large numbers of beneficiaries. Just as a hospital serving the needs of a large population requires an intensive care unit, countries with huge problems require special organization with interdisciplinary staff to plan and implement watershed rehabilitation activities rapidly on a priority basis. One umbrella organization (in Nepal) involving different disciplines works well in this situation. Similarly, in some cases, watershed management should be managed with due consideration of forest management (predominantly in forested watersheds with low population density [Bhutan]). In these cases, there is no need for a separate department to organize WM activities. Existing departments, as an interdepartmental working group, can easily handle such situations, with the Forest Department playing the role of focal point. The next generation of projects should focus on creating watershed management infrastructure to support both umbrella projects and interagency-driven projects through the establishment of nodal points at the national, provincial and district levels.

- Watershed management is not a panacea for all problems in mountainous areas. Nor does the responsibility of managing watersheds lie with a single discipline. Teamwork is mandatory to address the multifaceted problems characterizing watersheds in Asia. Several countries in Asia – especially countries in transition – have a legacy of central planning (Viet Nam, Myanmar, Lao People's Democratic Republic, China). Government departments and associated institutes are still vertically structured. Promoting teamwork is always a daunting task. Therefore, emphasis on teamwork and interdepartmental cooperation should be advocated by donors, international funding agencies and UN specialized agencies. For this also, WM nodal points at all levels of government are important.

Watershed planning unit: Several countries in Asia seem to be engaged in a debate about the planning unit for WM. The centre of this debate is whether to follow administrative or physical boundaries. However, as long as the country capacity to audit the input–output relationships of soil erosion and runoff, and to analyse the costs and benefits of tangible or intangible values does not exist, WM projects could continue to be planned over administrative boundaries. Projects with a manageable number of administrative units and local functionaries should be considered in the next generation of WM projects. This is especially true for participatory WM projects directed at multiple-resources productivity. In the long term, WM should follow watershed boundaries for the purpose of input–output analysis and cost and benefit sharing. This is where the strength of watershed management lies.

Top-down and bottom-up planning and implementation approach: Debate about the best approach to WM (participatory or departmental-driven) is futile and a waste of energy. Documentation of best approaches has proved that projects that combine social engineering to make participation meaningful and have technical extension services guided by the departments have performed far better. Therefore, watershed management in the future should combine the best of both approaches to provide the most benefits.

Programme approach: The majority of incumbent watershed management initiatives in Asia are characterized by the project approach rather than the programme approach. WM projects tend to establish parallel project organization for fast delivery of goods and services, intensive extension, training of farmers, etc. During the process of project delivery, the WM extension team encroaches on the jurisdiction of incumbent institutions. As a result, watershed management staff face continuing conflict with regular extension outfits in the project area. Consequently, project delivery suffers. In the future, countries should initiate watershed management as programmes with nodal coordinating organization at different levels, and planning and implementation through respective disciplines and NGOs.

Resource mobilization

Two issues are of primary importance to ensuring sustained financing of WM initiatives in the future. First, approaches to mobilize internal resources need to be sought. Second, strategy to mobilize long-term commitment of the donor community needs to be developed. Each country should develop statutory means to mobilize resources for WM initiatives internally. It is suggested that countries in the region initiate the appropriation of certain percentages of revenues from hydropower, ecotourism, irrigation water fees and forest products to fund watershed management initiatives. Such fund mobilization initiatives cannot be generalized, but depend on the specific situation of a country.

There are good examples in the region that have led to the mobilization of long-term commitments of donors to fund projects. The first example is that of Bhutan, where the Environmental Trust Fund[4] has been established to fund nature conservation and biodiversity-related projects in the country. A second example is the recent donor–government partnership in the forestry sector in Viet Nam. A comprehensive exercise characterized by the programme approach led to the evolution of a Forest Sector Support Programme and Partnership document (Government of Viet Nam, 2001) consisting of portfolios of different investment projects. Efforts are under way to invite potential donors to pledge their financial commitment in a trust fund or to pledge their support to a subsector activity identified by the programme document on a continuing basis. A similar approach could be tried to ensure sustained funding in the next generation of national WM programmes.

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CHAPTER 5
INTEGRATED WATERSHED MANAGEMENT IN LATIN AMERICA AND THE CARIBBEAN

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Major efforts aimed at upgrading the natural resource status of Latin American and Caribbean watersheds began in the early 1980s, intensifying in 1990. This followed decades of sectoral attempts to deal with specific problems with scant support and using a plethora of approaches, which led to only partial or limited success.

An important change in policy and strategy took place in the 1990s, owing largely to the establishment of close contacts among the countries of the region. These included the establishment of REDLACH, the Latin American Network for Technical Cooperation in Watershed Management which was promoted by FAO, and the implementation of Agenda 21. Concern has also arisen over water access problems, which are steadily affecting a growing percentage of the world's population.

Between 1990 and 2000, REDLACH held 11 international meetings on this theme, in North, Central and South America, and in the Caribbean. Prominent among these were the First, Second and Third Latin American Congresses on Watershed Management, held in Chile, Venezuela and Peru (the last in June 2003).The general public, public and private sectors and the international funding and cooperation agencies started showing greater interest in enhancing watershed management, adopting common approaches and strategies for technology transfer and cooperation, and validating effective practices and models.

Some do question, however, whether there has been genuine progress, and if the right moves have been made to solve the various problems. Also, are we succeeding in improving the water resource situation and are we achieving the hoped-for results in poverty reduction? These are two of the prime objectives of integrated watershed management, and have been given top priority by major world meetings such as the Johannesburg Summit of 2002.

At the regional level, the most important recent event was the Third Latin American Congress on Watershed Management, held in Arequipa, Peru, from 8 to 13 June 2003. This important meeting provided an opportunity for the countries of the region to analyse, evaluate and exchange scientific and practical information and ideas, and to assess technical and conceptual progress in sustainable watershed development. More than 300 invited papers and talks on scientific research and experiences were presented and discussed in this occasion, leading to the conclusions and recommendations summarized in the Declaration of Arequipa.

FAO convened an expert workshop in connection with the Third Congress, taking advantage of the presence of professionals from various countries, including national representatives of REDLACH. This workshop took a closer look at watershed status in the region. It was held

from 16 to 17 June, 2003, in Arequipa, with the participation of 30 experts from 19 Latin American and Caribbean countries, and from FAO and the World Conservation Union (IUCN). The three phases of the workshop included:

1. the presentation of five reports to establish a framework for discussions and anticipated results;
2. the establishment of three working groups representative of the three subregions of Central and South America and the Caribbean, to review the current situation and highlight lessons learned; and
3. the definition of benchmarks for planning the next generation of watershed programmes and projects.

THE LATIN AMERICAN EXPERIENCE: OUTPUTS, GAPS AND LESSONS LEARNED

Outcomes achieved in promoting watershed management outputs identified by workshop participants include:

- greater public awareness of watershed management in the region, and enhanced participation of community organizations, governments and local actors in project planning and implementation as part of a decentralization-targeted process;
- consideration to watershed management in policy, legal, sectoral and environmental frameworks, and country progress in the establishment of watershed authorities;
- watershed management approach followed in almost all countries in the region, with regional conceptualization and validation under way throughout the region;
- numerous plans, programmes and projects under way throughout the region, with an abundance of planning and technological tools available, using the watershed/sub-watershed/micro basin concept widely, often in connection with territorial planning;
- NGO advancement in their role as promoters; fostering community participation and contributing to progress in watershed management;
- strategic alliances forged among the public and private sectors and local and community authorities for the implementation of specific projects;
- substantial progress in human resource training and capacity building, and in the production of information and reference materials;
- policy-level acknowledgement of the importance of international watersheds, and a heightened regional approach to project and programme planning and implementation;
- a positive highlighting of the role of REDLACH in the exchange of information and promotion of technical cooperation among the countries of the region.

Weaknesses in watershed management

Main weaknesses in watershed management were summarized in the conclusion of the workshop as follows:

- limitations in terms of official support and lack of continuity in the implementation of plans programmes and projects using the integrated management approach;
- political will with respect to environmental management seriously affected by the high levels of investment required to establish watershed governance bodies and implement guidelines;

- limited scope for the process of consensus building and application of norms, laws and guidelines for natural resource management;
- lack of qualified staff to meet watershed management needs, which is partially due to lack of job security for technical staff (as a result of government changeovers threatening management continuity and fostering institutional weakness);
- weak (or absent) public and local institutions, hindering their effective participation, and also affecting inter-agency coordination and conflict resolution;
- few mechanisms for promoting community participation in training programmes for watershed users and dwellers, with virtually no upstream-downstream integration;≤
- insufficient quantity and quality of baseline and implementation data for planning, monitoring and evaluation;
- data on water pollution not considered in management plans;
- insufficient public sector funding to plans, programmes and projects, and lack of appropriate financial instruments to promote private sector intervention;
- watershed management programmes frequently very limited in social, environmental and economic terms, offering insufficient technical assistance for small rural producers.

Watershed management lessons learned

Main lessons learned in this workshop include:

- Watersheds are optimal as territorial planning and management units. The watershed approach can be a springboard to sustainable development and natural resource protection. However it still needs to be recognized by administrative divisions and local governance.
- The concept of integrated watershed management has evolved. It is now founded on community participation. Despite this, the participation of the various stakeholders is limited, and close links with decision-makers have yet to be established. Where participation has achieved consensus and a multidisciplinary approach has dominated, watershed management has been strengthened.
- Decentralization and institution building and reinforcement are essential, but the lack of local, regional and multi-regional coordination, plus weak local capacity, have proved obstacles to watershed management
- Many watershed management projects have failed to focus sufficiently on the water quantity, quality and appropriate use aspects. This is one of the main reasons why the importance of watershed management is not recognized. There is also some confusion as to the separate concepts of integrated watershed management and water resource management.
- Policies, programmes and projects aimed at reducing poverty and providing basic services fall short of the region's needs. Subsequently, they have failed to make an effective contribution to higher living standards. This has hindered their acceptance.
- There is a gap between the amount invested in physical infrastructure and that earmarked for natural resource conservation and protection, even though technical and financing agencies give priority to watershed management.
- Traditional and local practices and lore need to be revalidated, especially those of indigenous peoples.

CHAPTER 6
MEDITERRANEAN WATERSHED MANAGEMENT: OVERCOMING WATER CRISIS IN THE MEDITERRANEAN

Luc Dassonville and **Luca Fé d'Ostiani**
Plan Bleu, FAO

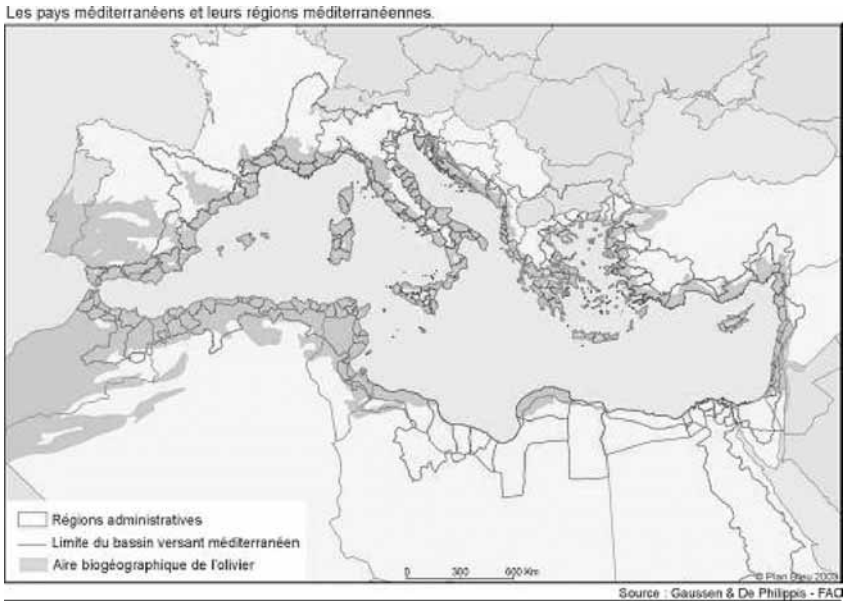
Water is the subject of much bilateral and regional cooperation in the Mediterranean. The Global Water Partnership for the Mediterranean is now composed of 12 networks and institutions, including Plan Bleu, which has elaborated the Mediterranean Vision on Water for the 21st Century.

Plan Bleu is a regional activity centre of the Mediterranean Action Plan (Barcelona Convention), created in 1975 under the aegis of the United Nations Environment Programme (UNEP).

Plan Bleu activities on water issues are focused on research and studies on water policies, sustainable development indicators, environmental information publications, sharing of experience among countries, statistical data production and database management.

Plan Bleu is the main support centre of the Mediterranean Commission on Sustainable Development to back the regional strategy for sustainable development in the Mediterranean.

FIGURE 1
Mediterranean countries and their Mediterranean regions



FROM SCENARIO BUILDING TO STRATEGIC CHOICES

In the Mediterranean, climate conditions have led people to learn to plan and manage their water since the earliest times. Yet the demographic growth and social and economic changes of the twentieth century created a new situation. In the degraded environment, water – a rare resource – is under threat and has become a factor limiting development in many ways.

To face up to a rise in the problems that seem unavoidable, the people of the Mediterranean must learn how better to manage water resources in the long term, for all economic sectors.

Within the Mediterranean Commission for Sustainable Development (MCSD), water sector actors are thinking about and assessing the best ways of avoiding local water crises.

Increased use of unconventional resources (e.g. desalination and waste water reuse) and long-distance water transfers, which are unavoidable in certain places but costly, will respond only very partially to the increased need for water.

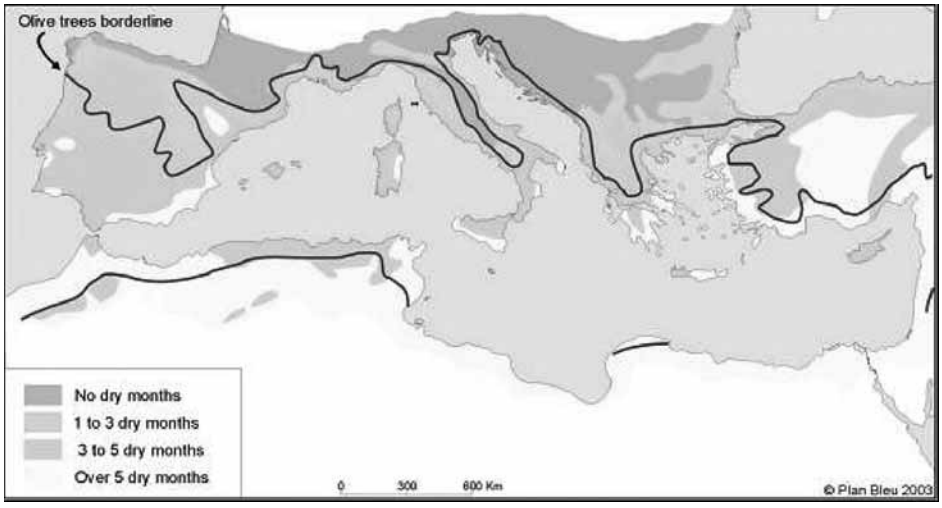
Faced with the necessity to improve the water supply significantly, optimizing water cycles becomes imperative. Integrated watershed management is a field that is becoming better known and implemented, as shown by many national and local experiments.

A RESTRICTING CLIMATE

The Mediterranean region is bioclimatically characterized by strong summer droughts. Over the past 20 years, most countries have experienced memorable droughts lasting several years.

Precipitation is irregular and often violent. Mediterranean high water often causes disastrous flooding, and rain is a major cause of soil erosion.

FIGURE 2
The "olive border" in Mediterranean countries



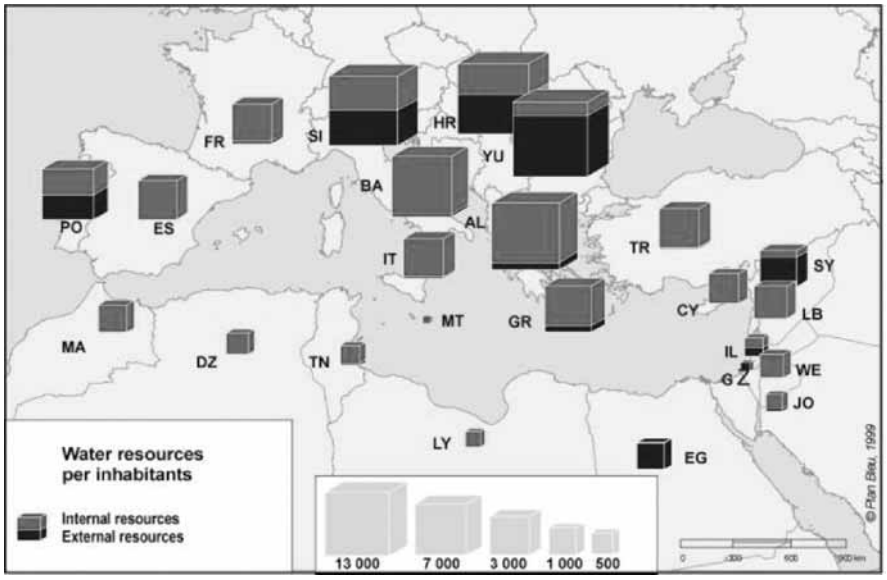
Faced with these constraints, local societies and governments have always endeavoured to plan and manage water and soils, as witnessed by the ancestral expertise of farming communities and the major urban water works of antiquity. In the nineteenth and twentieth centuries, major drainage and irrigation works made it possible to transform numerous marshy plains into high-yielding land.

WATER RESOURCES STILL JUST AS CONSTRICTING

On its own, the Mediterranean represents 60 percent of the "water poor" (less than 1 000 m^3 per capita per year) world population, or 162 million people, mostly living in the south and east, but only 8 percent of the world's total population (at 450 million people).

Natural resources are very unequally distributed among the countries (72 percent in the north, 23 percent in the east and only 5 percent in the south) and among population groups.

FIGURE 3
Water resources per inhabitant



SHARED WATERSHEDS

Some countries or territories (e.g. the Syrian Arab Republic, Israel, the Palestinian Territories and Egypt) are heavily dependent on other upstream countries.

POPULATION: A DETERMINING FACTOR FOR WATER DEMAND

Despite the present drop in the fertility rate, the Mediterranean population will have almost tripled in a century because of demographic growth in the south and east. A young, strongly growing population in the south and east contrasts with a stagnating, ageing population in the north, while migratory movement continues between the Mediterranean's two shores.

FIGURE 4
Shared watersheds

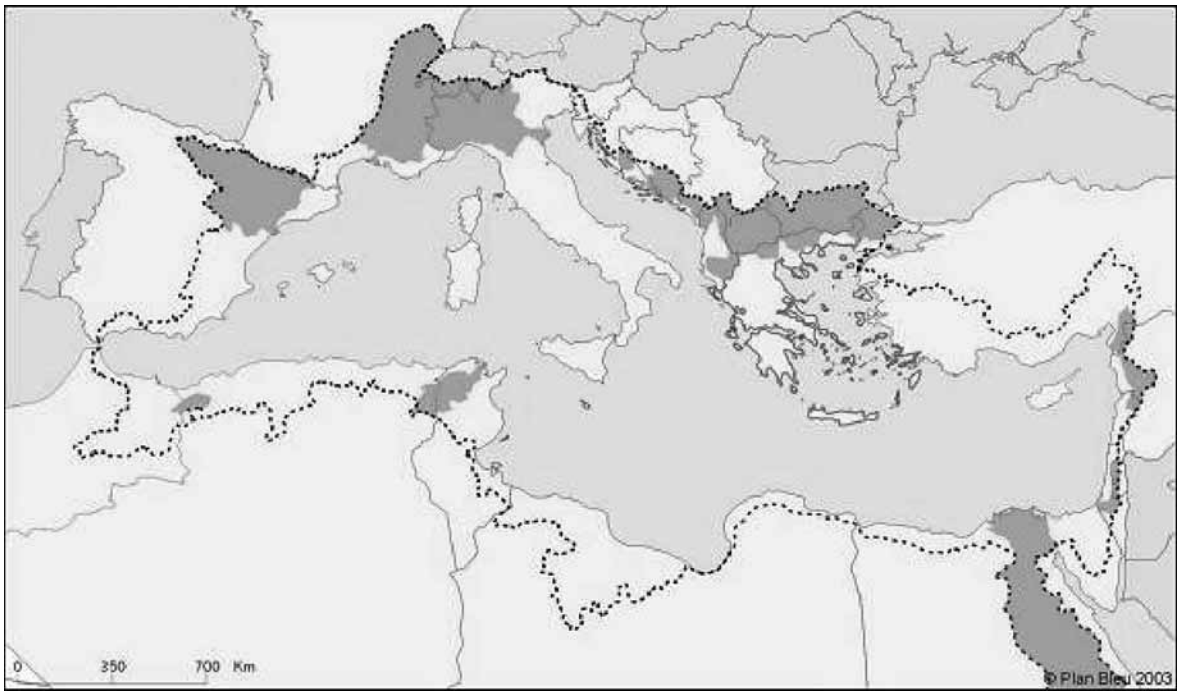
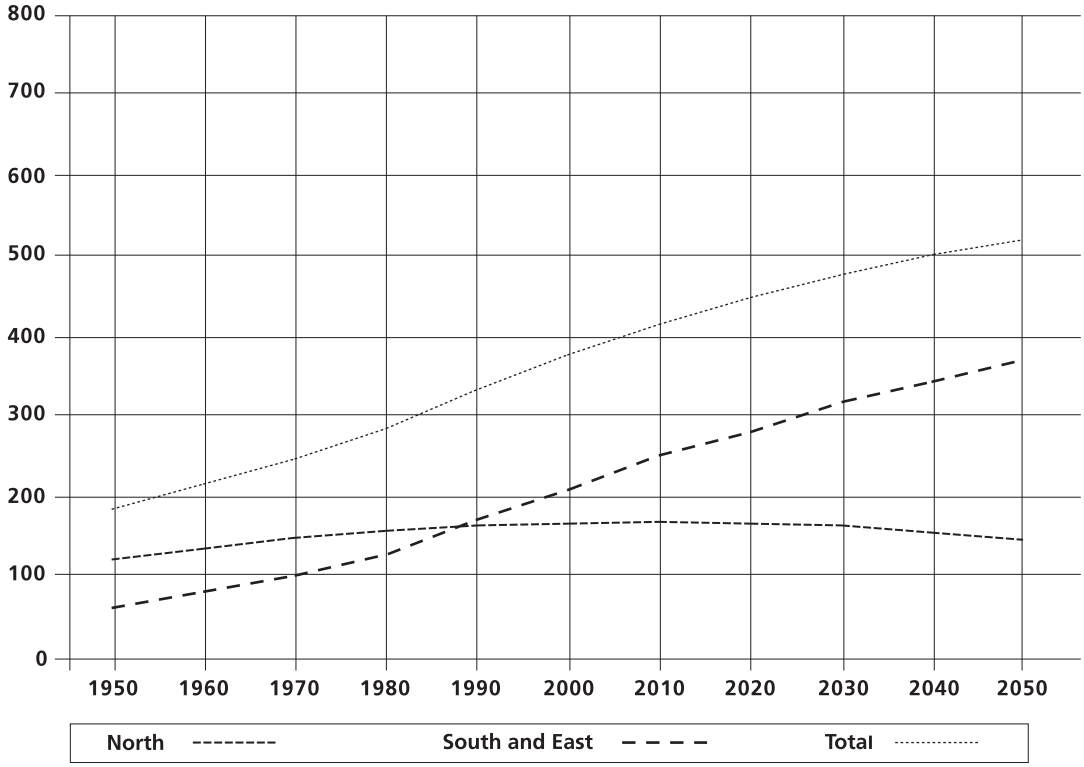


FIGURE 5
Population projections in the Mediterranean



IN THE SOUTH, AN INCREASINGLY IMPOVERISHED AND WATER-STRESSED POPULATION

The southern and eastern parts of the Mediterranean basin host many rural populations, some of which are still growing. In these regions, 79 percent of the rural population lives from farming; irrigation water is a vital economic resource for these people.

At the same time, migration from the country to towns is generating increased urban demand.

STRONG AND GROWING SECTOR-BASED WATER DEMANDS

300 billion m^3 of water are being used today in the entire region. This water demand (consumption + losses from conveyance and distribution) has doubled in a century, and increased by 60 percent over the past 25 years. It remains unevenly distributed (from 100 to more than 1 000 m^3/capita/year), depending on the country.

The main cause of increased total demand is irrigation, which represents 82 percent of the total demand in the south.

FIGURE 6
Per capita water supply

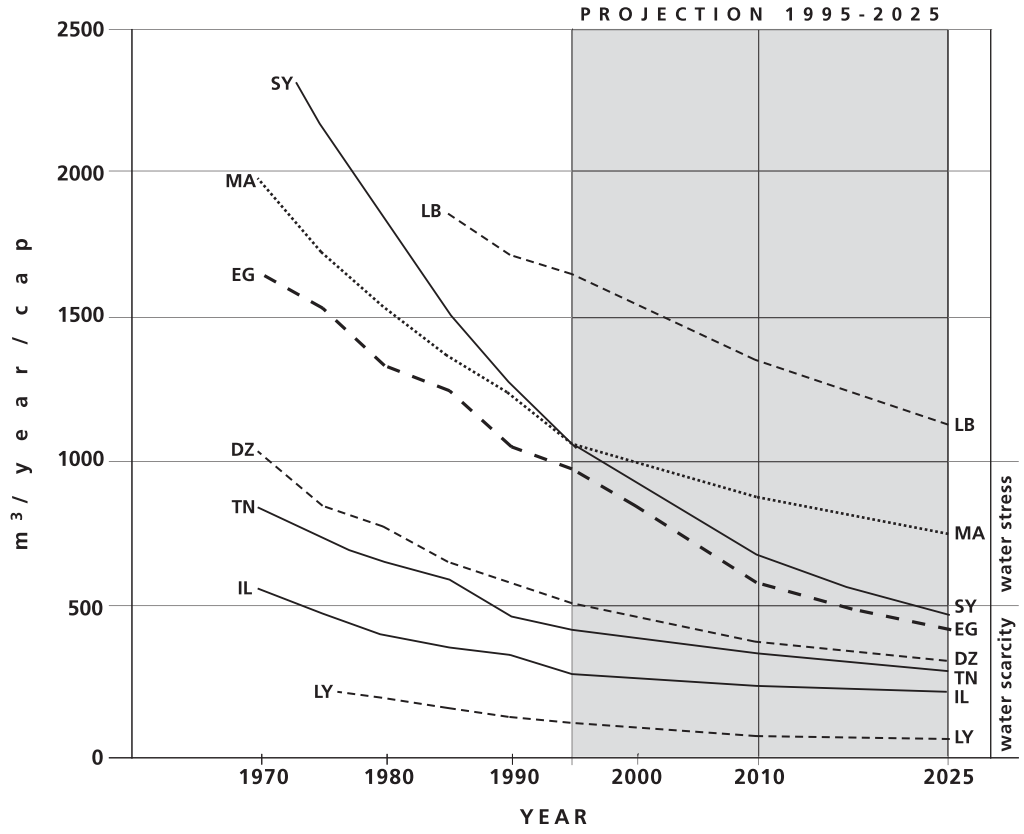
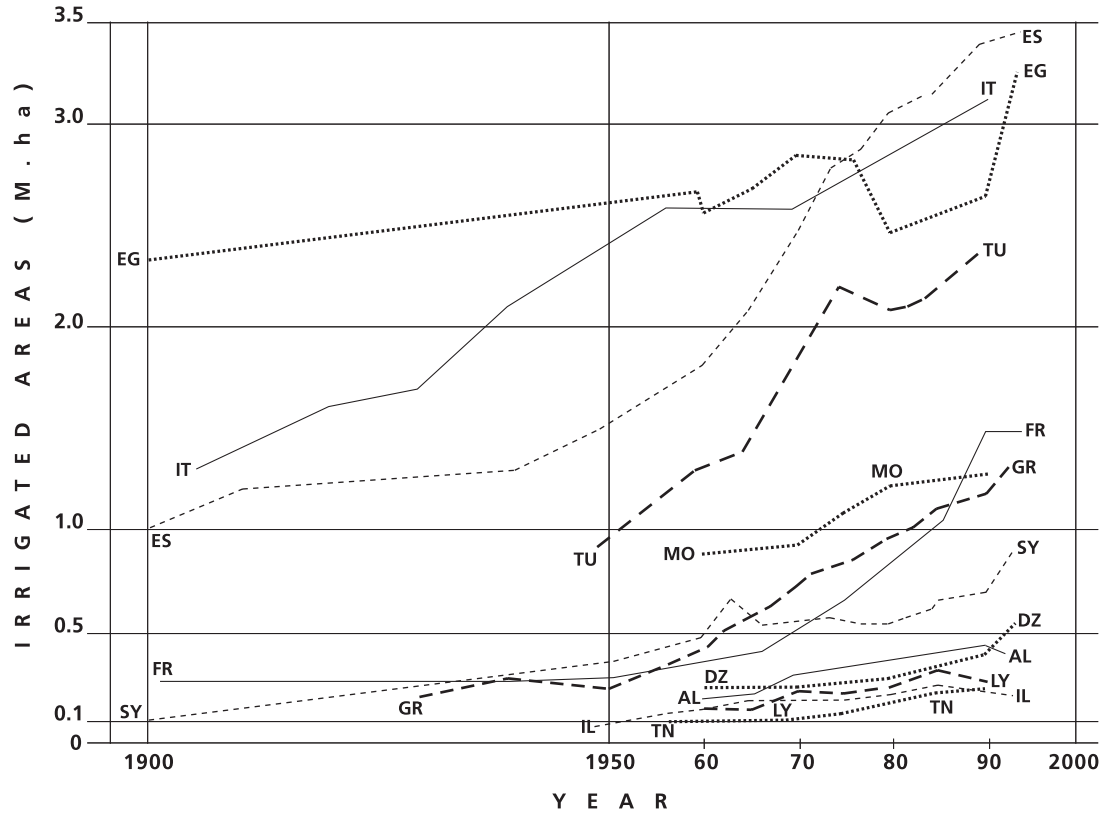


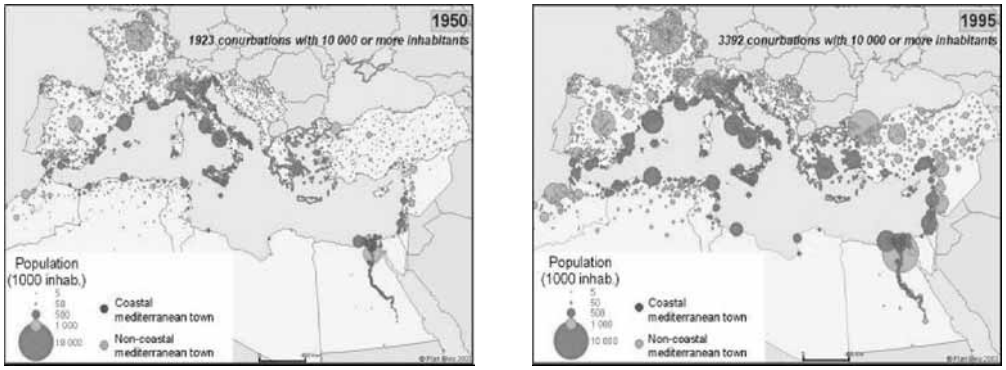
FIGURE 7
Irrigated areas



Urbanization

Towns of more than 10 000 inhabitants will account for 80 million inhabitants by 2025 (compared with 43 million in 1995). Water supply and sanitation needs for this population will require more and more water and considerable supply investments in water supply and treatment. Several experiments show that service improvement (leakage control, customer monitoring, adapted water pricing) make it possible to mobilize water loss volumes and orient them towards new water demands.

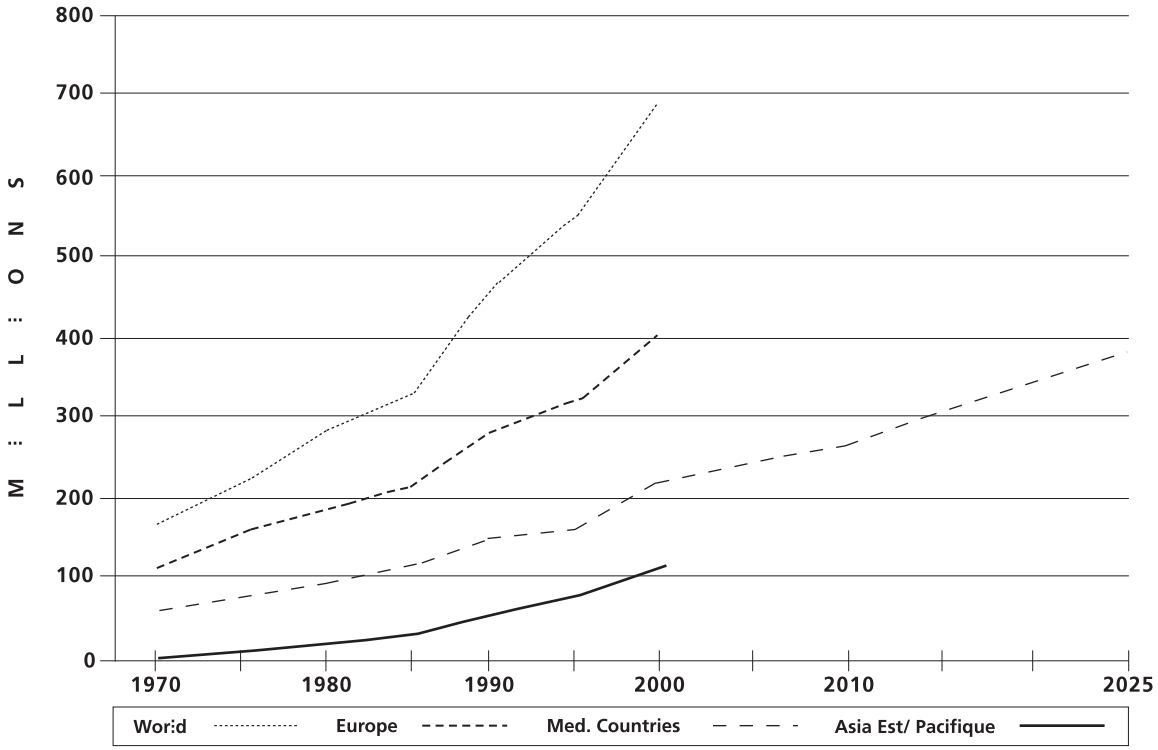
FIGURE 8
Cities of at least 10 000 inhabitants, 1950 and 1995



Tourism

Very rapidly developing tourism (the Mediterranean is the most visited destination in the world) greatly increases the summer need for potable water in the coastal areas.

FIGURE 9
Worldwide tourist numbers



THE TERRITORIAL IMBALANCES OF THE TWENTIETH CENTURY

Populations and economic activity tend to concentrate on the coastline. Accelerated and uncontrolled urbanization and accrued competition among activities for soil and water have led to the degradation of particularly precious and fragile countryside and ecosystems. Coastal groundwater is overexploited, while inland areas are often abandoned and degraded from lack of upkeep. Water need is especially acute on coastlines and islands (tourism).

EXISTING MAJOR IMPACTS

Withdrawal already exceeds 50 percent of the renewable natural water resources (all of which are far from "exploitable") in countries such as the Syrian Arab Republic, Tunisia and the Mediterranean watershed of Spain, and 90 percent in Egypt and Israel. The exploitation index goes beyond 400 percent in the Libyan Arab Jamahiriya, a country that uses mainly non-renewable fossil resources. These averages mask extremely strong local pressures on water resources.

FIGURE 10
Traditional and today's Mediterranean slopes

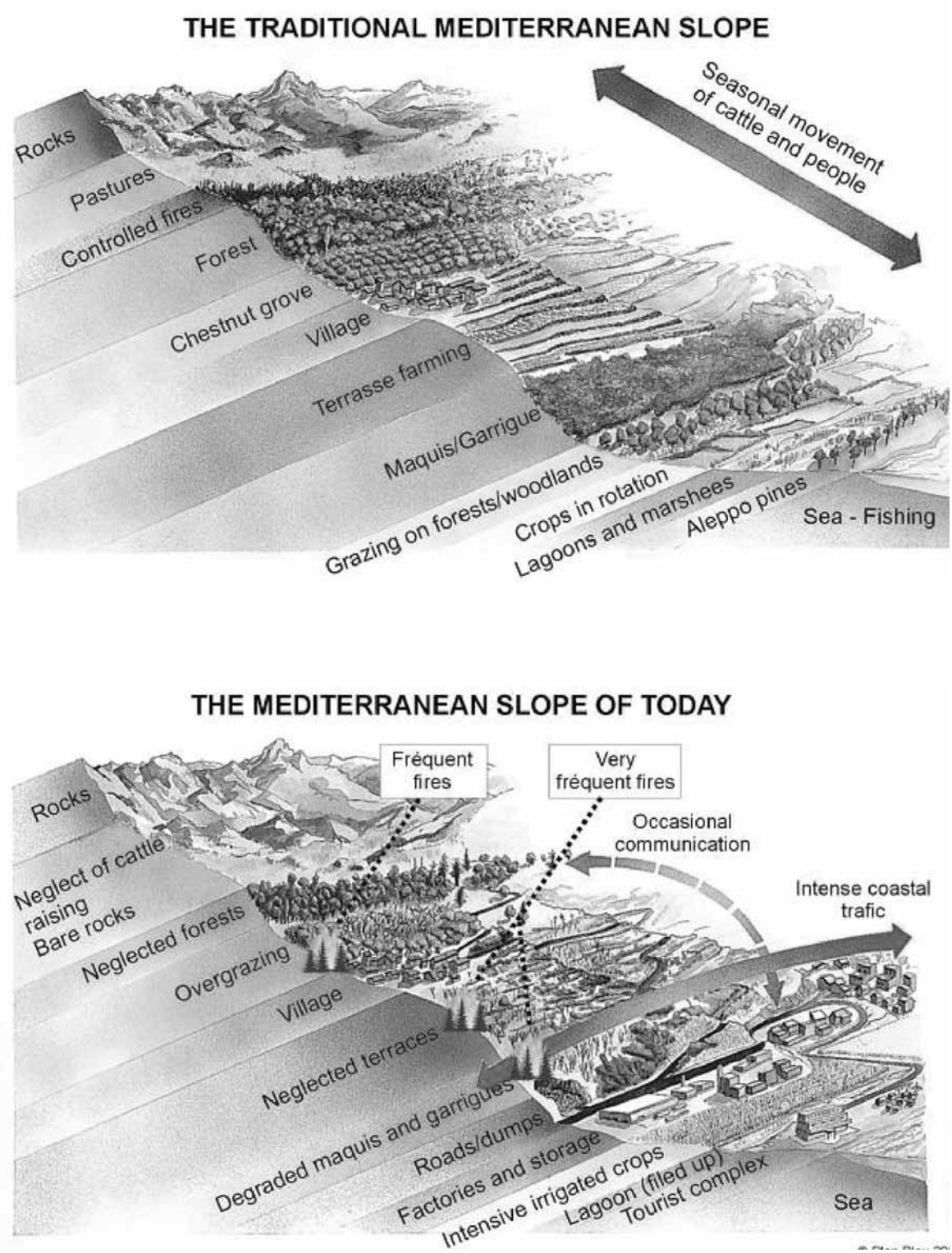
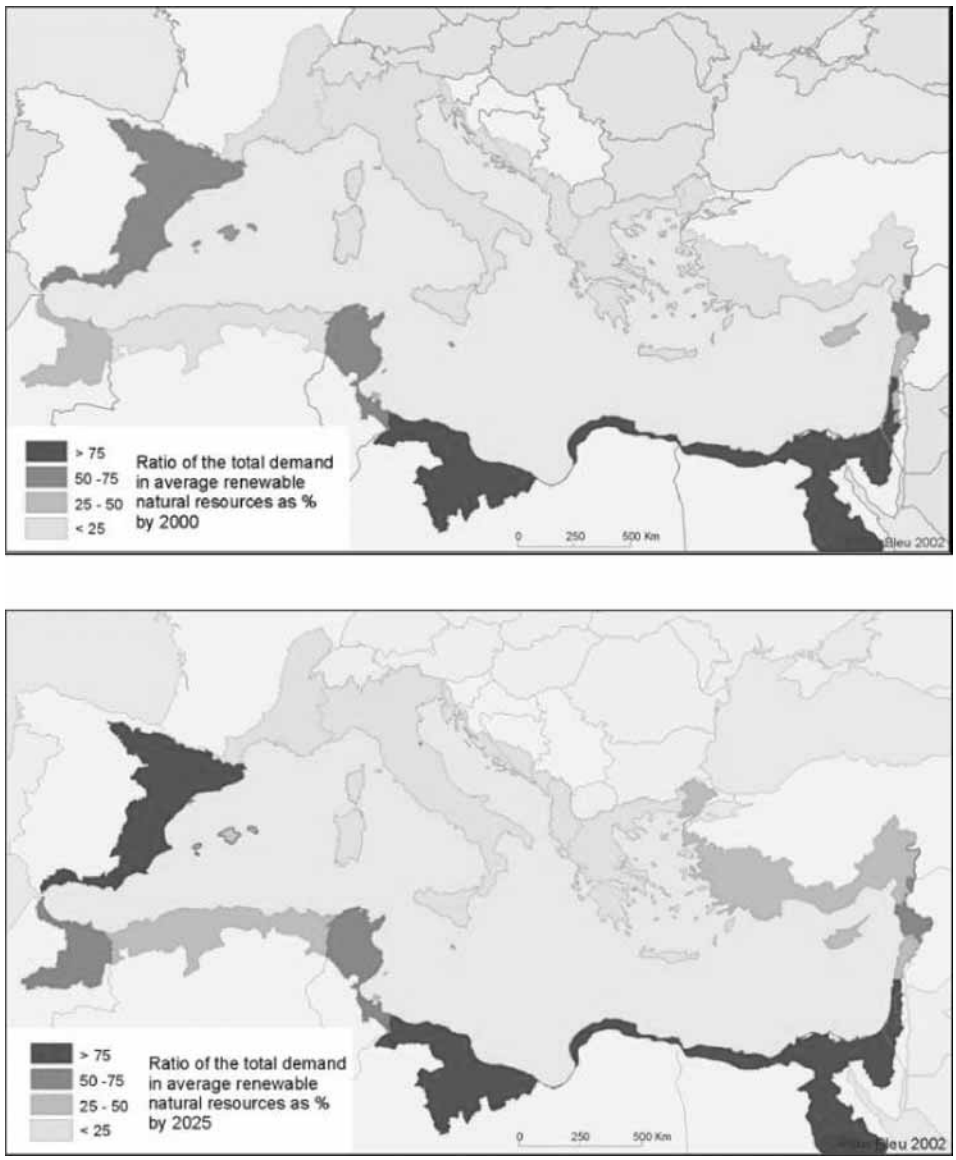


FIGURE 11
Exploitation index 2000 and 2025



The magnitude of the unsustainable water production index in the Mediterranean is explained by the overexploitation of groundwater by multiple, unsupportive and short-term users, and the increased use of fossil resources.

The erosion-generated silting of reservoirs is another cause of unsustainability, with annual loss of useful capacity being as much as 2 to 3 percent in northern Africa. Half of this useful capacity will be lost by 2050 in Morocco.

The overexploitation of coastal aquifers has already caused a lot of nearly irreversible invasion by seawater.

More than half (and up to 90 percent in some places) of the Mediterranean wetlands have disappeared, creating a huge impact on ecosystems.

Conflicts of use and interest between upstream and downstream areas, cities and farming, the short- and the long-term are about to get worse.

Water-resource management costs are growing (water protection, urban sanitation and pollution control).

THE SUSTAINABLE MEDITERRANEAN WATER SCENARIO

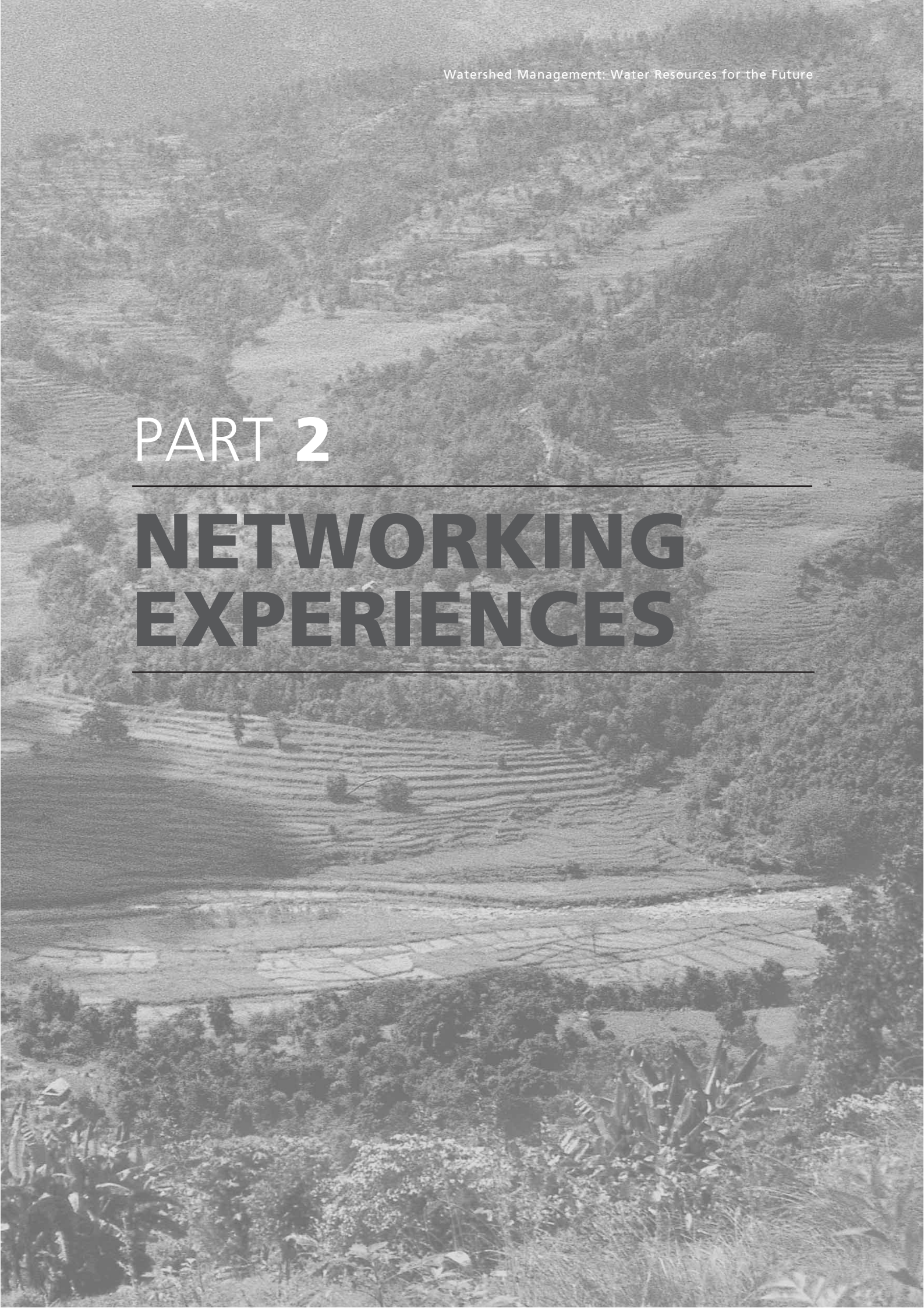
The question is: How to avoid a breakdown in the balance of water supply and demand, while stabilizing pressure on the natural milieu at an acceptable level and taking social and economic issues into account?

The answer calls for closely combining resource management and water demand in order to stabilize the latter, particularly through reducing loss, increasing efficiency in use and arbitrating in resource allocation.

This implies much determination and a new water "culture", as well as renewed water policies. In particular, it means adopting performance and environmental and social conditionalities with the definition of quantified objectives, a new allocation of roles between the public and private sectors, a change in behaviour with degree of decentralization of management and increased participation by players in management, and the use of technical and economic tools.

Above all, it encourages structural adaptations of agricultural and rural development policies in the Mediterranean region, which should teach better consideration of environmental and social issues while seeking higher irrigation efficiency.

For these reasons, Plan Bleu hopes the results of the study presented by Mr Fé d'Ostiani will contribute, by dissemination and exchange of information on watershed management policies in the Mediterranean region, to provide elements of orientation for the formulation of new approaches.



PART 2

NETWORKING EXPERIENCES

CHAPTER 7
INTEGRATED WATER RESOURCE MANAGEMENT OVER THE WORLD

Gilles Neveu
Office International de l'Eau

INTERNATIONAL NETWORK OF BASIN ORGANIZATIONS

The International Network of Basin Organizations (INBO) was established during the constitutive assembly in 1994 at Aix-les-Bains, France by organizations whose common goal was to implement integrated basin water resource management. The organizations made a voluntary act of joining the charter, which was adopted in 1996 at Morelia, Mexico and then confirmed at the following general assembly meetings in Valencia, Spain (1997) and in Salvador, Brazil (1998).

INBO's members established an association governed by the French Law of 1 July 1901 and the Decree of 16 August 1901 in accordance with the following statutes. Its headquarters is located at the Permanent Technical Secretariat in Paris.

INBO's objective is to promote integrated water resources management at the level of river basins as an essential tool for sustainable development. According to this objective, INBO endeavours to:

- develop lasting relations among the organizations interested in such comprehensive management, and favour exchanges of experiences and expertise among them;
- facilitate the implementation of tools suitable for institutional and financial management, for knowledge and follow-up of water resources, for the organization of databanks, and for the concerted preparation of master plans and action programmes in the medium and long terms;
- develop information and training programmes for local elected officials, users' representatives and the different stakeholders involved in water management, as well as for the executives and staff of the organizations in charge of water management at the river basin level;
- encourage education of the population regarding these issues;
- promote these principles in international cooperation programmes;
- evaluate ongoing actions initiated by the member organizations and disseminate their results.

The term "important river basins" means the catchment areas of rivers and lakes, including their aquifers and the catchment areas of their various small tributaries.

The following legal entities may be members of INBO:

- basin organizations – i.e. organizations that have been entrusted by relevant public administrations with integrated water resources management at the level of important river basins, either national, federal or transboundary, as well as the cooperation structures they have developed among them. These organizations must be entrusted with a mission of

public interest, have legal existence and their own budget, in accordance with national or federal legislation or international agreements in force;
- the governmental administrations in charge of water management in the countries that apply or are interested in applying integrated and sustainable water resources management: organized at the level of river basins; associating administrations and local authorities, as well as users from the various sectors; having specific budgetary resources at their disposal, obtained by applying the "user/polluter-pays" principle;
- bi- and multilateral cooperation agencies supporting activities related to integrated and sustainable water resources management at the level of river basins.

The Permanent Technical Secretariat of the Network is operated by the Office International de l'Eau.

For developing and strengthening river basin organizations, INBO and the Global Water Partnership develop an associated programme, the goal of which is to support all initiatives for the organization of integrated water resource management at the river basin, lake and aquifer levels, whether national or shared. It also aims to develop many experiments to reconcile economic growth, social equity, environmental conservation, water protection and the participation of civil society.

Output 1: Twinning of existing, future or pilot basin organizations

Purpose: To allow direct cooperation for stimulating and supporting water management at the river basin level.

Proposed services:

- direct exchanges of experiences among twin basin organizations;
- regional and international promotion;
- exchange of decision-makers and technicians.

Output 2: Mobilization of professional support capacities in existing basin organizations

Purpose: To promote the setting-up and development of new basin organizations and assist with their management options. To help, on request, progress in this long process of discussion, reflection, dialogue and decision-making undertaken at the level of river basins, or at the national or regional level. These teams may be broadened to include experts from international organizations.

Proposed services:

- assistance with the implementation of institutional reforms;
- initiation of pilot projects;
- support to several countries sharing a transboundary river basin;
- design of monitoring networks and databases;
- training of personnel from basin organizations;

- assisting new basin organizations with the setting-up of technical teams;
- formation of partnerships and establishment of institutional mechanisms allowing equitable citizens' participation in the decision-making and activities of basin organizations.

Output 3: Synthesis of available knowledge and expertise

Purpose: To collect and analyse actual practices in order to generate ideas and recommendations, and to promote practical guidelines for putting integrated river basin management into practice. To promote the initiation of pilot projects and implementation of institutional reforms in interested countries.

Proposed services:

- assessing the performances of the different systems;
- contributing to the improvement of knowledge and expertise in the area of basin organizations and integrated water resources management;
- making available a set of common, easily accessible and measurable performance indicators, in a typological form;
- training in good practices.

Output 4: Networking of water documentation systems

Purpose: To exchange knowledge about water resource management at the river basin level. To allow all INBO members and possible partners to share and exchange institutional documentation.

AQUADOC-INTER aims to:

- manage water-related information in a comprehensive and coordinated manner;
- make an inventory of all information networks, and develop lasting links;
- develop common meta-crawlers to address queries to all existing networks;
- build multilingual tools, dictionaries and glossaries, norms and consistent grids for classifying the information;
- organize specialized workshops.

AQUADOC-INTER is already being implemented in Latin America and Europe. In the Mediterranean, EMWIS involves the 27 country signatories of the Barcelona Convention.

Proposed services:

- exchange of information and documentation;
- assistance with the structuring of national relay documentation centres, responsible for validating, collecting, storing and accessing knowledge useful for water management in each country concerned;
- services to professionals and decision-makers to provide them the most appropriate information and documentation.

PROJECTS SUPPORTED BY INBO

TWINBASIN^{XN}: Promoting Twinning of River Basins for Developing Integrated Water Resources Management Practices

A basin organization (BO) is generally regarded as one of the best solutions to adopt for developing integrated water resources management (IWRM) at the catchment level.

There have then been many types of BO, some of them existing for several decades, and many in the process of development. They present a great diversity of legal statutes and economic schemes. None of these examples can be regarded as a model, but by facilitating direct exchanges on best practices, as well as on failed experiments, twinning can help BOs to improve their effectiveness: BOs can profit from peers regarding administrative, technical and institutional matters, or a quicker diffusion of the research outputs in real life.

The main goal of TWINBASIN^{XN} is to support effective use of research and development in the field of IWRM by promoting the twinning of BOs. This will be achieved by creating a worldwide forum dedicated to identifying and sharing knowledge and best practices.

A Memorandum of Understanding (MoU) takes the form of a cooperation framework signed by a wide range of organizations, both public and private, which have an interest in the deployment of IWRM practices. It is a voluntary agreement, entered into by organizations that are prepared to be active participants in developing consensus on issues of common interest, and that are willing to commit both human and financial resources for this purpose. This MoU implies public commitments from signatories to cooperate in the production of recommendations and guidelines for developing twinning and related services by cooperating in the specification of twinning activities – exchange of information, exchange of personnel – and of common knowledge representation systems and dissemination practices. The project will support staff mobility between twinned BOs.

The initial partnership gathers 18 participants, but is forecast to expand to up to 150 MoU signatories involved in the exchanges after 48 months.

The project is financially supported by the European Commission within the Sixth Research Framework Programme.

IWRM.Net: Towards a European-wide Exchange Network for Improving Dissemination of Integrated Water Resources Management Research Outcomes

The objective of this project is to check the feasibility and prepare a proposal of an ERA-Net project (coordination activities to prepare the European Research Area[ERA]) on IWRM at a European scale (including candidate countries), from the point of view of the implementation of the Water Framework Directive (WFD). The potential of including other countries (in particular Newly Independent States [NIS] and Africa) within the framework of the European Water Initiative (EUWI) will also be examined.

The proposed project will consist of:

- identifying and describing all the national programmes that are related to IWRM in the concerned countries;
- locating sources of information of recent and current projects;
- identifying and contacting the people in charge of these programmes;
- organizing a workshop for these programme managers to prepare the basis of long-term collaboration, as a basis for the ERA-Net proposal;
- proposing new ways of reinforcing dialogue with stakeholders, in order to develop more demand-driven research and better dissemination of outputs;
- preparing the ERA-Net proposal.

In each selected country (between ten and 15), a monograph will be prepared according to a common framework, defined by a Steering Committee made up of eight INBO member representatives, progressively opening up to national or local people in charge of the identified research programmes.

A workshop will join together about 50 invited research programme managers (one to three per country), to improve and validate proposals for action prepared by the Steering Committee from an holistic analysis of the country reports. This creativity workshop will define the working rules of a future exchange network ready to support synergies among programmes and the better valorization of their outcomes at the practitioner level.

This nine-month project is financially supported by the European Commission within the Sixth Research Framework Programme.

WFD-Community: Virtual Learning Community for Water Professionals

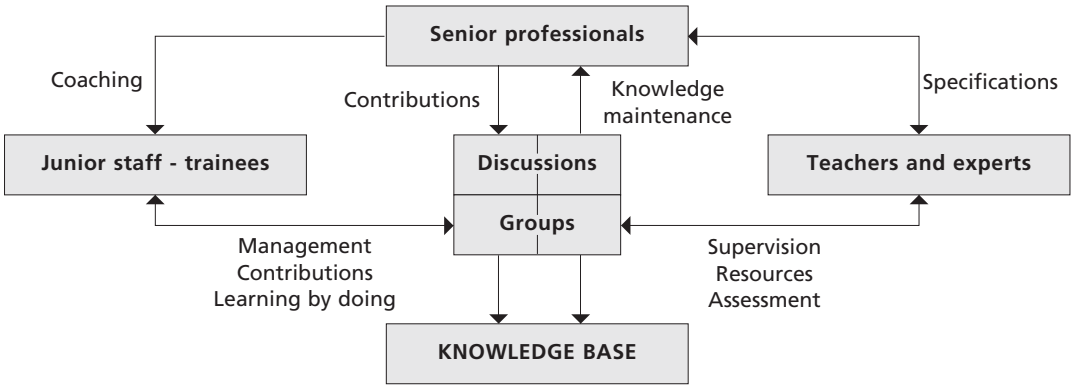
The project consists of creating a continuous education and training scheme for water professionals, based on collaboration among peers, working together on the implementation of the Water Framework Directive (WFD), through a virtual learning community (VLC).

The target public gathers junior and senior executives from basin organizations – members of INBO at the European level who are responsible for the implementation of the WFD to help them to “learn by doing”.

The VLC will help to train the junior managers in charge of integrated water management, by backing them with the experiences of senior staff, either as tutors or as contributors to exchanges, who will thus bring to the young people their knowledge and expertise (both formally and informally), while updating their own knowledge.

A group of 20 trainees (junior staff) will be divided into working groups, each with the responsibility for covering one aspect of the WFD. Group leaders will distribute tasks among the individuals, organize exchanges, moderate fora, synthesize the various contributions, bring complementary elements to the exchanges (documents, testimonies, case studies, etc.) and organize virtual conferences via Internet with ad hoc experts – all actions that make it possible to improve the quality of work.

FIGURE 1
Functioning of the VLC



Each individual trainee will contribute to all groups, prepare inputs on sub-topics and prepare monographs on the implementation of WFD in various contexts. Group discussions will be widely open to senior professionals, so that theories can be compared with hands-on practice.

The role of the teachers will be to define the course path and milestones, supervise the exchanges, guide the students and help them to analyse the external inputs, provide additional resources if needed, and assess the results to validate acquired knowledge. Each group will profit from the coaching of a senior member; it will basically be a matter of guiding the group in reflective analysis of its own work, and helping it to mobilize complementary resources.

The various contributions will be capitalized to feed a base of knowledge for future users. The technological system will be multilingual and include a translation program. The partnership includes basin organizations, universities and water training centres.

This 36-month project is supported by the European Commission within the Leonardo da Vinci programme.

CHAPTER 8
INTEGRATED WATERSHED MANAGEMENT AND FORESTS

Pier Carlo Zingari
European Observatory of Mountain Forests (EOMF)

WHY INTEGRATED WATERSHED MANAGEMENT AND FORESTS?

Since Rio's United Nations Conference on Environment and Development (UNCED) in 1992 a close link has been established at the international level between watershed management, forest and forestry. Indeed, processes such as the United Nations Forum on Forests (UNFF) or, at the European level, the Ministerial Conference on the Protection of Forests in Europe (MCPFE) have been contributing to draw attention to cross-sectoral and integrated approaches to forests, including – among other issues – water resources.

There is no objection to the fact that although forest cover may have different interactions with water regimes, efforts in forest conservation and sustainable management lead to overall positive effects on the watershed, both on the environmental components, such as soil, biodiversity or water quality conservation, and on the socio-economic aspects, such as the diversification of revenues, employment, food alternatives and livelihood opportunities.

Therefore, whenever we think watershed and water we are not wrong in thinking forests and forestry. This is one of the reasons why countries from all over the world recently requested FAO to establish a permanent entity devoted to water and forests in order to meet technical needs on this key issue.

The European Observatory of Mountain Forest (EOMF) has been operating since 1996 on the exchange and feedback between local forest actors and national and international bodies over a wide range of issues: watershed management is one of the priorities. Although definitions may vary, watershed management affects and benefits a number of local actors and relies on the shared responsibility of a number of non-local actors: the European Union uses the term "subsidiarity" to express the sharing of responsibilities among various levels, and we may want to use the term "solidarity" because work on watershed management is a common issue, with common responsibilities and common benefits. By "common" we refer to the upstream–downstream relationships, and also to the relationships among different sectors of society. Much can be learned by making available experiences in Europe and ensuring that exchanges of experiences can be done effectively, both in time, with a retrospective look to the past, and in space, by communicating national and sub-national initiatives. At the same time, the experience of other regions of the world can help to reorient the approaches in Europe.

INTEGRATED WATERSHED MANAGEMENT AND FORESTS INITIATIVES

Given the issue raised by this conference, it is our aim to bring here a few forest-related examples of the work going on with reference to integrated watershed management and water resources:

- ***FAO/European Forestry Commission Working Group on the Management of Mountain Watershed – WG-MMW.*** This is a 52-year-old group dealing with exchange among countries of their experiences and progress in watershed management. It has become evident during recent decades that technical aspects, be they engineering, hydrological or ecological, require sound communication, open debates and involvement of local stakeholders. WG-MMW is currently investigating some 40 governments in Europe regarding different aspects of watershed management: the first outcomes show a growing interest in the issue beyond sectoral and geographical borders. To give just one example, the Netherlands is turning its interest to mountainous countries in order to know more about policies and practices in watershed management that may affect water and risks downstream.

- ***IUFRO Task Force on Forests in Sustainable Mountain Development.*** The International Union of Forest Research Organizations (IUFRO) has been developing a cross-sectoral Task Force on Forests in Sustainable Mountain Development. After a first phase, concluded in 2000, the current work is concentrating on water-, watershed- and risk-related management in both research and practice.

- ***International Consultation on Mountain Forests 2002, Navarra, Spain and Iraty, France.*** This consultation took place on mountain forests at the global level. There was a strong consensus on considering forests not as isolated ecosystems, but as part of a larger land-use system. Forests appear as necessary but not sufficient in watershed management. Forests require rehabilitation with special attention to lands with low cover, high erosion levels, low revenues and employment or strong poverty patterns. The highest rates of deforestation and forest degradation are found in mountain areas in developing countries. Effective tools have been identified by participants in multistakeholder alliances, coalitions, partnerships, agreements and contracts.

- ***Shiga Expert Meeting Declaration, Japan, 20 to 22 November 2002.*** Among the important issues identified, this expert-level meeting raised the issues of: holistic approaches to forest and water management; improved understanding of the biophysical interactions between forest and water; improved understanding of the cultural and socio-economic impacts of policies and practices; development of mechanisms for managing upstream and downstream interactions; and better dissemination of scientific knowledge.

- ***Chambéry Workshop on Forests and Water, France, 5 to 6 June 2003.*** A major recognition reached at this meeting is that continuous and determined efforts are needed to integrate the management of forests and water. These efforts are better supported by: a watershed perspective; participation and cross-sectoral mechanisms; full valuation of water-related services; national and sub-national policies; solidarity among countries; and improved datasets for use in monitoring progress.

CONCLUDING REMARKS

Watershed management is one of the oldest socially organized, economically based and culturally driven human activities. Indeed, where I was born, in Rome, Italy, I could benefit from the work done by my Etruscan and Roman ancestors on soil conservation, drinking- and sanitation water availability by means of the well-known aqueducts, and on land-use harmonization through the system of "centuriae", i.e. pieces of land structured according to their value, use and administration patterns.

Integration and participation in watershed management require dynamic and process-like tools, such as communication skills, capacity building and training programmes, contract-based and multisectoral management of resources versus planned and sectoral approaches, governance as an operational and not a conceptual instrument, and dataset development and availability.

Forests are a key component in watershed, water and risk management. Forests are preventive tools in watershed management. Even when low forest or no forest cover occurs, rehabilitation of a minimum level of forest should be considered as a watershed management tool. On the other hand, when there is forest cover, it should be considered as a necessary but not sufficient element of a complex patch-dynamic system, i.e. one element of a mosaic-like system.

CHAPTER 9
THE CANADIAN MODEL FOREST CONCEPT

Peter Besseau
Executive Director, International Model Forest Network Secretariat

Superficially, the relationship between model forests and integrated watershed management is not immediately apparent. Admittedly, the words "model" and "forest" would not naturally lead to such a connection. To clarify, model forests are not exclusively about modelling or forests, *per se,* although they can include the former and always include an important component of the latter. Rather, model forests are chiefly about people, and their current and future relationship with the landscapes that support them in many different ways. Most model forests have major elements of, or even complete, watersheds within their boundaries while several – in China, Chile, Costa Rica, the Philippines and the Dominican Republic – are deliberately watershed-based and contain significant water management values in their action plans.

What model forests are, essentially, is a process to translate policies of sustainable forest management into practice, on a large scale and for the benefit of all stakeholders, from communities to national policy-making bodies. They do this at an operational level on a specific land base (often a watershed or sub-watershed) through voluntary, locally based partnerships of stakeholders who jointly agree on a process to:

- develop a shared, locally relevant vision of sustainability;
- define goals, objectives and strategies for working towards it;
- agree on specific actions and activities in support of it;
- work together to achieve it.

The idea of model forests can be traced to the early 1990s and a point of intersection of multiple unanswered questions that served as a barrier between policy and practice in the field of sustainable forest management (SFM): If no single actor or agency is capable of achieving sustainability, how do we organize ourselves to create an effective consortium of interests, and pool resources to make lasting progress? If we are obligated by necessity to integrate disciplines and sectoral plans and strategies, how can we go about this at the operational level? If those who challenge traditional planning and management processes are to be included, how can they be brought in constructively and what – if any – concessions are needed from those who have traditionally wielded power over such issues?

Not only had this latter situation of "we and they" been a source of conflict over resource planning and management, but the continued failure to address it also meant that often very valuable options, ideas and views were neglected or, worse, misunderstood, misrepresented or unknown. There were other reasons as well: the need to devise a functional feedback loop between the field and the policy level; a need to scale-up local advances and extend and adapt innovations elsewhere; a need to see sustainability as an approach or process, rather than a

project; and a need to devise instruments to share and network field-level and policy advances with those who were ready and willing to use them.

But, if we were to pare down the question of what explains the emergence of model forests to its most elemental it might simply be that model forests were needed to answer the very important question that arose from many years of talk, workshops, seminars, debate, experimentation, research and proceedings: now that we have agreed on the fundamental policy lines for framing SFM what – operationally – are we supposed to do? That is, what – as woodlot owners, regional administrators, educators, communities, industry and other players who influence and are influenced by resource planning and management – are our roles, what are our options, what are our opportunities and obligations? How do we get from here to there?

In much of the above – the people issues, the need for integration and so forth – the difference between model forests and integrated watershed management is one of weight and emphasis. While in the former we will expect forest resource values to be dominant, in the latter the chief management value and objective will be water. In between these we find an extremely high complementarity of issues at play, and a need for a similar, people-centred process to guide and improve decision-making to safeguard both the resources in question and the communities that depend on them.

BACKGROUND AND DEFINITIONS

Since emerging in Canada in the early 1990s, where a national network was established, the International Model Forest Network (IMFN), which is a separate entity from Canada's own network, has grown from three sites to 20, and from two countries, as well as Canada, to nearly 15. The core following defining attributes that make up a model forest have not changed measurably since the concept was first introduced:

- based on an inclusive, locally based partnership;
- stakeholder commitment to SFM;
- large enough in scale to capture all of the values and uses represented in a landscape;
- a programme of action representative of stakeholder values;
- a governance structure that is transparent, representative and accountable;
- a commitment to networking at all levels – from the local to the international.

These minimum defining attributes allow considerable flexibility for each site to develop a locally relevant programme of SFM while maintaining sufficient commonality to support networking opportunities from local to global levels, regardless of ecosystem type, history of resource use, administrative system or stakeholder dynamics. In practice, it has been discovered that while no two model forests – even within one country – are alike, there is significant overlap in both the types of problems being addressed and the tools used to address them. Out of this, multiple opportunities have emerged to share and accelerate the introduction of specific advances, views, methodologies and approaches.

Two further observations are helpful in describing what a model forest is. First, model forest partnerships do not remove any authority over land-use planning or management from tenure holders. While this might appear at first to relegate a model forest partnership to the status of

a debating club, with resources to support action and broad common goals, it has instead proven to be its strength. Model forest partnerships have developed largely as constructive, neutral fora where non-traditional players can work together, horizontal linkages can be established and specific action can be agreed. Second, in the absence of technical and scientific rigour and a context of SFM, model forests could easily become convenient packaging for unrelated projects, however, the actions and activities decided on by the partnership must be technically and scientifically sound and based on a strategy of achieving SFM.

As noted above, model forests originated in Canada at a time of high-level conflict in the Canadian forest sector. Following a promising start, Canada announced the IMFN at the Rio Conference in 1992. Subsequently, the IMFN Secretariat, was "incubated" at the Canadian Forest Service until 1994, and has been located at the International Development Research Centre (IDRC) since 1995. IMFN's first regional centre was launched in October 2002, hosted by the United Nations Development Programme (UNDP), Santiago de Chile, and work is now under way to develop options for a similar centre for Asia, with inroads also being made in Central Africa.

Today, including Canada's 11 sites, the network consists of some 30 sites established or under development in 14 countries, across five continents. Their aggregate land-base is approximately 28 million ha, and there are currently several additional countries actively exploring model forest development within IMFN. What this adds up to is a unique and potentially very powerful global community of large-scale platforms, well supported by policy, research and science, and implementing virtually all aspects of SFM through a common partnership-based approach.

While the Secretariat is supported by a consortium of Canadian Federal agencies and departments, a large array of institutional donors and collaborators have supported model forest development through parallel support from numerous bilateral and multilateral collaborators at the regional and site levels. These have included FAO (Asia, Africa and Latin America), UNDP (host institution for the Regional Model Forest Centre for Latin America and the Caribbean, in Santiago, Chile), UNDP-GEF (through a global partnership agreement on co-location and joint networking), CUSO (in Latin America) and site-level support provided to individual model forests by the International Tropical Timber Organization (ITTO), the United States Department of Agriculture (USDA) Forest Service, the Japanese International Cooperation Agency (JICA), the Japan Forest Agency and many others. In addition, the model forest partnerships themselves are engaged in regional- and global-level networking. The Canadian network alone represents within its 11 sites more than 400 partner organizations. Fundamentally, however, model forests must be country/demand-driven, with country- and site-level partners fully invested in the risks and dividends of the effort. This investment shows itself in the form of political will, direct and in-kind resources, and participation.

WHAT DO MODEL FORESTS DO?

Model forests typically operate as registered not-for-profit organizations. Their activities can be broadly set in two areas: support to the partnership, and delivery of the programme identified by the partners. On the operational side of things this typically means that a small staff and supporters will work to develop and maintain the partnership, facilitate strategic and

operational planning (defining SFM in locally relevant terms and describing goals, objectives and activities from it), mobilize resources and manage information and data, as well as documentation, analysis and reporting.

At the level of programme and project delivery, the model forest organization is responsible for elaboration of a balanced programme that reflects the priorities identified by the partners, and feeds into a broader strategy for SFM. The priorities vary in ranking from one model forest to the next, but the core group of themes is highly consistent among all model forests. Generally, many of the following issues will be found among a given model forest's programme objectives:

- best forest management practices (a broad group of initiatives);
- criteria and local-level indicators of SFM;
- economic development/poverty alleviation;
- issues of partnership, governance and conflict mitigation;
- integrated planning and management;
- GIS applications;
- demonstration, training and capacity building;
- link and feedback between the policy and the operational levels;
- leveraging of resources.

SOME LESSONS LEARNED

Model forests have been operational for more than 12 years in Canada. Internationally, some have been active for nearly a decade, but most for no more than five years. As such, this latter group is only now maturing in terms of cohesiveness within its members' partnership groups and impacts. Perhaps the most important conclusion that has been reached is also the most fundamental – the concept works. The concept/approach is valid across ecosystems, forest types and administrative circumstances. To the extent that a successful integrated watershed initiative must create effective partnerships with local stakeholders, integrate planning and management, and maintain a high technical and scientific quality, the following lessons learned from model forests may be of value. Most of the lessons learned will seem familiar. But what the model forest network possesses, and what I believe is unique, is an operational mechanism – a highly varied "how to" of experiences around the world in the areas of SFM at an operational level – which are available to be shared with those who can benefit from them:

- Local communities, including traditionally marginalized groups such as indigenous peoples, can and should be made full and active contributors to SFM.
- Partnerships take time to demonstrate their net worth – often about three years.
- SFM must demonstrate benefits that are tangible, relevant and timely, particularly to local stakeholders and particularly in the area of sustainable economic opportunity.
- Networking works, but only with resources, a deliberate strategy and clear self-interest from the beneficiary groups.
- The overall effort needs to fit with national objectives and must be country-driven, particularly as policy impacts are an objective.

- SFM is a process, not a project: this poses challenges for funding agencies whose typical time horizons are too short and whose evaluation standards are not equipped to deal with the so-called "soft" (people) issues of sustainability.
- In all cases a "champion" or "champions" have been required in order to help chart the course and attract resources and political support.
- National and lower levels of government must see themselves as primary enablers, investors, participants and beneficiaries in the process.
- Partnership without resources is a debating society – these efforts need money.
- Governments tend to be among the first beneficiaries of the work of model forests, as it allows different government departments an open door to collaborate and share with one another.

Much of what we have learned in the IMFN has application to watershed management issues.

ROLE OF THE SECRETARIAT

The IMFN Secretariat plays a critical role in facilitating the work of model forests around the globe. It provides the central day-to-day coordination of support and development services to the network, works to strengthen and expand the network and, at the site level, supports new and existing model forests in the following areas:

- networking among sites and regions (transfer of technology and expertise);
- assistance in resource expansion;
- technical and logistical issues in establishing and operating model forests;
- communications, advocacy and outreach;
- targeted programme support (as available);
- documentation;
- monitoring and evaluation (with partners).

While each model forest differs from the others in its history of land use and the management concerns it faces, there are a range of common issues of special significance to the Secretariat, including:

- partnership development and capacity-building;
- poverty alleviation and economic diversification;
- measuring and assessing progress towards SFM;
- development and demonstration of best forest management practices;
- monitoring and evaluation;
- good governance and support for civil society;
- conflict management;
- integrated resource planning and management.

Support to model forests comes through regional and global meetings, training and extension work, specialized workshops and the dissemination of information. While the Secretariat is not a grant-making institution, it does manage a small programme fund earmarked for issues and areas of high priority.

CHAPTER 10
IUFRO AND WATERSHED MANAGEMENT: THE CHALLENGES BETWEEN RESEARCH AND APPLICATION

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Human society and its research have always been in close relation to forest and watershed management. Forests and water have always been reflections of society. Multifunctional forest and watershed management should be practised and considered on an international scale. As a result of historical development small-scale ownership structures prevail in the European Union (EU), family forest farms and family water plants play a decisive role in this respect.

For centuries, forestry and watershed management have been a crucial element in the development of rural and mountain regions.

The global discussion on sustainable development of mountainous regions focuses in particular on forests and water resources. This is the challenge between research and application, where sustainability originates. Not to take more from the earth than it offers from natural regrowth and renewal, to extend planning periods over several generations and to show a sense of responsibility when optimizing the effects on the area are important guidelines that must also be considered in other fields of economy and policy.

By means of appropriate services and improved public relations, the challenges between research and society in forests and water can make important contributions to sustainable mountain development. Cooperation between society administration research and education assists in making knowledge available beyond the circle of forest and water, forestry and watershed management.

The high water retention capacity of forests is of vital importance for a well-balanced water cycle, and therefore for watershed management. The high bonding capacity with respect to dew, hoarfrost and fog drops, and the slowing down of snowmelt in spring are to the benefit of protection against natural hazards and of water utilization. However, forests and water are also in a close ecosystemic relation.

Humans' freshwater supply has always been a great challenge, particularly in urban centres. Lack of watershed management, e.g. polluted water from wells, has been responsible for the course and spread of a number of epidemics.

Water pipes running over great distances from forests to people's homes have been known since Roman times, including in the Alps. Even then, bridges made of stone – so-called aqueducts – overarched whole valleys as part of water piping systems. Until the beginning of

modern times, simpler and shorter water supply systems were often made of joined wooden pipes. In this way, the water reached the settlements, and wells, most of which were situated in central places, became the heart of social life. However, wooden constructions were also indispensable for scooping water from groundwater wells.

At the moment, only 3 percent of the available water resources are exploited in the central Alps. There is hardly any other region on earth where the positive interaction between watershed management and forests and water is so clearly visible, as can be proved by the excellent quality of drinking-water of Alpine regions.

As early as 1864, large cities such as Vienna purchased large forests in the mountains, and managed them with special consideration of the water supply and yield and of spring protection. The identification of water protection areas and water sanctuaries according to applicable modern water legislation is frequently based on the positive effects of forests. This has to be mentioned during the Year of Freshwater, 2003.

Torrents, brooks and rivers have not only been exploited as suppliers of drinking-water, but the power of running water, utilized by means of wooden water wheels, was the strongest and most important driving force for centuries, e.g. for mills, sawmills, hammer mills and many other trades. Later, the turbine for energy generation was developed out of the same technique. This marked the beginning of modern watershed management, which today is of great importance to all countries.

As the famous German poet J.W. Goethe puts it: “Everything originates from water. Everything is maintained by water.”

IUFRO CRITERIA AND INDICATORS FOR PROPER AND SUSTAINABLE WATERSHED MANAGEMENT, FORESTRY AND LAND USE

Sustainability

At the Second Ministerial Conference on the Protection of Forests in Europe, held in Helsinki in 1993, sustainable watershed and forest management was defined as follows:

> The stewardship and use of watersheds and forest land in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality, and their potential to fulfil, now and in the future, relevant ecological, economic, and social functions at local, national and global levels, and that does not cause damage to other ecosystems. This definition, which is generally accepted in Europe, takes into consideration the multifunctionality of the forest and the striving for sustainable development by nature and the economy. In order to reach that goal, the European watershed management and forestry policy must be oriented toward a seminatural watershed and forest management. It has also been given high priority in the Council Resolution on a forestry strategy for the European Union. (*Official Journal C 56* of February 26, 1999, p. 1)

WATERSHED AND FOREST RESOURCES AND PRODUCTIVE FUNCTIONS

Special importance is attached to the economic effect of watershed resources and forestry. Wood constitutes an important raw material for many economic areas, and thus safeguards many jobs in rural communities. Wood helps to reduce the consumption of fossil fuels, and thereby the CO_2 emissions and consequent impacts on the climate related to them. Sustainable watershed management guarantees that this basis of raw materials is not exploited in either quantitative or qualitative terms.

Socio-economic function

A healthy and appropriately tended watershed can bring about multifarious benefits. However, in order to render all the services desired by the public (balancing the climate and the hydrological budget, regenerating air and water, protection from natural hazards, recreation, nature protection) to the necessary extent, measures need to be covered from the profits made from forests. By means of appropriate compensations and directed subsidies, watershed management policy aims at ensuring the necessary management. Additional protective measures are taken by means of erosion control and natural disaster management. With the programme on rural development, which was approved in summer 2000 by the EU, measures to promote watershed management have also been included in the rural development scheme, and are co-financed by the EU. Priority is given to measures that have a favourable effect on the maintenance and enhancement of a healthy environment. The promotion of watershed management is accompanied by continuous information and public relations work. This is a basic requirement to ensure knowledge and understanding of watershed management and forests. Knowledge and understanding, in turn, are the basis for creating awareness of the complex interrelations in watersheds and forests, and the interactions between ecology and economy. Fundamental prerequisites for sustainable watershed management and forestry are high-level research, training, and further training and once again training. The existing institutions in this field are currently subject to considerable restructuring and reorganization processes aimed at increasing efficiency, complying with the standards of state-of-the-art technology, and coping with international competition.

Health and vitality

External influences such as air pollution, excessive game population, tourism and forest pastures result in environmental burdens on the ecosystem at a regional level. However, they do not in general pose an existential treat to the forest. The monitoring of the watershed and forest condition takes place mainly by means of permanent European-wide investigations such as European Forest Inventory and European Watershed Management Monitoring and the European Watershed and Forest Damage Monitoring System.

A large-scale dying of forests as feared in the 1980s should be prevented in Europe by means of measures in the fields of watershed and environmental and forestry policy. However, the European Watershed and Forest Damage Monitoring System could show that there is still a high level of pollution and underlines the need to continue with a consistent watershed management and forestry policy.

Problems are arising first and foremost where several weakening factors coincide. The situation is particularly unfavourable in protective forests and protective watersheds. In these sensitive watersheds and forest regions, efforts towards stable land use and forest stands are often rendered more difficult by ageing, damage caused by game and grazing stock and tourist activities.

Biological diversity

Studies have confirmed that it is possible to preserve a high degree of naturalness of watershed ecosystems by means of a sustainable forestry and land use adapted to the natural site conditions. Natural forest reserves are forested land that is left for free development of the forest ecosystem, where no direct intervention takes place except for game management. The natural forest reserves programme should be developed for Europe as an important contribution to the maintenance and enhancement of forest biodiversity on the basis of research, teaching and education.

Further measures aiming at the maintenance of biodiversity in general, and of genetic diversity in particular, are gene reserve forest, clone archives and seed orchards.

Protective functions

The conservation of the living environment in mountain areas depends considerably on a healthy forest stand, because this is the only way to ensure the necessary protection and the desired recreational opportunities. According to the classification of some Alpine forest inventories only 60 percent of the sampling plots of protective forests (without dwarf pine and green alder areas) are described as stable. In the Alps, large parts of the protective forest areas are identified as overmature and patchy. All in all, forest inspection of the central Alpine part of Austria only has identified about 165 000 ha of protection forests, designed for the protection of special objects, as being in urgent need of sanitation.

These are forests with a direct protective effect on settlement and transport routes, which are located in catchment areas of torrents and avalanches or in hazard zones, and which are in a bad condition with respect to their protective function. As far as these priority areas are concerned, rehabilitation measures are indispensable. Therefore, new strategic concepts should be elaborated on the safeguarding of the protective effect of the high elevated protective forests, in order to increase the efficiency of the implementation of current measures.

Criterion 1: Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycle

- area of forest and other wooded land and changes in area (classified, if appropriate, according to forest and vegetation type, ownership structure, age structure, origin of forest);
- changes in: total volume of growing stock; mean volume of the growing stock on forest land (classified, if appropriate, according to different vegetation zones or sites classes); age structure or appropriate diameter distribution classes.
- total carbon storage and changes in the storage in forest stands.

Criterion 2: Maintenance of forest ecosystem health and vitality

- total amount of and changes over the past five years in depositions of air pollutants;
- changes in serious defoliation of forest using the UN/ECE and EKU defoliation classification (Classes 2, 3 and 4), over the past five years;
- serious damage caused by biotic or abiotic agents: severe damage caused by insects and diseases with a measurement of seriousness of the damage as a function of (mortality or) loss of growth; annual area of burnt forest and other wooded land; annual area affected by storm damage and volume harvested from these areas; proportion of regeneration area seriously damaged by game and other animals or by grazing;
- changes in the nutrient balance and acidity over the past ten years (pH and CEC), level of saturation of CEC on the plots of the European network, or of an equivalent national network.

Criterion 3: Maintenance and encouragement of productive function of forest (wood and non-wood)

- balance between growth and removals of wood over the past ten years;
- percentage of forest area managed according to the management guidelines;
- total amount of and changes in the value and/or quantity of non-wood forest products (e.g. hunting and game, cork, berries, mushrooms, etc.).

Criterion 4: Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems

- changes in the area of: natural and ancient semi-natural forest types; strictly protected forest reserves; forests protected by special management regime;
- changes in the number and percentage of threatened species in relation to total number of forest species (using reference list e.g. IUCN, Council of Europe or the EU Habitat Directive);
- changes in the proportions of stand managed for the conservation and utilization of forest genetic resources (gene reserve forests, seed collection stands, etc.); differentiation between indigenous species and introduced species;
- changes in the proportions of mixed stands of two to three tree species;
- in relation to total area regenerated, proportions of annual area of natural regeneration.

Criterion 5: Maintenance and appropriate enhancement of protective functions in forest management (notably soil and water)

- proportion of watersheds and forest area managed primarily for soil protection;
- proportion of watersheds and forest area managed primarily for water protection.

Criterion 6: Maintenance of other socio-economic functions and conditions

- share of the forest sector in gross national product;
- provision of recreation: area of forest with access per inhabitant, percentage of total forest area;

- changes in the rate of employment in forestry, notably in rural areas (people employed in forestry, logging, forest industry).

Management of watersheds and forests

Watershed management and forestry sciences have to develop:
- rules for protective forest and sustainable watershed management;
- area utilization politics: it should be understood that policy has the responsibility for public awareness about the habitat, soil and ground protection, protected water quality and support of intact ecosystems as goals;
- basis of support for lawful regulations;
- technical guidelines for protection against natural dangers and hazards.

CONCLUSIONS

Mountainous areas provide the basis of life for millions of people in Europe. For example, in the EU 15 countries, 54 million people live in mountains and mountainous areas, accounting for 38.8 percent of the total EU15 land area. Some 14 million people live in 5 800 municipalities in the Alpine arc, which is 1 200 km long and 200 km wide and stretches from Vienna to Nice. There are also important mountain areas in other parts of Europe.

Mountainous areas and watersheds provide employment, transit zones, water reservoirs, landscape, wilderness, natural parks and reserves, recreational and sport areas, open spaces or simply nature. But mountainous areas and watersheds are also vulnerable to natural catastrophes and hazards, as well as to global change.

Our generation has the responsibility to ensure that our mountain heritage is passed along to future generations in such a way that it will provide the basis for their livelihoods, while maintaining its specific characteristics.

The last session of the FAO/EFC Working Party on the Management of Mountain Watersheds considers that the concept and practice of integrated watershed management are necessary for sustainable development in the mountain areas of Europe. The following measures are important for maintaining intact mountain areas to meet social, ecological and economic needs in the future:

- Watershed management and land use in mountainous areas should be adapted to local natural conditions in order to minimize danger to human life. Areas highly threatened by erosion and natural hazards, such as avalanches, debris flows, rockfalls, landslides and floods, are not appropriate for human settlements and infrastructure.

- To ensure sustainable development in mountainous areas and watersheds it is essential to pay simultaneous consideration to agriculture, forestry, land-use planning, transport, trade, tourism, conservation of nature, landscape and cultural heritage, water management, and protection from and prevention of natural hazards. Cross-sectoral approaches are required, and therefore, land-use planning should be integrated rather than sector-based.

- Mountain ecosystems are fragile and particularly vulnerable. They suffer from the adverse impacts of soil erosion, forest fires, air pollution and other phenomena, as well as the impact of globalization, including climate change. Governments have a responsibility to fulfil their international obligations, in particular in the difficult area of air pollution control and climate change, and to implement the United Nations Framework Convention on Climate Change and the Kyoto Protocol.

- All preventive efforts to ensure protection against natural hazards in watersheds and catchment areas should be coordinated in such a way that the residual risk for human beings, infrastructure and property is minimized for all types of natural hazards.

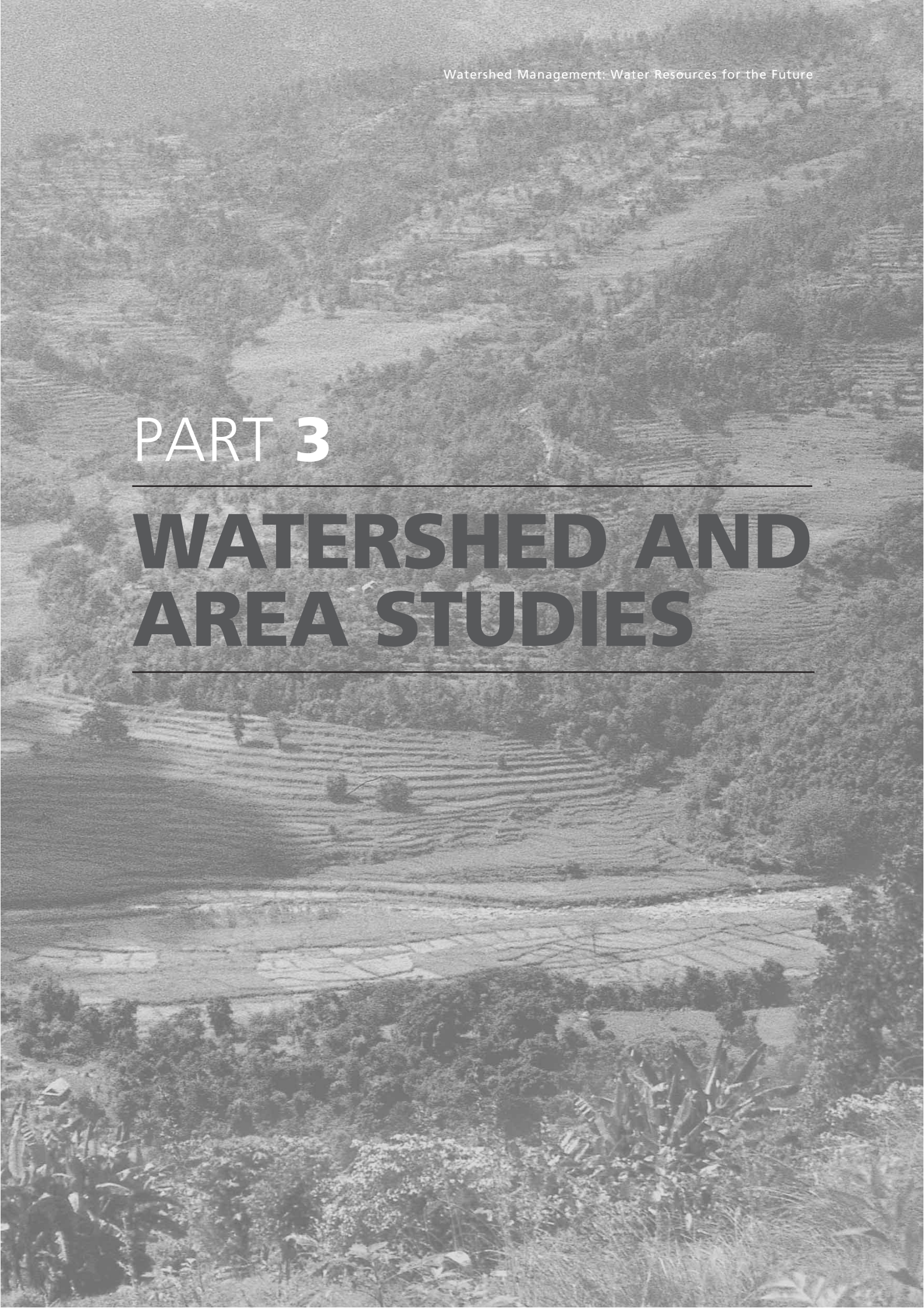
- Mountain watersheds and forests provide a wide range of goods and services and are necessary for human settlement in many areas. Employment linked to all these activities is important, not only for the regional economy, but also to prevent outmigration from mountain areas. Therefore, sound management and protection of mountain forests are of vital importance to the sustainable development of many mountain areas, and the services that mountain forests provide to the public should be fairly compensated through appropriate financial mechanisms at the regional and international levels.

- A greater effort should be made to extend the knowledge generated in the mountains of Europe to other watersheds in the rest of the world. The need for exchange at the international level of experience and progress in knowledge on mountainous areas is greater than ever.

- Education, capacity building, training and research can make important contributions to sustainable development in mountain areas. Specific issues regarding mountainous areas must be studied critically in greater depth when making plans for the future. Better use of information technology tools should be made, particularly in the area of teaching.

- Continuous, long-term monitoring of ecological and hydrological phenomena is necessary for a basic understanding of watershed processes.

- Close cooperation and shared responsibility in watershed management among local, regional and national authorities, at appropriately decentralized levels, are necessary.



PART 3

WATERSHED AND AREA STUDIES

CHAPTER 11
RESTORING HYDROLOGIC FUNCTION OF ALTERED LANDSCAPES: AN INTEGRATED WATERSHED MANAGEMENT APPROACH

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More than a century and a half of agricultural development in the Upper Midwest of the United States has resulted in one of the most productive agricultural areas in the world. Through technological advances on rich prairie soils, the corn–soybean cropping system has become a production centrepiece and is practised on more than 20 million ha in the Upper Midwest. Today, however, questions are being raised about its sustainability in terms of profitability and its impact on human and environmental resources. To expand production in the Upper Mississippi River basin, and particularly in the Minnesota River basin (MRB), wetlands have been drained and converted to croplands. Extensive tile drainage networks and ditch systems have been developed to move water more efficiently off the land and into stream channels. Annual crops have largely replaced tall grass prairie species in the uplands and native riparian forests along stream banks and in floodplains. Stream channels have been modified to convey floodwater in an effort to reduce flood damage to crops and farming communities.

A major environmental consequence of our enhanced agricultural productivity is non-point pollution of water bodies in the Upper Midwest. The Minnesota River is one of the most polluted water bodies in the state (Magner, Johnson and Larson, 1993; MPCA, 1994; State of the Minnesota River, 2001), and among the most polluted rivers in the United States, largely the result of agricultural non-point sources. Intensive agriculture is common in much of the Minnesota River basin. One of its tributaries, the Blue Earth basin, is more than 85 percent cultivated in corn–soybean, and although it represents only 20 percent of the area of the MRB, it contributes between 40 and 50 percent of the annual pollutant load in the Minnesota River (BERBI, 2003).

A serious concern in the basin is that nutrients are largely exported to streams through drain tiles and ditches that effectively by-pass riparian vegetation. More than 6 370 000 acres (2 325 000 ha) of Minnesota cropland is artificially drained (Ohio State University, 1998) and agricultural runoff is thus largely discharged directly into channels. This results in substantial nitrate loading because as much as 50 percent of nitrogen fertilizer applied to crops can be lost from agricultural fields in the form of nitrate (Neely and Baker, 1989).

The Minnesota River basin has also experienced frequent damaging floods, and many of the tributary streams and sections of the main stem river channel are considered to be in a degraded condition. These effects have been exacerbated by the loss of hydrologic storage on watersheds and in floodplains through the loss of wetlands, tile drainage, ditching and perennial riparian vegetation (Magner, Johnson and Larson, 1993). As a result, flow rates of water have increased (Miller, 1999), contributing to unstable stream channels and greater sediment delivery downstream. The importance of perennial vegetation on the landscape is apparent when satellite imagery of the Upper Mississippi River basin is examined in spring and early summer (see: www.nass.usda.gov/research/avhrr/avhrrmnu.htm). The spring period typically exhibits the highest runoff and stream flow of the year, a time when the annual cropping areas can be seen as expansive brown areas. In contrast, areas with perennial vegetation during this same period are a bright green, suggesting active uptake of soil moisture and soil protection from rainfall impact. Shifts towards more perennial cover on the basin, therefore, have the potential to reduce flow and sediment rates during the most active runoff season.

The cumulative watershed effects of current land use described above can be considered in terms of increased flow rates, increased channel instability and increased loading of pollutants to the river; all contribute to degradation of water quality of the river. These effects are recognized throughout much of the Upper Mississippi River basin and are reported to be contributing to the hypoxia problem in the Gulf of Mexico (Goolsby and Battaglin, 2000).

This paper describes an interdisciplinary and participatory watershed management programme in the Minnesota River basin. A research and education approach is taken to guide the identification, evaluation and development of alternative cropping and management strategies that incorporate trees, woody vegetation and herbaceous perennials into the landscape, with the purpose of improving water quality and the hydrological services of the Minnesota River and its tributaries. Alternatives are being considered to provide farmers with options that can compete financially with current production systems on their own or through payments for the environmental services that such practices provide.

We have developed the following five objectives to accomplish these goals:

1. Promote the creation of, or support existing mechanisms that place leadership with local landowners and existing stakeholder groups in the identification, evaluation, promotion and implementation of alternative production systems, with support from universities and local, state and federal agencies as appropriate.
2. Through changes in cropping and increased perennial vegetative cover on watersheds and riparian areas of the Minnesota River basin, improve the hydrologic condition of the Minnesota River, reduce the magnitude of peak flow rates associated with the more frequently occurring storms, and reduce nutrient and sediment transport downstream.
3. Estimate the economic consequences of changes in cropping and increased perennial vegetation cover in watersheds and riparian areas, considering both the financial benefits to farmers and the economic impact of hydrologic and water quality improvements that can result.
4. Identify agronomic, economic and policy constraints and key knowledge gaps to crop diversification with agroforestry and perennial crop systems.

5. Develop information for landowners, citizen groups, government agencies, policy-makers, industry and researchers in a format (materials, meetings, conferences and learning groups) that is appropriate for aiding stakeholders in the decision-making process and furthers management consistent with improving water quality.

RATIONALE FOR CHANGE

The issues summarized earlier point to the need for change on the agricultural landscape. However, immediate and widespread change from current farming practices is not possible; furthermore, many potentially viable land-use alternatives have yet to be identified and tested. Therefore, incremental change is a more realistic approach, using pilot projects to demonstrate which changes are most effective and acceptable to farmers. A fundamental question that will be addressed in this programme centres on determining the scale and landscape positions for agroforestry and other perennial cropping systems that are most effective in improving water quality and the hydrologic condition of the river. It has been shown, for example, that scale and placement of restored wetlands and perennial vegetation will govern the magnitude of hydrologic response and nutrient export to water bodies (Almendinger, 1999; Ahn and Mitsch, 2002).

What we are suggesting in this programme is that some major changes are needed, at least on portions of the agricultural landscape. The reasons for these changes, in contrast to modifying the existing corn–soybean farming, are many. For one, conversion from annual cropping to perennial and woody crops will, in most cases, reduce the application of fertilizers and other chemicals on watersheds. This alone can reduce nutrient and other chemical loading to wetlands, lakes and rivers. Where sufficient proportions of watershed areas are converted to perennial vegetation, which eliminates the need for artificial drainage, water flow rates may return to levels closer to those associated with the original prairie–savannah ecosystems within which the Minnesota River was formed.

Improving water quality

Replacing annual crops with perennial cover crops such as switchgrass and hybrid poplars has been shown to reduce chemical export to receiving watersheds in northwestern Minnesota (Baskfield, Magner and Brooks, 1996; Perry *et al.,* 1998; Stockhaus, 2000; Shank *et al.,* 2001). Randall *et al.* (1997) report that nitrate-nitrogen (NO_3-N) loading from tile drains was 45 times higher under row crops than perennial crops and native grasses in the Minnesota basin. Restoring perennial vegetation in riparian areas, including cottonwoods (*Populus* spp.) and willow (*Salix* spp.), has important water quality and hydrologic implications for the river, including reduced nutrient export to rivers, improved stream channel stability and improved aquatic habitat. Denitrification and uptake are the major processes by which NO_3^--N is removed in floodplains and associated riparian areas (Burt *et al.,* 1999; Gold *et al.*, 2001). Riparian forests and associated communities are effective in removing nitrate-nitrogen and also in trapping excess sediment and phosphorus (Thornton *et al.*, 1998; Whigham, 1988; Addy *et al.*, 1999).

Phosphorus (P) is a limiting plant nutrient in most freshwater systems of Minnesota. As a result, even small quantities of P can cause serious eutrophication of lakes and rivers (Lüderitz and Gerlach, 2002). Significant algae blooms and a corresponding increase in turbidity result.

Because P is most often adsorbed to soil particles, soil erosion and sediment transport influence the export of phosphorus and, consequently, the retention of phosphorus on the watershed. Basins in which more than 50 percent of the land is in agricultural cultivation can experience suspended loads that account for 56 to 59 percent of total P export (Cooke *et al*., 1993). Phosphorus farming in wetlands is possible, but because P removal in natural wetlands is often poor (results vary from 0 to almost 100 percent removal), with a mean removal of 29 percent (Lüderitz and Gerlach, 2002), reducing P loading to receiving waters is greater where there is uptake of P by vegetation in the watershed and where that vegetation is periodically harvested and removed from the site. Ornamental willows and other willows thus have potential to reduce P and provide income through periodic harvesting.

Reducing excessive stream flow

To grow corn and soybeans in much of the basin, wet soils are a major obstacle, hence the proliferation of drainage systems. Perennial crops that are adapted to these conditions provide an alternative for wet sites and, furthermore, can reduce excessive water flow in the river, a trend that has been observed from 1938 to the present (State of the Minnesota River, 2001).

Many independent studies have shown that areas with trees and other woody plants have higher annual evapotranspiration and generate lower amounts of runoff and stream flow than do herbaceous plants, including annual crops (Bosch and Hewlett, 1982; Whitehead and Robinson, 1993; Brooks *et al.,* 2003). Conversion from annual agricultural crops to hybrid poplar in northwestern Minnesota reduces soil moisture and water yield (Kaster and Brooks, 2001; Perry, Miller and Brooks, 2001; Shank *et al.,* 2001). Hybrid poplar and natural forest remnants also experience less concrete soil frost than annual crops, yielding lower snowmelt runoff in the spring. In contrast, conversion of native perennial vegetation to annual crops and the accompanying wetland drainage in the Minnesota River basin has been shown to more than double the magnitude of peak flows associated with recurrence intervals of 1.5 to more than 20 years (Miller, 1999; Mickelson, 2001). Changes in average annual peak flows contribute to degradation in the river channel (Rosgen, 1994) and these effects can be exacerbated by loss or degradation of riparian vegetation (Dwyer, Wallace and Larsen, 1997; Burckhardt and Todd, 1998; Bendix and Hupp, 2000; Tabacchi *et al*., 2000; Riedel, Verry and Brooks, 2002, and others).

The cumulative effects of increased and more diversified perennial crops in the basin can *restore storage* to Minnesota's watersheds that have been lost through decades of: 1) wetland drainage; 2) conversion from native prairie and savannah ecosystems to annual crops; and 3) loss of riparian forest corridors in floodplains and along streams and rivers. Hey (2001) suggested that through restoration of riparian and associated wetland storage alone, we might experience significant reductions in flood peaks and hence flood damages. Hey and Philippi (1995) suggested that 13 million acres of restored wetland/riparian areas would have reduced flood damages caused by the 1993 flood in the Upper Mississippi River.

Opportunities for farmers and other landowners

As is the case with many watershed management benefits, those benefits derived from replacing annual crops with perennials can be many but may not all be reflected in the market.

Innovative mechanisms that will allow landowners to capture the value of the benefits they provide to downstream communities are needed to encourage land use that is consistent with improving water quality. Both financial (landowner) benefits and economic (societal) benefits can be obtained by implementing woody and perennial crop systems. Buffers around wetlands have also been shown to provide both economic and important water quality benefits when enrolled in the Conservation Reserve Program (CRP) (Rickerl, Janssen and Woodland, 2000). Growing short-rotation woody crops in Minnesota with incentives similar to CRP benefits provides a financially attractive option for rural landowners in areas of the state where markets exist for pulpwood or bioenergy. The current CRP programmes do not allow for productive use of the lands enrolled in the cost-share programme.

There are many opportunities to expand the use of woody and herbaceous perennial crops in floodplains and riparian corridors with agroforestry systems such as living snow fences, windbreaks and timber belts. Markets exist for woody biomass, either as an energy feedstock or as fibre for the wood products industry (Center for Rural Policy and Development, 2001). However, current fuel/fibre prices are too low for farmers to be willing to risk land conversion and the loss of short-term income, without additional incentives such as CRP (Streed, 1999). The bewildering array of federal and state policies and programmes that affect the management of farmland add to the need for effective risk-reduction strategies (Schertz and Johnson, 1997; Kuch and Crosswhite, 1998).

At present, CRP is essentially a set-aside programme that does not allow for the cultivation of marketable biomass crops on enrolled land. However, in 2001 the United States Department of Agriculture (USDA) approved the enrolment of land in the Minnesota River watershed as part of a pilot programme to evaluate the production of biomass fuels within the CRP framework (Johnson, 2001). Other types of incentives have also been considered. Hey (2001) suggested that credits might be given to individual landowners for increasing "storage" in upper watersheds and along main reaches of the river that translates into reduced downstream flood losses. He further indicated "Perhaps a futures market in flood storage credits could be established at the Board of Trade in Chicago". If non-point source (NPS) pollution were regulated, a permit trading programme might encourage the implementation of agricultural best management practices (BMPs) such as riparian buffer zones. The difficulty of monitoring NPS pollution makes design-based incentives (such as agricultural BMPs) more feasible to implement than performance-based incentives such as can be applied to point source polluters (Horan and Ribaudo, 1999). Ultimately, basin-wide total maximum daily load (TMDL) standards may provide the mechanism for instituting watershed-based performance incentives (Ribaudo, Horan and Smith, 1999).

Perennial crops and agroforestry configurations provide opportunities to combine environmental services with productive and profitable crops. These options may be of particular importance to enhance the survival of smaller-scale farms with a greater diversity of production and markets. The status of these farmers is particularly threatened because they lack the resources to expand and adopt the new competitive technology necessary for economic survival. The complex forces that have an impact on farming in the Upper Midwest corn belt have local, regional, national and global origins and have created substantial barriers to farmer implementation of perennial crop/agroforestry options.

Given the recent poor market conditions for corn, soybeans and other grain crops, the problems of non-point agricultural pollution, pressure to establish TMDLs and other concerns about downstream impacts, such as the hypoxia issue in the Gulf of Mexico, opportunities for diversifying farm income and improving the condition of Minnesota's watersheds and rivers are attractive. Nonetheless there are a number of issues that limit our ability to take advantage of the potential opportunities that exist.

OBSTACLES TO CHANGE

The challenge in this programme is to develop and implement perennial cropping systems that are hydrologically effective, financially attractive to landowners and can be directed to appropriate landscape positions at a scale that provides both viable economic alternatives to farmers and the environmental benefits necessary to improve the condition of Minnesota watersheds. Not surprisingly, there are several obstacles to implementation that must be overcome in this programme, as summarized in the following:

- ***Lack of information on the aggregate impact of landscape changes on hydrologic storage and water quality.*** Although many studies have shown field-level effects of different land-use practices and vegetative conversions, the dearth of information about the aggregate watershed response to such land-use change has made it difficult to convince those who make decisions about land use.

- ***Understanding constraints to and motivations for farmer adoption of soil and water conservation options.*** Such options have been available to farmers for many years, but despite the potential benefits of these practices, they are often not adopted. The reasons for this lack of adoption include financial, technical and other constraints that are very real and well understood by the landowner. To motivate landowners to adopt sustainable practices, we need to understand the constraints they face, and together identify options that overcome constraints and offer productive and profitable opportunities.

- ***Institutional and policy constraints.*** Those factors and policies that influence farmers' use of the land need to be analysed; barriers to innovation and diversification of the agricultural landscape need to be identified so that better policies can be developed to support practices that provide benefits to society as a whole. Financial safety nets for farmers, rules for obtaining loans and crop insurance benefits, all are being examined for an array of different cropping systems and land-use practices.

- ***Lack of financial information on costs and benefits of alternative cropping and land management systems.*** Information about financial opportunities provided by diversified production systems, such as agroforestry practices, living snow fences, tree farms and alternative perennial crops, must be presented to farmers. Knowledge of production, processing and marketing is necessary so that farmers can make informed decisions.

- ***Internalizing externalities – valuing the benefits of improvements in water quality and storage.*** Many of the watershed measures that reduce peak flows and the amount of nutrients and chemicals entering water courses provide economic benefits for society or downstream users, which are not reflected in the market. The external and cumulative benefits and costs

of land-use change need to be quantified and valued. This information is needed by policy-makers to make decisions about government programmes that may help finance practices that provide benefits to society.

- ***Lack of understanding and communicating of the adverse impacts of past land use and the benefits of land-use change to stakeholders.*** Farmers, other landowners, local communities and policy-makers, although aware of environmental problems related to land-use practices, may not understand how historical and cumulative changes in land use, and practices such as field and wetland drainage have affected stream flow peaks, channel erosion, sedimentation and water quality. In addition, there is little understanding of the hydrologic and water quality benefits that can be derived from restoring perennial woody vegetation on watersheds and in riparian areas.

AN INTEGRATED APPROACH

This multifaceted programme is a participatory approach that involves people from different sectors and with different backgrounds and disciplines. It incorporates demonstration projects, monitoring and research, educational programmes, hydrologic and economic modelling, market and policy analysis together in a way that invites expansion and continuity of successful outcomes.

Participation of stakeholders

Stakeholders are involved in this project in a number of ways. Programme objectives emerged largely from meetings, conferences and other activities involving a diverse group of stakeholders (landowners, local citizen groups, local, state and federal government agencies) in the Minnesota River basin. Partnerships have been formed with concerned citizen groups, agency personnel, agroforestry cooperatives, university faculty and individual farmers. One such partnership is the "3rd crop" initiative led by a local watershed group, the Blue Earth Basin Initiative (BERBI), which was formed to develop alternatives to intensive corn–soybean farming with the aim of improving water quality. Another group, Clean Up the River Environment (CURE), has been an active proponent of improving water quality and, together with the Minnesota River Joint Powers Board, has sponsored activities that bring together a broad range of landowners, citizen groups, government agencies and university researchers in the development of a Minnesota River Basin Action Plan. One of the top three recommendations in this plan is the improvement of land management practices, which this programme directly addresses.

Because the changes in land use and management practices to be evaluated in this programme are meant to be adopted by farmers and other landowners in the Minnesota River basin, the projects rely on "learning groups" that include some who have already implemented agroforestry and perennial cropping systems. These learning groups, patterned after the model of Jordan *et al.* (2000), provide the vehicle for stakeholder interaction to exchange and share ideas with the objective of designing sustainable and profitable land management options that can easily be adopted by landowners

Project activities

Through learning groups and workshops with stakeholders and project collaborators, scenarios of potential cropping changes are being identified in pilot project watersheds, the Chippewa and Blue Earth watersheds in the Minnesota River basin. Through a series of meetings with farmer learning groups, acceptable perennial cropping systems are being identified that have the potential for both financial opportunities for landowners and hydrologic/water quality benefits.

Demonstration areas of 10 to 20 acres (4 to 8 ha) are being established as pilot projects within small watersheds, and are accompanied by field research and monitoring to quantify production outcomes and hydrologic and water quality changes that are associated with the different cropping systems. These pilot projects are complemented by a series of plot studies in which seven perennial crops of interest to farmers are being studied to determine differences in soil moisture regimes, runoff and the export of sediment and nutrients. The results of this research and monitoring effort have important implications for the federally mandated TMDL process, which requires all states to identify and mitigate all impaired waters. Furthermore, the resulting data allow for testing and validating models to be used to extend field results across the basin.

Changes in vegetative cover and related changes to wetlands, stream channels and ditches will be simulated for upland watersheds and for riparian areas; different scenarios of change will be investigated to determine the effects of scale and landscape position on project objectives. The Hydrologic Simulation Program – Fortran Model (HSPF), as described by Bicknell *et al.* (1997), has been calibrated and will be used to simulate hydrologic, hydraulic and water quality changes due to project activities. Areas of upland watersheds that undergo conversion would not require drain tiles; therefore, where such changes occur, the removal of tile drainage would be a component of the simulation. In addition, changes in seasonal evapotranspiration, including interception, would be major hydrologic changes that would be reflected in model parameters, which would result in different soil moisture storage. Changes in the stream channel/riparian corridors, restoration of selected wetlands and riparian forests on floodplains and along stream banks will also be simulated. Field studies on ditch redesign that can create a functioning riparian vegetative buffer will provide empirical data to test and validate models. Furthermore, restored wetlands have been and continue to be monitored; their storage and water quality benefits can thus be better quantified and the data used to model the effects of expanded wetland restoration in the basin.

The output from the hydrologic modelling provides critical information for economic evaluations of downstream impacts. Stream flow volumes, peak flows, dry season (summer) base flows and sediment export will be examined under current land-use conditions. These same hydrologic variables will be simulated for conditions associated with perennial vegetation in uplands and riparian areas. Comparisons of these two conditions form the basis for further economic analysis. Hydrologic analysis considers how changes in stream flow pattern will affect bank full flow conditions and the resulting impacts on river stability and sediment-nutrient export. In addition, land-use effects on low flow conditions and the implications for water quality, aquatic habitat and diversity are all of interest.

Economic analyses will be performed using field monitoring data and hydrologic modelling results using the framework of FAO Conservation Guide No. 16 (FAO, 1987). On-site and

off-site costs and benefits are being examined from both the perspective of individual farmers and that of the broader stakeholders in the river basin (externalities). Farmers may have to change their farming approach in some cases, requiring new equipment costs. Such costs must be compared with benefits derived from new crops. In terms of externalities, downstream impacts need to be quantified and valued. For example, if peak flow discharges associated with two to 20 year recurrence intervals are reduced, to what extent would such changes translate into reduced flood damages (benefits)? Any reductions in sediment levels in the channel and nutrient loading may be translated into sediment removal costs in ditches, effects on aquatic (fish) productivity, reduced water treatment costs and so forth. Valuing externalities represents a challenge and will depend, to a large extent, on the results of ongoing non-market valuation research. In some cases, only a rough estimate of potential downstream benefits can be obtained; regardless of whether all such externalities are valued, they will be identified as project outcomes. For example, the Minnesota River has good recreational potential and we will attempt to estimate the recreational value of a cleaner river.

An assessment of markets (current and future) for the variety of products derived from agroforestry and other perennial cropping systems is an integral component of the project. For example, there is now a planned bioenergy project proposed in the basin, which will require more than 25 000 acres (9 100 ha) of short rotational woody crops, such as willow, to be located near the site. This new market is in an area that is primarily under corn and soybean cultivation at present.

Workshops are planned for land managers and farmers to discuss economic and policy issues that constrain implementation. Discussions will be held to determine steps needed to provide necessary incentives and technical support to farmers, as well as explaining how the various land-use changes affect the flow and quality of water in the river. Topics covered will range from farming methods for perennial cropping systems, to hydrologic principles and examples of how improved riparian conditions, wetland conditions and uplands benefit stakeholders in the basin.

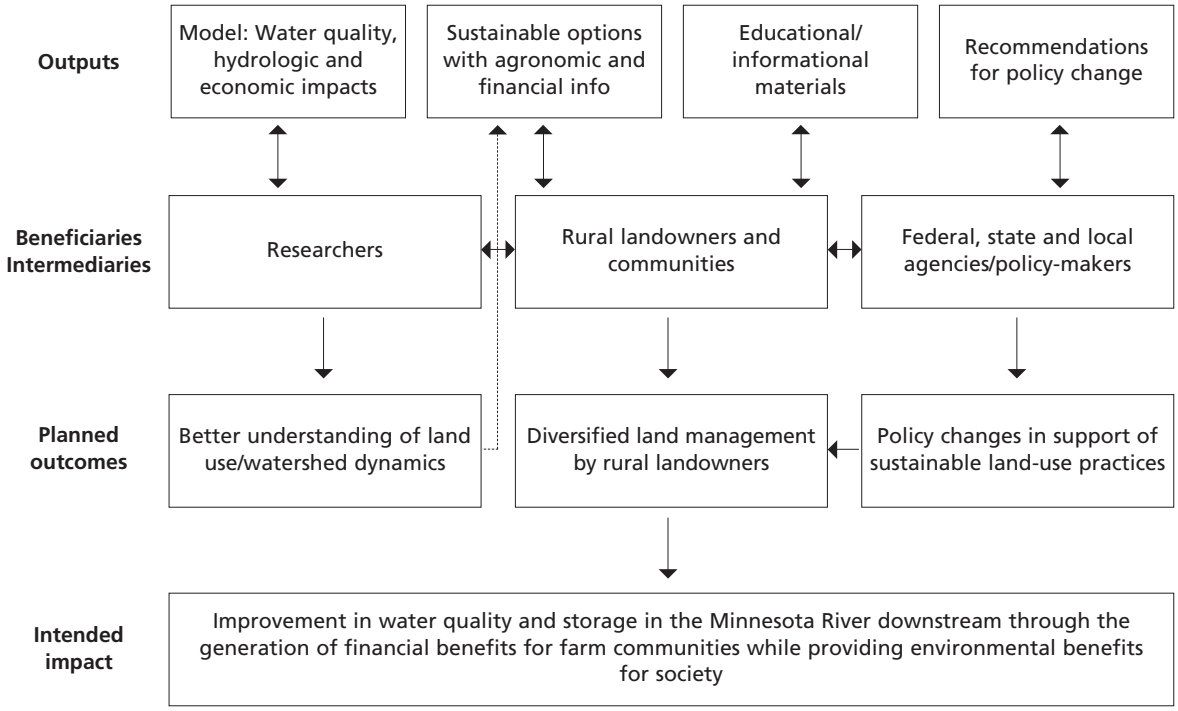
Educational materials will be prepared that are appropriate for different audiences (landowners, citizen groups, local, state and federal agencies, and policy-makers). The format for these materials will be determined through interaction with the various constituents in learning groups, workshops and more general meetings. Ultimately, the information will be distributed and evaluated through this same strategy. This participatory process should yield educational materials that support viable land-use options that have financial vitality and environmental benefits that can help shape agricultural and environmental policy in the state and region.

Programme summary and expected outcomes

This programme is expected to promote desirable land-use changes that will diversify the agricultural landscape, sustain the rural economy, enhance hydrologic storage and function and improve water quality in the Minnesota River basin (Figure 1). Prospects for broadening the agricultural production base can lead to more sustainable financial benefits to landowners while enhancing the environmental benefits to both local communities and downstream communities as well. All these objectives can only be achieved when individual landowners adopt more sustainable land-use practices in sufficient numbers to generate the desired impact.

To promote the adoption of alternative systems, the programme will identify options with benefits sufficient to convince rural landowners to make the change. Therefore, this integrated approach must develop the technology, markets and policy changes necessary to make those systems attractive to landowners. The key to this approach is that landowners, technical service providers, policy-makers and other interested parties/stakeholders have been involved from the outset. We expect that our initial learning groups will expand into an ongoing network of groups working to improve and adapt management practices for using perennial crops and agroforestry options, as has occurred with our earlier groups that addressed annual cropping systems. What should emerge from the programme is an expanded and continuing diversification of land use and management, a better understanding of watershed benefits that are derived from improved land use, more involved and informed citizens, and ultimately policy changes that are needed to support sustainable land-use practices.

FIGURE 1
Programme outputs



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CHAPTER 12
WATERSHED MANAGEMENT IN THE ALPINE CONTEXT: SUMMARY OF THE REPORT ON STORM EVENTS AND LESSONS LEARNED IN ALPINE COUNTRIES[1]

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The aim for the future in the Alpine region is to provide better protection to human life and material assets against floods, debris flows and landslides, in accordance with internationally comparable safety standards. The principles for solving the problems are very similar to those used to solve the problems we have in getting enough good-quality drinking-water for the next generations. Based on a report written for the Alpine Conference of the Alpine Convention, a short summary of the main conclusions is presented in the following pages. The conclusions are based on the experience gained in the context of the storm events of 1999 and 2000 in the area covered by the Alpine Convention. The aim of the report was to highlight the need for cross-border action in different areas so as to provide more effective protection in the future to human life and material assets against floods, debris flows and landslides.

The following were the objectives adopted in the compilation of the report:

- to demonstrate the possibilities for the improvement of future cross-border cooperation for the protection of humans and their material assets at the administrative level, within the area covered by the Alpine Convention;
- to raise political awareness of the possibilities that exist for the improvement of protection against natural hazards, such as floods, debris flows and landslides.

Thus, the core concern is to ensure comparable levels of cross-border protection against natural hazards in the Alpine region.

THE STORM EVENTS OF RECENT YEARS, PARTICULARLY 1999 AND 2000

In 1999 and 2000, heavy precipitation falling on already saturated ground in most Alpine countries resulted in an accumulation of debris flows, landslides and floods, some of which were devastating. The repeated natural disasters claimed a total of 73 lives and gave rise to material damage and follow-up costs totalling billions of Euro.

1. Published by the Alpine Convention Conference.

At Whitsun (June) 1999, the cumulative effect of heavy precipitation falling on ecosystems that were already waterlogged as a result of heavy snow cover gave rise to extensive flooding and unconfined debris flows in Germany (Bavaria), Austria, Switzerland and Liechtenstein.

In summer and autumn 2000, extreme precipitation events, in conjunction with the already exhausted water absorption capacities of the soil, vegetation and water bodies, again triggered floods, debris flows and landslides. In this instance, the countries affected were Germany (Bavaria), Italy, Liechtenstein, Austria, Switzerland, Slovenia and, to a far lesser extent, the French Alps.

For example, on 14 October 2000, after days of intensive rain, the Gondo slope in the Simplon area of the Swiss canton of Valais began to slide. Mud and debris plunged into the valley, sweeping everything in their path along with them, i.e. trees, roads and houses. Fourteen people met their deaths in the masses of mud and debris, and a large part of the village in the canton of Valais on the Italian-Swiss border was completely destroyed.

Debris flows, landslides, torrents and valley rivers breaking their banks claimed dozens of lives in the entire European Alpine region and caused extensive life-threatening damage. Along with the Swiss canton of Valais, the Valle d'Aosta valley in northern Italy was the most severely affected area.

Solidarity with the victims

The populations in the affected countries demonstrated their solidarity by providing rapid help with the clean-up operations, which were carried out by the fire brigade, army and civil defence, and through generous financial donations to private aid organizations. The ministers who participated in the Alpine Conference of 30 to 31 October 2000 in Lucerne, Switzerland also expressed their solidarity with the affected regions.

TABLE 1

Overview of the number of victims and material damage caused by storms in 1999 and 2000 (not including hurricane Lothar)

NUMBER OF VICTIMS	MATERIAL DAMAGE IN MILLIONS OF EURO
5	250
	80
44	5 700
	80
	440
	10
24	1 000
73	7 560

Debris flows, landslides and floods claimed a total of 73 lives and gave rise to estimated material damage in excess of 7 billion Euro – including indirect effects on the economy (see Table 1). The only reliable figures available concern the death toll. Owing to the lack or approximate nature of the available data, it is only possible to estimate the cost of the material damage incurred.

Consequences, climate change and its harbingers

The fact that the cost of the damage arising from natural disasters is rising owing to increasingly intensive land use is not the only issue that provides food for thought here. The fact that extreme storm events are clearly occurring more frequently than in previous decades is also extremely worrying. The question arises as to whether the phenomenon at play here is merely a regular recurrence of natural weather phenomena, or whether it already signals the consequences of anthropogenic climate change. The fact that an accumulation of extreme natural events in the Alpine countries also gave rise to death and destruction in the nineteenth century makes it more difficult to provide conclusive scientific evidence of a causal link between anthropomorphic influences and climate change.

The consequences of climate change represent a major challenge for the new millennium. The current level of insight into climate processes would suggest that climate warming can involve an increase in the potential for heavy precipitation and extreme wind speeds. These extreme meteorological phenomena may be particularly significant in the context of the southern slopes of the Alps. However, floods in winter and in transition periods could also increase in intensity. The influence of climate change on summer storms and wind storms is still uncertain, however. Today, climate research assumes that shifts leading to extreme weather events will first become manifest at the global and continental levels. Furthermore, it assumes that it will not be possible to prove conclusively the existence of an altered climate-induced risk of extreme meteorological events at the national level in the near future, as the number of such events will be insufficient to enable demonstration of such shifts with sufficient statistical certainty.

Today the main danger lies in the fact that the gaps that exist in the complex argumentation proving the links between human influences and ongoing climate change are often more strongly emphasized in the general debate than are the existing indications of a causal link between the two.

For this reason, instead of rapid and consistent action being taken to protect the environment, there has been a rather hesitant adoption of effective measures. This is the case despite the fact that research has provided sufficient indicators to substantiate environment policy and sustainability-oriented arguments that legitimize the rapid reduction of burdens on the environment. Furthermore, in view of the long-term effects, complete and conclusive proof from climate and environmental research will come too late to enable the implementation of the kind of precautions that would provide speedy relief and assistance.

Thus, for the above-mentioned reasons, the following two-pronged approach is recommended:
- a more intensive and targeted consideration of the principles of sustainable development that reduces anthropogenic pollution and conserves non-renewable resources;
- the promotion of preventive measures to minimize the damage caused by climate change.

The creation of ever-expanding access to the Alpine region has a significant role to play in this context. Thanks to the construction of roads, railway and road tunnels, bridges, funiculars, avalanche barriers, rockfall protection systems and barriers that provide protection against the forces of nature and assist in the straightening and damming of watercourses, new settlements, recreational areas and transport axes have been created in areas that were previously considered as high risk. It is impossible to provide complete protection for these structures in extreme storm conditions. Thus, a residual risk to human life and material assets must always be reckoned with. The situation is further intensified by increasing soil sealing due to the constant extension of settlement areas, which gives rise to increases in peak flows.

THE MOST IMPORTANT CONSEQUENCES FOR THE ALPINE REGION

Due to the increasingly intensive use of areas at risk from natural hazards and the associated rise in values in those areas, the potential for damage in the Alpine region is growing continuously. At the same time, the general public expects the State to continue to provide ever-improving protection against natural hazards. However, the growing safety requirements cannot be fulfilled without the consistent adaptation of land use to the existing risks.

Natural hazards such as avalanches, rockfall, landslides and floods have been part and parcel of the Alpine region for centuries. The following two questions are central to the future of the region:

- how should the use of the Alpine environment be organized in the future so that it meets the requirements of sustainable development? And;
- where do the boundaries lie with respect to the use of the mountain region and the Alps – from an ecological, economic and social perspective in particular?

The answers to these questions are of crucial importance for the future of part of the 14 million people who live in the eight states, 53 regions and 5 800 local authorities in the area covered by the Alpine Convention.

In the context of the organization of livelihoods, the question also ultimately arises with respect to the level of safety necessary to safeguard livelihoods and the willingness to provide the resources required to provide this safety.

The tension among risk-appropriate land use, careless exploitation and absolute protection requirements necessitates the continuous weighing-up and balancing of the different interests. This can only be achieved through a democratic debate among all of the participating parties at the local, regional, national or international level, depending on the issue at stake.

The increasing potential for natural hazards and damage

In using the Alpine region, humans have had to confront the forces of nature since the beginning of time. The extreme weather conditions, in combination with the steepness of the terrain and its propensity to erosion are mainly responsible for the more or less distinctive dynamics of natural processes. The hazard potential has altered drastically over the past

century. Round about the year 1900, in many places, the threat of natural hazards was still due to the extreme overexploitation of the mountain forest, as settlements and transport axes were insufficiently protected against avalanches, rockfall, landslides, floods and debris flows. Today, the potential for damage is constantly growing, above all as a result of the increasingly intensive use of areas at risk – and the associated increase in values.

While, in the past, avalanches and debris flows in mountain areas only threatened seasonally used agricultural buildings, pastureland and agricultural crops, today these areas contain permanently occupied houses, important transport and transit axes and tourist infrastructure.

The following scenarios must be assumed for the Alpine region, which is already densely populated:

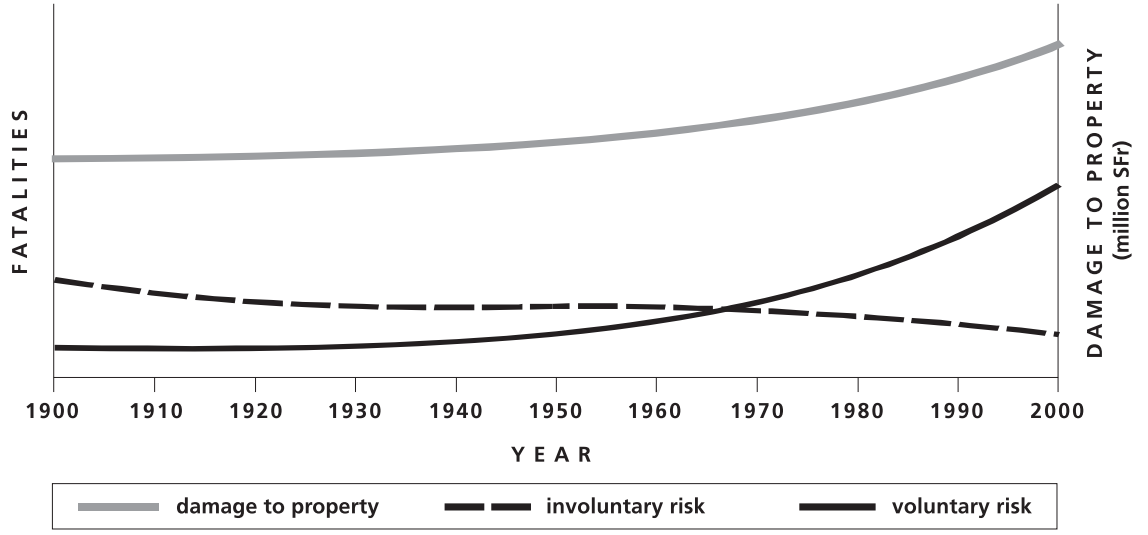
- Owing to growing settlement density and vulnerability, the material damage arising from natural disasters will increase.
- The willingness of individuals to take greater risks in the pursuit of leisure activities (adrenaline kick) – including risks posed by natural hazards – will increase.
- In our society, there is a tendency to hold the community and the State responsible for ensuring that the desired level of protection against natural hazards is provided. Individual responsibility is increasingly denied.
- The demands of society for greater safety in the area of protection against natural hazards will put the public purse and insurance companies under increasing pressure to finance the requested safety services.
- Settlement pressure will continue to increase in already densely populated areas.
- The value of development areas that have already been built on – and those that have just been zoned as such and are not yet built on – will continue to grow and, at the same time, intensify the risk posed by natural hazards.
- The increasing mobility requirements that are fuelled by both economic and leisure factors will give rise to greater risks along transport axes in the Alpine region.
- Extraordinary storm events will become more extreme and even more frequent.
- The pressure to adopt more intensive uses in the vicinity of protection structures will continue to increase as the public is less prepared to spend money on preventive protection against natural hazards, if such investments do not pay off in terms of making more development land available.

It is difficult to quantify the threat posed by climate change that leads to a growth in the potential for damage and thus also increases the risks posed by natural hazards.

The current understanding of climate change prompts the conclusion that proven climate warming involves extreme wind speeds and increased heavy precipitation. Furthermore, it can be expected that flooding in winter and in transitional periods will become more intense.

FIGURE 1

The decreasing trend in the loss of life due to natural events compared with the increasing trend in the loss of life through voluntary risks undertaken in natural settings (assumptions)



Society's increasing safety requirements

The legislation governing protection against natural hazards has been extended and expanded on a regular basis over the past century. In addition, insurance systems have been established and natural disaster funds created in some countries. As a result, the State, the insurance industry and voluntary organizations became the guarantors of protection against natural hazards and the management of natural disasters. Today, the fire brigade, military and emergency services are also trained and equipped to be able to limit the damage caused by natural events through rescue and clean-up operations. In general, they also ensure the rapid rehabilitation of damaged areas – under the crucial condition, of course, that well-established emergency planning is in place.

Society's safety requirements grow with the improvement of the public services provided for protection against natural hazards. While individuals may consciously take considerable risks in certain specific situations, the demand for State-guaranteed and virtually comprehensive safety dominates in the collective sphere.

Owing to modern leisure requirements, and the fact that places of work and residence are often considerable distances apart – including in mountain regions – the volumes of both rail and road traffic have increased significantly. As a result, the likelihood of accidents occurring as a result of natural events is increasing along the transport routes in the Alps. This in turn gives rise to the demand for additional safety measures such as protection structures, early warning systems and the improvement of communication options. Thus, for example, rockfall nets and other protection systems are being requested and installed on roads where the risk of rockfall was not previously a matter of particular concern.

This increase in safety requirements can be demonstrated using the example of protection measures implemented along the Gotthard railway line in Switzerland. Increased use, more passengers and more valuable freight, as well as the trend towards "just-in-time" deliveries, have given rise to a level of risk that is no longer acceptable and must be reduced through suitable measures. Figure 2 shows the technical developments in the reduction of risks posed by natural hazards over the past century. It also demonstrates modern society's increasing safety and mobility requirements.

FIGURE 2
Development of safety requirements between 1900 and 1980: the example of the Gotthard railway line

Protection at any price is an illusion

The current proliferation of extreme meteorological events and the damage they cause is a clear reflection of the fact that even modern industrial societies – such as those of the Alpine countries – with their access to state-of-the-art safety technology cannot guarantee absolute protection against natural hazards, and are becoming more and more vulnerable to them.

Thus, for example, in a typical Swiss Alpine canton such as Graubünden, 450 known natural hazard locations have been identified along the 1 600-km long road network. For financial, technical and ecological reasons, it would simply not be possible to provide protection against all of these risks or to safeguard the transport routes using suitable protection measures. However, the general public's awareness of the limits of technology is declining. Today, people in the Alpine region want roads that can be used safely day and night all year round, irrespective of the difficult climatic and topographical conditions. The availability of such infrastructure is taken for granted with respect to Alpine transit traffic, in particular.

Owing to the increasing trend for expressing and validating individual freedom and self-fulfilment, individual responsibility now takes a back seat. The erroneous view that nature must submit to human requirements often prevails. This can be seen in the boom in dangerous sports such as off-piste canyoning and snowboarding, which involve a willingness among participants voluntarily to expose themselves to natural risks – for example the release of an avalanche (see Figure 1). Thus, the increase in fatalities for which the victims themselves bear responsibility is not coincidental.

In view of the knowledge that an absolutely reliable level of safety does not exist, it is important to identify the risks arising from natural processes and the implications of their development for humans and infrastructure. For it is only when we know what can happen that we will have an opportunity to define what we wish to do about it in terms of precautions, and how much we are prepared to invest in the eventual safety measures.

Integrated risk management

In order to guarantee the risk-appropriate and sustainable use of the Alpine region, the necessary decision-making basis must be developed for spatially based integrated risk management. Together with overviews of the potential damage, hazard maps constitute an indispensable basis for decision-making in the context of risk-appropriate land use.

In order to fulfil sustainability criteria, land use must take equal account of economic, safety technology, ecological and sociological factors.

These documents, be they hazard, intensity, damage potential maps or risk maps, provide valuable decision aids in the context of prevention. This also includes the use of the fire brigade, the military, emergency services and other aid organizations for the management of disasters and the subsequent rehabilitation. Thus, for regions that still do not have such documents, their creation is a key priority.

Crisis management, which requires simple, safe and fast communication and decision-making channels, is also an important part of integrated risk management.

In the interest of risk-appropriate land use, users require documentary and regulatory bases created with practical application in mind for the definition of protection objectives, risk analysis and risk assessment. Furthermore, the State should introduce suitable measures to ensure that risks in threatened areas do not increase any further as a result of rises in the value of previously zoned and built-up development zones and in agricultural zones.

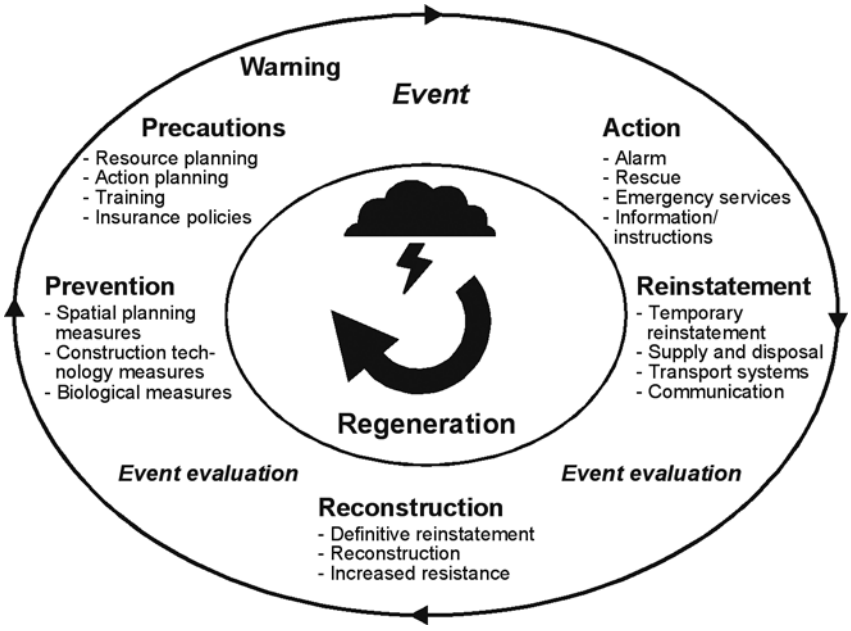
Prevention for protection against natural hazards

In the interest of sustainability and comparable levels of safety, protection concepts should incorporate larger spatial units such as valleys or entire catchment areas. Integrated regional management that takes all requirements into account can only be implemented in larger spatial units. If these preconditions are fulfilled, all of the available preventive measures can be tailored to each other and implemented in an equal and balanced way.

Systematically structured documentation of disastrous natural events and their management is necessary to enable the lessons from the past to be made to benefit future prevention work. For this reason, attempts to develop natural hazard registers should be promoted, as is the case with the DOMODIS project. The planned follow-up project, DISALP, which is being implemented in the framework of INTERREG IIIB, intends to establish the natural hazards register on a broad international basis so as to enable its widespread practical implementation.

FIGURE 3

Integrated natural hazard risk management means the equal implementation of all possible measures for the protection of human life and significant material assets. Risk communication and risk dialogue are essential prerequisites of this process



Risk-appropriate and sustainable land use necessitates knowledge of the potential hazards and potential damage. The protection objectives that the State acknowledges as worthy of promotion must also be defined. Close cooperation and risk dialogue among State bodies, the owners of land and other assets, aid organizations and the insurance industry are also indispensable. This is the only way that the coordinated – and thus optimum – use of the resources and instruments available for disaster management and subsequent rehabilitation can be guaranteed.

The future organization of the living environment in mountain regions is of crucial importance for the Alpine countries. In view of the increasingly difficult production conditions for the agriculture and forestry sectors in mountainous terrain, which for reasons of cost mean that they can no longer compete with the same activities in the lowlands, the maintenance of watershed areas, which also provide preventive protection to humans and infrastructure, is no longer guaranteed. Current requirements in terms of landscape management and protection against

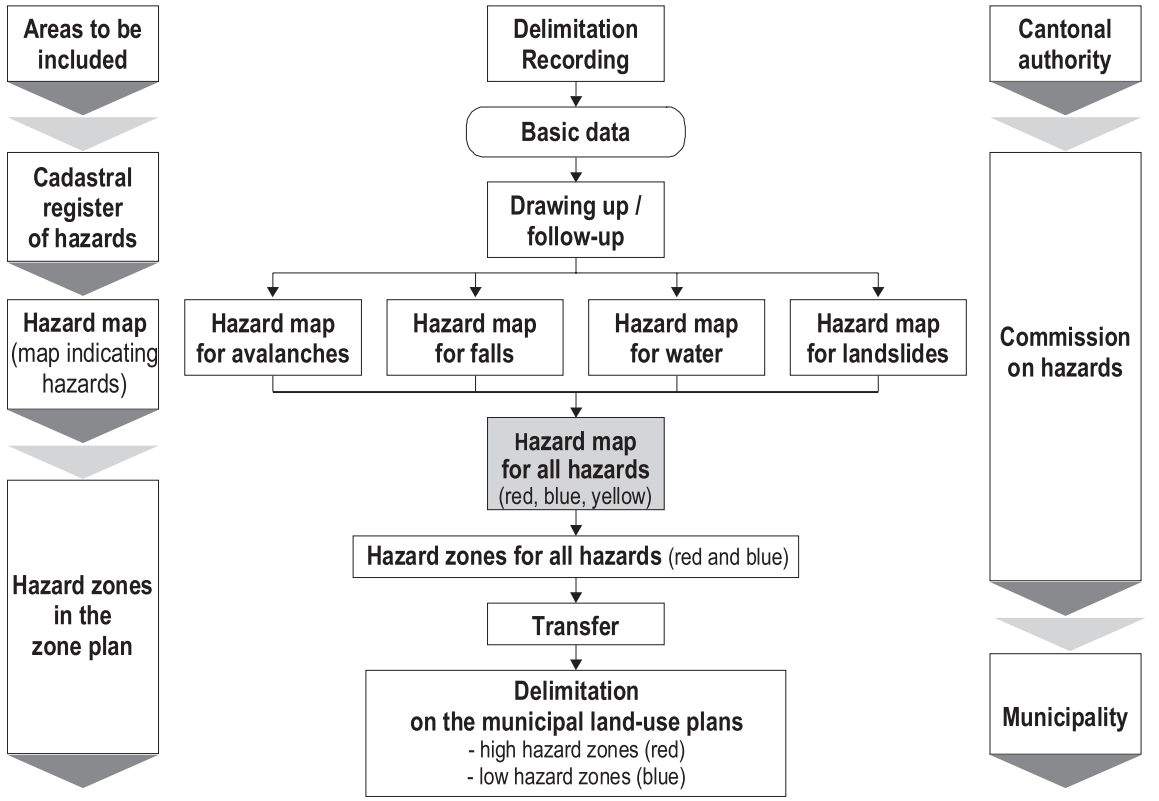
natural hazards – with suitable forms of land use – and the lack of public funding necessitate greater efficiency and effectiveness in the use of public resources. A change in direction, which involves consideration of both the land-use aspect from an economic perspective and the natural hazard protection aspect from an ecological perspective, requires substantial and organizational adaptations. If financing of the producers of socio-economic safety and traditional landscape services is not guaranteed, the existence of primary sector producers is also under threat.

Risk-appropriate zone planning

In many cases, the options available for land use in the Alpine countries, with their characteristic watercourses, mountains and forests, are very limited. Depending on settlement pressure, the concentration of material assets under threat – in settlement areas in particular – has increased significantly in recent decades. Recent extreme events have repeatedly presented us with evidence of the limits of hazard prevention. In view of the increased values in the areas at risk, the basic question with respect to the acceptance and acceptability of the risks posed by natural hazards is highly relevant today.

The following core questions must be clarified in a detailed risk dialogue among the responsible authorities and, ultimately, with the populations to be protected: What can happen? What may happen? How much are we prepared to pay for safety?

FIGURE 4
Process diagram for the consideration of natural hazards in the context of land use



Over the past 50 years, encouraging experience has been gained in dealing with the avalanche hazard and its consideration in the context of land use. Thus, although it concerns a spatially limited problem as compared with flooding, for example, this experience can be used as a yardstick for dealing with other natural hazards.

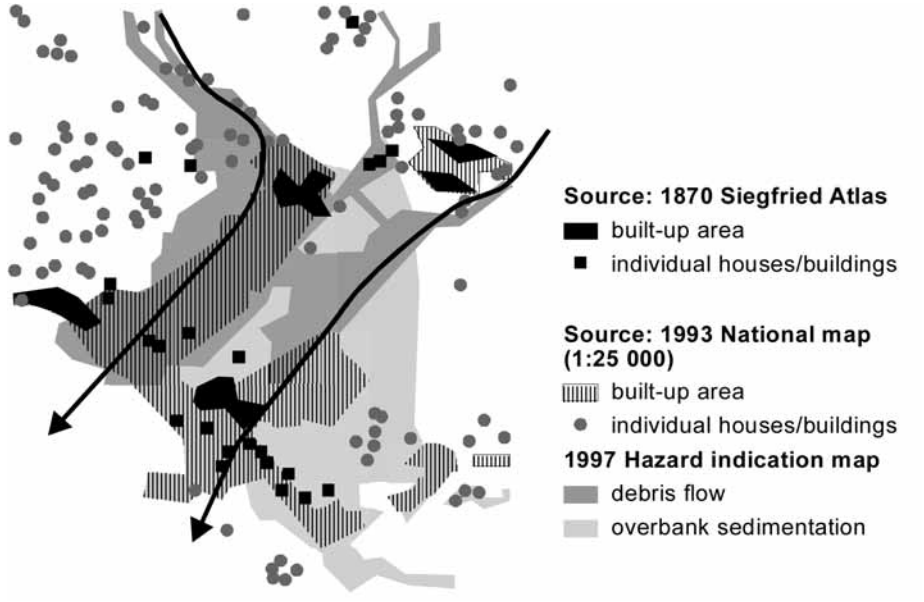
The avalanche winter of 1999 showed that consistent preventive and integrated protection against natural hazards pays off. An approximate comparison of the number of deaths and cost of damage in the extreme avalanche years of 1951 and 1999 supports this observation. The blocking of roads and rail links and the evacuation of people in the yellow and blue hazard zones made an important contribution to the success of the adopted management approach, although it must be said that luck also played its part.

Based on the knowledge that land use cannot continue to expand unchecked in areas at risk from avalanches, the results of the avalanche hazard maps have been integrated into spatial planning since the 1970s. However, it was only with the publication of the *Guidelines for the consideration of the avalanche hazard in the context of land-use-related activities* (*Richtlinien zur Berücksichtigung der Lawinengefahr bei raumwirksamen Tätigkeiten*) in the 1980s and the deployment of special hazard commissions in Switzerland, for example, that the threat of avalanche was consistently taken into account in the context of land use. As a result, the preconditions were created for the improvement of early warning systems and for organizational measures, such as evacuation and the closing of transport routes.

The municipality of Brienz in the Bernese Oberland (Switzerland) is an example of how settlement development expanded in areas at risk from landslides and overbank sedimentation between 1870 and 1993 (see Figure 5).

FIGURE 5

A comparison of the hazard situations prevailing in the municipality of Brienz (Bernese Oberland) in 1870 and 1993 shows that hazardous processes such as landslides and bank sedimentation were not given sufficient attention in previous zone planning



In view of the extensive number of such examples based on the experience of earlier avalanche and flood disasters, it is important that other natural hazards be taken into account in spatial planning along with avalanche, for example slope instabilities, debris flows, rock slides, rockfall and flooding. This should also be based on solid foundations that obligate the authorities and landowners.

Correspondingly, relevant instructions for the consideration of flood hazards and mass movements should be added to avalanche guidelines. The application of these guidelines represents a challenge in areas in which municipalities have already zoned plots for development that are located in areas at risk and that require additional areas for development. Cases whereby zoned development land must be re-zoned because of a natural hazard pose particular difficulties for authorities and landowners. This is particularly applicable when the price of development land exceeds the standard agricultural price by multiples – by several thousand euros per square metre, in extreme cases.

The possibilities and limits of technical measures for protection against natural hazards

Hazard protection structures that are intended to remain functional on a long-term basis must be maintained regularly. The costs associated with this maintenance are likely to increase significantly in the years to come.

The current status in the development of barrier and anchorage technology makes it possible to implement protection measures that would have been unthinkable in the past. However, there is still room for development in the areas of flood and rockfall protection. The first official system for the testing of rockfall nets came into operation in Switzerland in 2002, in accordance with the corresponding guideline.

However, it would do nothing for the advancement of sustainability if every major or disastrous event were to result in the further development of hazard protection structures. Technical protection structures offer no guarantee of 100 percent safety, as evidenced by the collapse of a tunnel following a rock slide at Lake Brienz in Switzerland in 2002.

With investments in protection structures, it must be taken into account from the outset that they involve maintenance costs that should not be underestimated if their protective function is to be guaranteed on a permanent basis. Thus, it is important to define the protection objectives towards which a particular measure or set of measures should be directed.

The value of all existing structures for protection against natural hazards in the entire Alpine region probably exceeds 100 billion Euro, and this represents a major commitment for the owners of these facilities. The basic prerequisite for the long-term preservation of the protection function is the ensuring of maintenance, repair and redevelopment measures. The cost of investment in sustainable protection against natural hazards, which also includes protection forest maintenance, should not be underestimated. It is foreseeable that the costs involved will increase considerably in the years to come if these structures and systems are not to be bequeathed to future generations as abandoned orphan sites and a growing source of potential danger.

Learning to deal with risks

In the case of natural hazards, the possibilities for risk reduction are also increasingly hampered by technical, ecological and economic limits. The distribution of the tasks adopted hitherto must be reconsidered. For when it comes to the use of sites in threatened locations, in many cases the individual responsibility of the landowner has not been given the necessary emphasis. The future organization of the division of tasks among private individuals, the State, insurance companies and voluntary organizations must be adapted to the changing economic, ecological and social conditions.

Thanks to technical progress and the concentration of material assets, such as important infrastructure, modern industrial societies in hazard zones are increasingly vulnerable to natural disasters. Extreme events threaten human life, destroy buildings and other facilities, bring entire systems – such as transport – to a standstill, and have serious economic consequences as a result.

The safety requirements of a modern society are determined by the variety of the risks it faces, for example, biological, climatic and social risks.

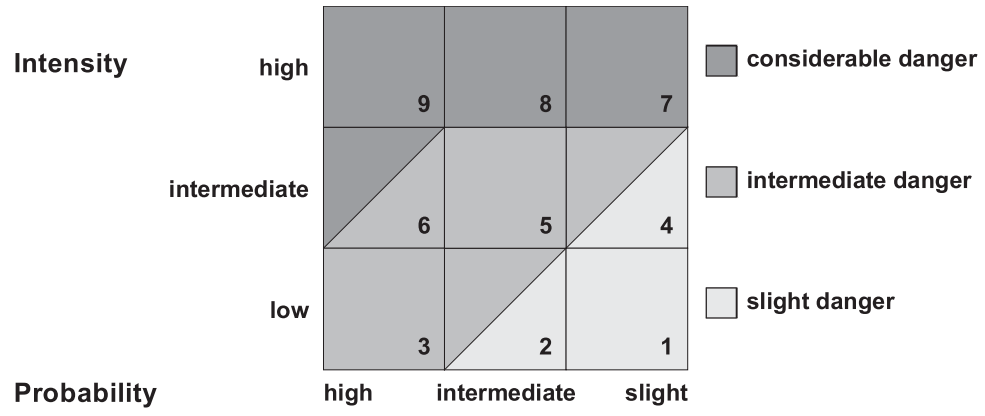
Thus, protection against natural hazards is merely part of a public sustainability-oriented risk management strategy.

Together with the limits of technical feasibility, ecological and, increasingly, economic restrictions diminish the possibilities for risk reduction – including reduction of the risks arising from natural hazards. The State and private individuals can no longer afford the cost of reducing the residual risks involved in dealing with natural hazards, or the adaptations in the social, health and transport sectors on the scale that would be seen as desirable from an individual perspective.

Insurance companies will find themselves confronted with the same problem if the damage caused by natural disasters continues to increase in the way it has in recent years.

FIGURE 6

Diagram of intensity and occurrence probability used as a basis for risk assessment and the compilation of hazard maps in Switzerland



In the case of abrupt processes, such as those arising from avalanche and rockfall hazards, lives are instantly endangered and the risk involved is intolerable. For this reason, avoidance and prohibition strategies are to the forefront in the area of avalanche and rockfall protection.

In the case of processes that unfold more slowly, for example floods, the threat to life is generally minimal, however the potential material damage is extensive (see Figure 6). Sites on the shores of inland water bodies have always been attractive settlement locations thanks to the use of hydropower and the various other advantages offered by inland water bodies. In this case, the disadvantages posed by occasional floods are viewed as acceptable and prepared for accordingly. Thus, despite regular floods, extensive settlements have continued to be developed in lake locations and along rivers. The advantages attained during flood-free periods significantly outweighed the losses suffered in the event of damage.

In the past, the damage was contained with the help of suitable measures – such as the limited use of ground floors and basements, the implementation of temporary protection measures and precautionary construction of footbridges. Today, there is no such awareness of exceptional situations, and individuals are no longer as willing to become personally involved in the event of a crisis. Individual responsibility is being replaced by the expectation that the State will undertake the necessary measures, which are expected to provide complete protection.

Based on the development of the distribution of tasks among the State, private enterprise and landowners, from today's perspective, natural hazards must be seen as events that are characteristic features of certain locations and that must be taken into account in all land uses adopted in the area. Thus, the negative consequences are accepted when the land is acquired, and any resulting costs must be born by the landowner. Due to the transformation in values and further development of the requirements of our modern society, which must live with a wide range of risks, a fundamental risk dialogue among the various groups and stakeholders is essential.

Nature sets limits

Balanced protection against natural hazards cannot be based entirely on technical measures and must take ecological criteria, along with economic and social criteria, into account. Agriculture and forestry have a key role to play here. They not only create employment, but also make a crucial contribution to the appearance and management of the landscape and to the safety of entire valleys and watershed areas. Their effects cover wide areas, while technical measures are more restricted and punctual in their effect.

The report on the avalanche winter of 1999 that was presented to the Standing Committee of the Alpine Convention indicates that the burden on fragile ecosystems in many tourist locations in the Alpine region is becoming intolerable. For this reason, greater attention must be paid to the demand for the sustainable development of the mountain regions.

The final assessment of the damage caused during the avalanche year of 1999 clearly demonstrated this. Thus, for example, in the entire Alpine region, 60 people lost their lives through no fault of their own, and the cost of the material damage caused – including

consequential follow-up costs arising from economic losses – exceeded 1 billion Euro. The traffic chaos on the transit axes, the supply bottlenecks and psychological problems suffered by marooned holiday makers are indicators of the fact that the limits of acceptability have been reached in some places.

The importance of agriculture and forestry

The future management of the Alpine region represents a major challenge for local populations. What is ultimately involved here is making the region capable of sustaining life and worth living in. It is one of the State's tasks to ensure that natural hazards arising from the location do not become an existential problem for the population in the mountain region. The priority here is the protection of the community and the reduction of the involuntary risk posed by natural hazards. The conservation of quality of life in the Alpine region also requires a sufficient supply of local jobs as a basis for the existence of the native population. Agriculture and forestry continue to represent important sources of income in this context. Furthermore, they contribute to the management of the landscape and the safety of entire valleys and watershed areas, and this in turn benefits tourism, the protection of settlements and infrastructure and the subjacent areas.

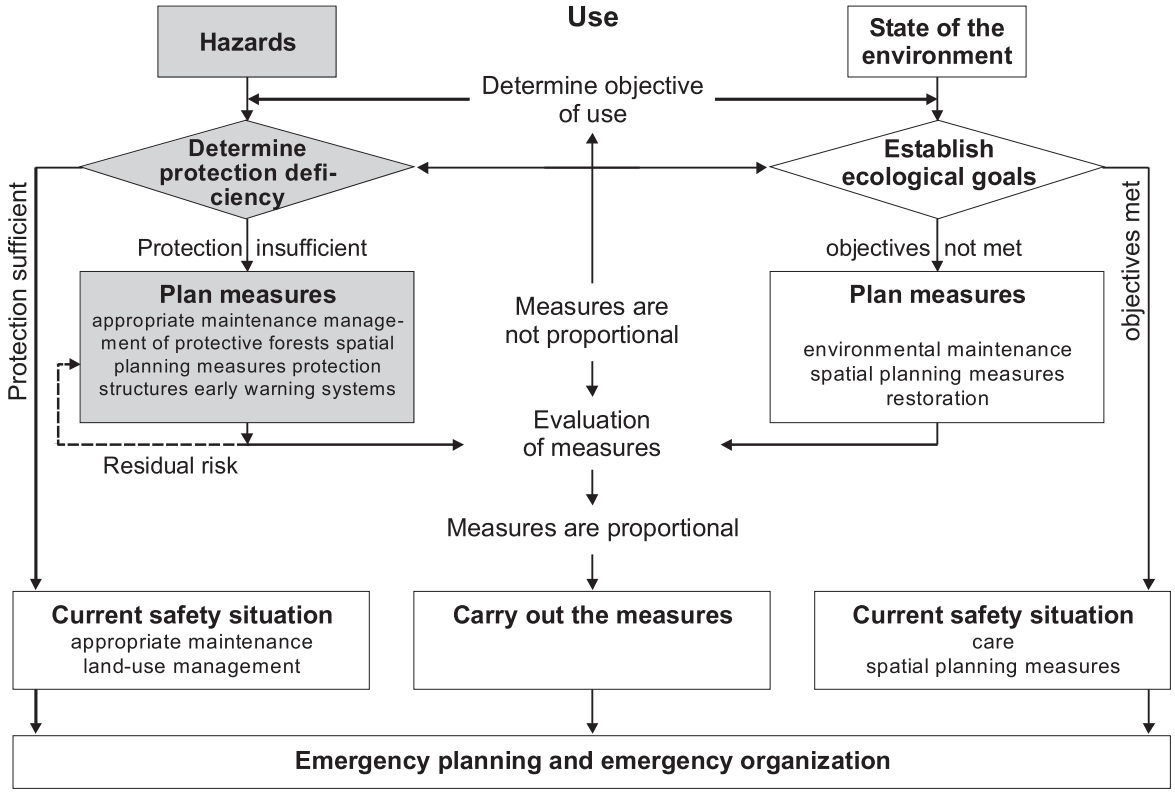
Concepts for sustainable protection against natural hazards

Sustainable protection against natural hazards cannot be based on technical measures alone, but must take social and ecological criteria into account, along with economic factors (see Figure 7). As key sustainability factors, social solidarity, a precautionary approach to the environment and economic efficiency are decisive in this context.

For reasons of sustainability and in the interest of safety it is essential that measures listed in the following for protection against natural hazards be implemented – in the listed order of priority:

- Use of areas at risk from natural hazards should be avoided.
- The effect of classified protection forests should be conserved and improved through maintenance and the establishment of new protection forests.
- Rural areas should be maintained through agriculture and forestry, in particular watershed areas that are prone to erosion.
- All land uses should be risk-appropriate.
- An increase in the risks arising from intensive land use and the associated increase in values in threatened settlement areas and along transport routes should be avoided.
- Organizational measures, such as early warning, evacuation, road closures etc., should be implemented.
- Flowing water bodies should be revitalized, and additional retention areas created.
- Existing hazard protection structures should be maintained properly.
- New protection structures should be built.

FIGURE 7
Protection concepts must provide integrated protection against natural hazards



Solidarity as a prerequisite for the protection of human life and infrastructure against natural hazards

The mountain region is more vulnerable to natural disasters than the lowlands. This inequality gives rise to a continuing need for solidarity between the victims of natural events and those in the areas less vulnerable to risk who are not affected by them.

Despite the implementation of sensible precautionary measures, extreme events in the mountains can threaten lives and livelihoods – for it is simply impossible to provide 100 percent protection against natural hazards. This increased vulnerability to the effects of natural hazards necessitates solidarity between victims and those not affected, and between areas that are less vulnerable to the risk of natural hazards and areas exposed to major risks, such as mountain regions. In addition to land and property owners, storm and tempest insurers also have a key role to play here. The aim of this kind of solidarity, however, is incompatible with a system in which the gains arising from the use of land in potentially threatened areas solely benefit the landowner, while the State, insurance companies and aid organizations are expected to make provision for eventual damage. Social solidarity can only be guaranteed in the long term if it is not one-sided or subject to abuse.

In order to guarantee trust in the area of natural hazard prevention, when disasters occur it is important to increase transparency with respect to the scope of the damage, the cost of remedying it and how this is financed. Close cooperation among the various donors – from the State to insurance companies and charities – is essential.

RECOMMENDATIONS TO THE ALPINE CONFERENCE

The recommendations to the Alpine Conference include the promotion of integrated risk management that makes optimum use of the possible measures for the reduction of risk in the different areas of activity, and tailors activities to each other.

Based on the analysis carried out, the Alpine Conference's Avalanche, Floods, Debris Flows and Landslides Working Group recommends the promotion of the following measures as a matter of priority:

- promotion and support of the early recognition of the life-threatening hazards posed by climate change, and of avalanche, flood, debris flow and landslide hazards;
- promotion and support of integrated risk management that makes optimum use of the existing range of measures and tailors them to each other. This includes – in the area of prevention – land-use planning, protection forest maintenance, renaturation of flowing water bodies, and construction and maintenance of protection structures, as well as disaster management (intervention) and rehabilitation;
- targeted and consistent promotion of a risk dialogue with all participants for the improvement of prevention in risk management and of risk awareness and acceptance among the general public;
- guaranteeing the conservation and improvement of protection forests' effects through suitable measures. It is particularly important that the rejuvenation of the protection forest be ensured;
- conservation and creation of retention areas to reduce flood peaks, and the renaturation of water bodies;
- promotion of the development of a modern computer-based hazard and protective structure register system as a basis for periodic analyses of the development of the measures implemented for the protection of human life and material assets. The documentation of events is the top priority in this context;
- promotion of the knowledge required to guarantee risk-appropriate land use;
- promotion of the transfer of expertise for the optimum use of all options offered by preventive measures, such as spatial planning, protection forest maintenance, organizational measures, protection structures, precautionary measures for crisis management and rehabilitation, taking safety technology, economic, ecological and social criteria into account. Early warning is the top priority in this context;
- improvement of communication options for the promotion of cross-border exchange of experience at the administrative level;
- increased support of the bodies in the Alpine Convention countries responsible for the implementation of the Avalanche Report 1999 ratified by the Sixth Alpine Conference;
- promotion of interdisciplinary education and training for dealing with natural hazards and the maintenance of watershed areas through the creation of corresponding post-graduate courses;
- increase in the efforts to reduce the risks arising from anthropogenic climate change through the targeted and consistent promotion of sustainable development that reduces the burden

on the environment and ensures the careful treatment of non-renewable raw materials of limited availability;
- sustainable provision of the resources necessary for optimum, integrated and holistic natural hazard management.

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CHAPTER 13
TOWARDS EFFECTIVE WATERSHED MANAGEMENT IN LOW FOREST COVER COUNTRIES

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Some progress has been achieved in watershed management in the low forest cover countries (LFCCs) of North Africa and the Near East, especially during the 1990 to 2000 period. However, there is room for improvement given the rapidly growing populations and the attendant expansion of rural land use. In order to achieve sustainable use and management of land resources, there is an expressed need for improved land, water and ecosystem approaches. They need to be based on the integration of inputs by different agencies and the direct involvement of stakeholders at all levels, especially the rural population and workers.

One of the regions under a global review by FAO is the North Africa/Near East region, the subject of this presentation.

The purpose of this paper is to bring forward highlights of experience with integrated watershed management (IWM) from LFCCs in North Africa and the Near East. The intention is to describe lessons learned and promising approaches to improve IWM in the future. The paper describes highlights from stocktaking, a case study and promising future measures. The stocktaking drew information from investigations and reports from missions to LFCCs in North Africa and the Near East, with emphasis on the present status, apparent trends and some results of project interventions. Studies were made on country reports from the Islamic Republic of Iran, Yemen, Morocco and Tunisia. Information was also drawn from the Plan Bleu paper on watershed conditions in the Mediterranean region and from a "Review and assessment of watershed management strategies and approaches", which was a global study by L.C. Tennyson (2002). A workshop on urban forestry (Tehran, July 2003) was also a useful source of information. The case study is based on a mission to Tunisia (May 2003), which focused on success stories and gaps in IWM, including observations on some advances in national policy, strategies, programmes and projects. A number of IWM results were studied and the mission findings included several observations and documented results.

Recommendations for promising future measures to improve IWM were drawn from the stocktaking of the selected LFCCs and the Tunisia mission.

The stocktaking revealed some of the common constraining environmental features that are present in the LFCCs. These include:

- harsh climatic conditions, including very high evapotranspiration, low and erratic rainfall, and large temperature ranges, which have an impact on the establishment, growth, survival and regeneration of crops;

- a variety of topographic conditions, ranging from plains, to steppes, to mountains, which harbour favourable site conditions for acute soil erosion and degradation, especially in combination with high population pressure in rural areas;
- soils in most arid regions generally low in organic matter with poor structure, causing widespread and severe erosion[1];
- natural calamities, such as earthquakes, floods, high winds and extremes of temperature and precipitation, are sometimes common[2];

Partly as a consequence of these realities, the quantity and quality of available water is the number-one priority in most regions of most LFCCs. Coupled with local or widespread misuse of natural resources, the broad situation is a candidate for IWM and the benefits that come from the activity. At present, some of the common constraints in the institutional and socio-economic side include the following:

- socio-economic and policy/planning conditions vary in LFCCs in accordance with national characteristics;
- a lack of commitment to IWM at the central and/or local government and community/village levels;
- the lack of sustainable financial and institutional mechanisms;
- a lack of real understanding on why some major catchment development programmes are working well, while others are not.
- weakness in the national research systems, particularly where the ongoing research programme is dependent on external project funding.

Constraints in the future may include the willingness and capacity of national governments to act on complicated issues, project design and management improvements to increase the participation and commitment of key stakeholders, including rural farmers and forest workers. It also needs to be recognized that IWM is an integrated land-use and natural resources management issue involving social, cultural, environmental and economic factors.

The Tunisia mission/case study showed that during colonial times there was a certain level of land and soil degradation brought on by extensive expansion of agriculture, including silvipastoral activities, coincident with rising rural population levels. There was an important shift from nomadic use of rangelands over to settlement on land (sedentarization), with the complications of new land uses, crop ownership and related effects.

What has worked stems from the fact that since the formation of the Republic of Tunisia, the problems of the rural and agricultural situation have come into focus. A general assessment of the national situation led to a variety of far-sighted reforms, which when examined with hindsight represent a comprehensive programme of problem analysis and corrective response.

1. Soils are often heavy-textured, which when taken with the limited available moisture, hampers natural regeneration and hinders forest and rangeland rehabilitation efforts.
2. Other forms of degradation have followed wars in the region, often attended by large numbers of fleeing refugees with livestock.

The initiatives were developed over some decades. They are described here using a visualization of a model of a pyramid made up by a number of strata, each representing one of the following six topics:

1. In Tunisia there is a national commitment to IWM; at the most senior levels of government, the need for a cohesive combination of initiatives was recognized. Steady support and commitment were sustained, commensurate with available resources for the management of land resources.
2. To support this commitment, the necessary policies were adopted, together with related legislation and regulations such as the new Forest Code (1988), which promoted the socio-economic role of forests, as well as reforestation and soil protection strategies and other key initiatives.
3. Strategies were developed and implemented to support the legislation and policies of government. One such strategy was to seek and obtain partnership involvement in IWM projects throughout the country.
4. Programmes were mounted to implement the strategies by marshalling the resources in a focused manner; for example several multiyear IWM projects that require a high degree of coordinated information gathering, planning with interdisciplinary teams and public participation.
5. Interrelated projects make up the programmes and are undertaken by teams drawn from different agencies and locations, all under the direction of a coordinator.
6. Capacity building is another successful activity that is ongoing, with key features such as institution building and reform to bring focus to changing priorities over time, sustained professional and technician training, and some active participation of farmers in project areas.

Three observations can be made on this combination of inputs to IWM in Tunisia: 1) for IWM to be planned and executed effectively, all of the six categories need to be present; 2) for success to be achieved a general sequence of work needs to be followed; and 3) the political will and commitment should come first, then – after one or two IWM projects are under way or completed – all parties, from senior decision-makers through to the stakeholders are all informed by the experience gained. This learning is then carried forward to the next proposal and project.

In conclusion, this study suggests that other LFCCs might benefit from the successes and lessons of the Tunisia IWM programme.

CHAPTER 14
WHAT ARE THE IMPACTS OF DEFORESTATION IN THE HIMALAYAS ON FLOODING IN THE LOWLANDS? RETHINKING AN OLD PARADIGM[1]

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THE OLD PARADIGM

Every year, during the monsoon season, the whole Himalayan region appears in the world's headlines because of disastrous flooding in the plains of the Ganges and the Brahmaputra. For example, the *Bangladesh Observer* in 1990 stated: "Bangladesh in grave danger: deforestation in the Himalayas aggravating floods". This headline is noteworthy as it:

- states that there is a direct link between the hydrometeorological processes in the Himalayas and the floods in the lowlands;
- assumes that it is the rapid forest removal in the mountains that is responsible for the intensification of the hydrological processes in the plains;
- assumes that flooding in Bangladesh has increased;
- accuses mountain people and other users of mountain forests of being responsible for this presumed increasing of flood frequency in the lowlands.

The question as to what extent these large-scale processes are natural or influenced by human activities has resulted in impassioned debate among politicians, journalists and scientists. The arguments are usually based on the following – rather convincing – chain of assumed mechanisms: population growth in the mountains > increasing demand for fuelwood, fodder and timber > uncontrolled and increasing forest removal in more and more marginal areas > intensified erosion and higher peak flows in the rivers > severe flooding and siltation in the densely populated and cultivated plains. This supposedly scientific sequence of events has been used by politicians in times of flood-related crises to apportion blame to the rural people of remote mountain areas. And the mountain populations themselves have accepted the blame because bad science has been presented to them as fact, and also because development agencies have funded reforestation programmes.

1. This paper was originally presented at the XII Forestry Congress, which was held from 21 to 28 September 2003 in Quebec City, Canada.

There is no doubt that the Himalayas and their forelands have undergone a dynamic change in land use in recent decades owing to rapid population growth. However, the validity of the "old paradigm" has been increasingly questioned over the last two decades, mainly in the scientific community, as being too simplistic and misleading (see e.g. Ives, 1987). This paper presents some new evidence resulting from research activities carried out over more than 20 years at different geographical scales in the whole Himalayan region. The author of this paper has been actively involved in many of these activities.

THE PROJECT AND RESEARCH CONTEXT

In 1979, Prof. Bruno Messerli (University of Berne, Switzerland) and Prof. Jack Ives (University of Boulder, Colorado, United States), together with many other institutions and individuals worldwide, initiated intensive scientific investigations of the ecological interactions between the Himalayas and the adjacent lowlands of the Ganges and Brahmaputra, as well as of the impact of human activities on these linkages. Most of the work, which from 1979 to 1991 focused primarily on the highlands, was carried out under the Highland–Lowland Interactive Systems Project, later renamed Mountain Ecology and Sustainable Development, of the United Nations University (UNU). The research addressed issues such as erosion processes in relation to land use, discharge characteristics of Himalayan rivers, forest cover change and forest history. The results, which were published in Ives and Messerli (1989) and Messerli, Hofer and Wymann (1993) as well as in a number of articles (Hofer, 1993; Messerli and Hofer, 1995), confirmed that the highland–lowland interactions are much more complex and that the traditional understanding of these linkages needed to be revised.

In 1992, a project on the processes and history of floods in Bangladesh was initiated, and thus the research focus was shifted from the Himalayan highlands to the lowlands of the Ganges, Brahmaputra and Meghna rivers. The project was jointly implemented by the University of Berne, the Swiss Agency for Development and Cooperation, UNU and a number of institutions in Bangladesh. A first project synthesis was published in 1997 (Hofer and Messerli, 1997). Further data analysis continued through the end of 2000. The final project report will shortly be published by the United Nations University Press (Hofer and Messerli, in press).

FLOODS IN BANGLADESH IN THE CONTEXT OF HIGHLAND–LOWLAND INTERACTIONS

The question as to whether deforestation in the Himalayas is responsible for the frequency and magnitude of the floods in Bangladesh was one of the main topics of the project outlined above, and will form the core of the following discussions. The history of flooding in Bangladesh, a second focus of project activities, is discussed in Box 1.

BOX 1

HAVE FLOODS IN BANGLADESH INCREASED AS A RESULT OF DEFORESTATION OR LAND-USE CHANGES IN THE HIMALAYAS?

The last 20 000 years: Large depositions in the Bangladesh delta indicate that massive floods must have occurred regularly long before human impacts on the large watersheds of the big rivers began.

Eighteenth and nineteenth centuries: A number of major floods were recorded. Fluctuations in flood frequency correspond to fluctuations of the monsoon rainfall. The catastrophic flood of 1787 was associated with an earthquake and resulted in major river course changes in the territory of modern Bangladesh.

1890 to the present: There is no evidence that the frequency of major floods in Bangladesh has increased. There is some indication, however, that the inter-annual variation of the flood dimension and the area extent of big events have been increasing since 1950. These trends can be related to similar trends in rainfall and discharge patterns. The concentration of suspended sediments in the Ganges, Brahmaputra and Meghna is highly variable over time and is not well correlated to the amount of river flow. The investigation of the available time series did not indicate any trend towards increased sediment load.

Based on demographic statistics and landholding figures, it is obvious that the impacts of flooding and the vulnerability of the Bangladeshi population to flooding must have increased.

Large-scale flooding has always occurred in Bangladesh. Based on these project findings, there is no reason to assume that anthropogenic activities in the Himalayas have changed the frequency and dimension of flooding in Bangladesh.

The data situation

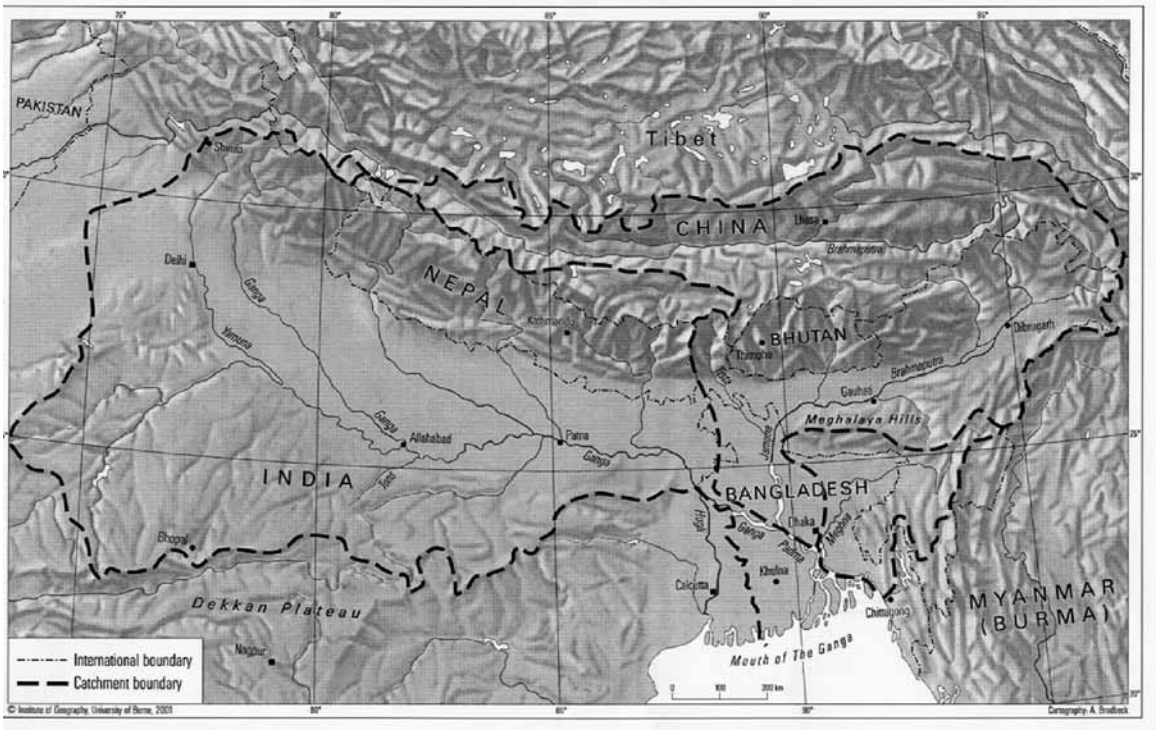
The water resources of the Ganges-Brahmaputra-Meghna basin are shared by Bhutan, Bangladesh, China, India and Nepal (see Figure 1). Water is a very sensitive issue in the area, and hydrological information is often classified. Climatological information is less restricted. The density of both hydrological and meteorological measuring sites is rather low, especially in the Himalayas. All these factors are a challenge for hydrometeorological research in the Ganges-Brahmaputra-Meghna basin.

Methodology

In order to approach the question as to whether deforestation in the Himalayas is responsible for the floods in Bangladesh, and considering the very difficult data situation, a methodology was developed to estimate the potential hydrological contribution from different areas of the

Ganges-Brahmaputra-Meghna basin to the river system and to estimate the relevance of this contribution to the hydrological processes in Bangladesh. Two variables, the potential runoff R(pot) and a relevance factor R(relev), were introduced based on the following premises:

FIGURE 1
Catchment area of the Ganga, Brahmaputra and Meghna rivers



- Each of the 13 sub-catchments of the Ganges-Brahmaputra-Meghna basin that were defined for the project potentially contributes a specific amount of runoff to the hydrological system per any time period during a year. This potential runoff R(pot) is mainly a function of precipitation, the size of the respective sub-catchment, and a discharge factor (percentage of the precipitation which is actually discharged). In the project, R(pot) was calculated individually for the four monsoon months June to September for each year.

- The relevance of the potential runoff R(relev) of a specific sub-catchment for hydrological characteristics at a reference point in Bangladesh decreases as the distance of the respective sub-catchment from the reference point increases. Accordingly, R(relev) results from the multiplication of R(pot) with a reciprocal and weighted distance factor.

For each of the 13 sub-catchments, R(pot) and R(relev) were calculated for the four monsoon months over a time period of approximately 90 years. Subsequently, 11 case studies of flood situations in Bangladesh were carried out covering the time period 1906 to 1998. In the analysis, R(pot) and R(relev) proved to be valuable indicators with which the different sub-catchments in the Ganges-Brahmaputra-Meghna basin can be compared in terms of their

hydrological characteristics, their contribution to the hydrological system and their relevance for the hydrological processes in Bangladesh, on average, as well as in specific, years. For more details about this methodology, see Hofer and Messerli (in press).

The key results

The hydroclimatological processes in the Himalayas do not seem to be important for the floods in Bangladesh. Compared with other parts of the study area, calculation of the relevance factor R(relev) for the Himalayan areas usually results in rather low values. Furthermore, the anomalies (variations from the average situation) of the potential runoff R(pot) calculated for the Himalayan areas and their foothills during a specific monsoon season are in most cases not related to the magnitude of flooding in Bangladesh. In particular, the potential runoff from the Himalayan areas tends to be below average in years of major flooding in Bangladesh. Finally, flood peaks originating in the highlands are levelled on their way downstream through the plains (see the example from 1993 presented in Box 2). In view of these findings, there is no reason to assume that deforestation or other land-use changes in the Himalayas will have any significant impacts on the flooding patterns in Bangladesh.

BOX 2

NO CONNECTION BETWEEN FLOODING IN NEPAL AND FLOOD PROCESSES IN BANGLADESH IN 1993

Evidence from Nepal: Between 19 and 20 July 1993, an extraordinary flood event took place in eastern and central Nepal with catastrophic effects: several districts were hit by floods and landslides, and many people died or became homeless. Widespread destruction of crops occurred in the wheat-growing zone in the Terai. Owing to very high sedimentation, the life span of the Kulekhani Reservoir was reduced by many years.

This catastrophic flood is hardly documented in the water-level graph of the Ganges at Hardinge Bridge, located approximately 600 km downstream to the flood-affected areas in Nepal. The flood peaks of the Nepalese tributaries to the Ganges were levelled.

Evidence from Bangladesh: Two flood periods were identified: 18 to 25 June and 10 to 26 July 1993. Both events were the result of heavy rainfall in Bangladesh and were concentrated on the Meghna and Brahmaputra systems. Western Bangladesh, which is the only part of the country that belongs to the Ganges system, was almost completely unaffected by flooding.

The Meghalaya Hills, which are located immediately adjacent to the Bangladesh floodplains (see Figure 1), tell a different story: precipitation in this area is usually very high, rainfall in Cherrapunji often reaches world record values. Accordingly, the relevance factor R(relev) of this area on hydrological processes in Bangladesh turned out to be very high. Furthermore, the anomalies of the potential runoff R(pot) in the Meghalaya Hills are usually well correlated to the dimension of flooding in Bangladesh (see Box 3).

BOX 3

RAINFALL IN THE MEGHALAYA HILLS IS DECISIVE FOR FLOOD PROCESSES IN BANGLADESH

Rainfall in Cherrapunji: Cherrapunji, a small town located on the southern slopes of the Meghalaya Hills, receives very high rainfall. The average monsoon rainfall (May to September) amounts to 9 527 mm, in 1974 it reached as much as 19 728 mm. The rainfall at Cherrapunji in the monsoon months of 1974 and 1988, which were two major flood years in Bangladesh, was far above normal. Indeed, some of the anomalies were extraordinary. In 1978 and 1986, years of very low flood dimension in Bangladesh, the rainfall in Cherrapunji was below average.

Discussion: The Meghalaya Hills are located adjacent to the vast floodplains of northeastern Bangladesh. They form a first orographic barrier for the humid monsoon winds on their way from the Bay of Bengal to the Himalaya. The southern slopes of the Meghalaya Hills, in particular, receive very high rainfall during the monsoon months. In addition, the shallow soils produce high surface runoff. As a result, considerable quantities of water pour down the steep slopes of the Meghalaya Hills into the Meghna floodplains of Bangladesh.

The large-scale investigations, based on the calculations of R(pot) and R(relev), were complemented with more detailed analysis of the flood process within Bangladesh. Resulting from these investigations and in addition to the regional differentiation presented above, the following factors, particularly in their combination, seem to be important for the floods in Bangladesh: temporal coincidence of the highest flow of the main rivers; rainfall and short-term discharge peaks within Bangladesh; high groundwater level; and back-water effects caused by spring tides.

There is not sufficient room in this paper to present the research results in more detail. For in-depth reading please refer to Hofer (1998) and Hofer and Messerli (in press).

DEFORESTATION IN THE MOUNTAINS, AND ITS LOCAL EFFECTS

The following thoughts about the roles of mountain forests at the scale of small watersheds in mountain areas aim to complement the large-scale discussion of the previous section. A substantial amount of work has been carried out on this issue, many projects have been implemented and much literature is available. It is widely accepted that in small watersheds (up to approximately 5 000 km^2), forests contribute to the regulation of river flows. Owing to the high infiltration capacity of forest soils and vegetation water use (evapotranspiration), good-quality forests can store and temporally retain precipitation and reduce runoff rates. It can therefore be stated that, in general, deforestation (if not followed by well-maintained agricultural use) or afforestation in small mountainous watersheds can have a direct effect, either negative or positive, on the discharge characteristics and sediment concentration of the watercourses in the respective watersheds. However, according to Hamilton (1987), a

mountain forest does not guarantee soil and water conservation *per se*. A forest without any canopy layers or litter cover may be much worse in terms of erosion than well-maintained sloping agricultural terraces or grazing lands. Big raindrops formed in the crowns of the trees might cause significant splash erosion on the unprotected soil. It is not the forest cover as such, but the vertical structure of the forest and the hydrologic properties of the forest soils that are decisive for the protective role of a mountain forest. There is yet another dimension to this: forest cover in a mountainous watershed only provides flood protection to near downstream dwellers in the case of normal rainfall events. In extreme events, floods and deep-rooted landslides will occur in any case, independently of the availability or absence of forest cover in the respective watershed.

CONCLUSIONS

The impacts of mountain deforestation on hydrological systems seem to be a question of scale (see Ives and Messerli, 1989):

- Human-induced ecological changes in the Himalayas are documented in some specific examples at the local, small-scale level. Forest clearance in highland watershed, if not replaced by well-maintained agricultural terraces or other adapted and well-managed land-use systems, can lead to increased runoff and accelerated soil erosion in these local watersheds.

- At the large scale of the Ganges-Brahmaputra-Meghna system it has not been possible to find a significant correlation between human activities in the mountains (e.g. forest removal) and catastrophes in the plains (e.g. floods), and the human influences seem to be concealed by the overwhelming dimensions of natural processes. There is no statistical evidence that the frequency or the volume of flooding in Bangladesh have increased over the last 120 years. Furthermore, precipitation and runoff in the Himalayas do not seem to contribute significantly to the floods in Bangladesh. Because the Himalayas are so far from the Bangladeshi floodplains, the flood flows and peaks of Himalayan tributaries are integrated and "levelled" into the base flow of the bigger rivers as they move downstream. The Meghalaya Hills, however, have a greater potential to contribute to downstream flooding because of their close location to the floodplains of Bangladesh and because of their high rainfall.

If these findings are accepted, it becomes obvious that it is not admissible to extrapolate results from a small watershed in the Himalayas to the entire Ganges-Brahmaputra basin. It also becomes clear that the habit of blaming mountain dwellers and their land-use practices for flood catastrophes in the plains far downstream must be abandoned. However, this does not relieve mountain people of their responsibility to use their environment in a sustainable manner. Mountain forests are crucial for the ecology of the entire Himalayas and the people who depend on them, and afforestation programmes should therefore be regarded in this context, and not as a means of preventing flooding in the lowlands.

These statements represent results from work in progress. A lot of questions about the effects of forest removal in the highlands on flooding in the lowlands remain open and need to be explored further, provided the availability and accessibility of data improves in the future. The e-mail conference on land and water linkages in rural watersheds, conducted in 2000 by FAO, has significantly contributed to the further understanding of these processes. In addition, FAO

is carrying out an exercise entitled "Preparing the Next Generation of Watershed Management Programmes" in which highland–lowland linkages are a key aspect. The International Year of Mountains 2002 has provided an excellent platform for the discussion of these issues, and the forthcoming International Year of Freshwater 2003 promises to do the same.

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CHAPTER 15
THE GUARANÍ AQUIFER SYSTEM: WATER RESOURCES FOR THE FUTURE

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From the end of the twentieth century, we all agree that water is becoming scarcer to society owing to overexploitation and quality degradation. This pattern has continued up until today, resulting in higher risks to human health, economic and social development and ecosystem functioning and environmental preservation.

Freshwater resources such as rivers, lakes, reservoirs and wetlands are suffering from various problems originating from the pollution of point and non-point sources, shore erosion and habitat loss due to construction and other unsustainable human activities and bad practices.

To stop and prevent this trend there is a need to develop proper planning and management approaches within the context of integrated water resource management.

Considering this, we can easily understand the importance of sound groundwater exploitation. These formations constitute enormous natural systems and make it possible to occupy vast territories by providing the output of superficial waters through relatively economical means.

For various reasons, in many parts of the world where economies depend exclusively on groundwater, investigations are being carried out to establish the dimensions, carrying capacity and recharge index of these reservoirs. However, knowledge of the total underground water lying beneath us is a global necessity in view of the problem that our world is going to face in the near future: availability of safe freshwater.

There are several ways in which these reservoirs are being severely neglected:

- Lack of knowledge about their functioning and dynamics can result in overexploitation, caused by extracting higher quantities of water than the recharge rate.
- Their vulnerability needs to be determined, which calls for the implementation of protective plans in order to prevent noxious substances from reaching the water layers.
- Most human agricultural activities considerably reduce the level of groundwater reservoirs. Nonetheless, the major problem with this form of water utilization is that it has caused an enormous increment in the nitrogenated element content of subterranean waters, and an increment in sodium in the aquifers near coastal zones, as a consequence of the invasion of saline waters.

In this context, I mention that the Guaraní Aquifer System is one of the most important subterranean hydric resources in the world, mainly because of its high complexity, dimensions

and its water quality, temperature and renewal rate. This complexity arises from hydrogeological technical aspects of the environment, and also from legal and institutional aspects that result from the transboundary character of this aquifer.

It is located in the eastern and south-central zone of South America, underlying parts of Argentina, Brazil, Paraguay and Uruguay.

It has an estimated total surface area of approximately 1.2 million km^2. As an example, the portion that lies within Brazil alone covers an area equal to that of the United Kingdom, France and Spain combined. Some 15 million people live within the aquifer's area of influence.

As reported by the World Bank, the main future threats to this resource are uncontrolled abstraction and pollution in the extraction and recharge areas.

About 40 000 km^3 of freshwater are contained within the aquifer. About 90 percent of this volume is estimated to be potable.

As we all know, groundwater recharge is restricted, and groundwater pollution is reversible only at very high cost, if at all. These facts make the protection of the Guaraní Aquifer System both a practical concern and a moral obligation to the benefit of current and future generations.

Groundwater is frequently the most viable water supply alternative, especially where surface waters are polluted by domestic and industrial effluents, solid waste or contaminated agricultural runoff.

As well as the excellent quality of the water that it provides, which is completely suitable for consumption, another characteristic of the Guaraní aquifer is the thermal quality of its waters.

At present, this water is used principally for home supply and tourism, although it could potentially be exploited as an alternative energy source, substituting non-renewable energy sources in the area.

For all these reasons, the four countries concerned have recognized the Guaraní Aquifer System as a valuable transboundary resource and have decided to create a framework for its shared management. The long-term objective is the sustainable, integrated management and utilization of the aquifer.

The World Bank, through the GEF, and the Organization of American States, since the preparatory period was completed, are co-financing and managing the studies of the aquifer that are about to be initiated.

The project is called "Environmental protection and sustainable development of the Guaraní Aquifer System" and has as its main aim the creation of a common institutional, legal and technical framework, which is capable of managing and protecting the aquifer for present and future generations.

Various technical and scientific activities have been foreseen, covering the fields of geology, hydrology, geophysics, geochemistry, isotopy, mathematical modelling of aquifers,

informative systems, environment, geothermic engineering, sociology, education, legislation and many others.

A special fund for investigations in specific areas of the project has been created, and the investigations will be carried out by universities in the region. The Citizenship Fund will be destined for the use of NGOs to attend to the social aspects of the project.

The total cost was estimated at almost U$S27 million, of which one half corresponds to GEF funding and the rest to national participants and the co-financing from the International Atomic Energy Agency, BGR of Germany, the Netherlands Water Partnership and OAS.

Three representatives of each country form the project leadership. Within each country, the structure has an Execution Unit of the Project, integrated with existing water resources bodies, environmental offices and foreign affairs ministries.

The General Secretariat of the project has been created in Montevideo, with a General Secretary (Brazil) and two Technical Coordinators for components one and two (Argentina and Paraguay).

The project activities up until the end of this year are described in the Project Operative Plan (POP) approved by the National Units of Execution of the four countries and the Superior Council.

Seven project components have been identified:
1. expansion and consolidation of current scientific and technical knowledge;
2. joint development and implementation of a Guaraní Aquifer System management framework based on an agreed strategic programme of action;
3. enhancement of public and stakeholder participation, social communication and environmental education;
4. evaluation and monitoring of the project, and dissemination of results;
5. development of regionally appropriate groundwater management and mitigation measures in identified “hotspots”;
6. consideration of the potential for using the Guaraní Aquifer System’s “clean” geothermal energy;
7. project coordination and management.

These seven interrelated components characterize the state of water-bearing based on its morphology and behaviour, its advantage and conservation, its relationship with the communities and institutions and the needs of planning and organization to improve the coordinated management of waters.

This knowledge will provide a scientific base for establishing a frame for the coordinated and consensual management of the aquifer, which is able to obtain environmental protection and integrated sustainable development of the water body.

The project will identify and provide key elements of management (including policies, mechanisms and instruments) that will facilitate the sustainable and coordinated management of the aquifer. This frame will also provide the means to mitigate the more urgent

transboundary environmental emergencies and will evaluate the potential to provide geothermal clean energy to the region's communities.

The beneficiary countries have long-standing experience in collaborating on transboundary water issues, most notably with regard to the Plata River basin.

However, this agreement on groundwater is a historical first, and will certainly enhance the dialogue on other water bodies within the region, and may also contribute to improving water management at a transboundary level.

LESSONS LEARNED

- It became clear that the institutional agreements for project preparation were adequate to integrate the different actors in the formulation of policies, nevertheless they imply higher participation needs.
- The success of the project depends mainly on the integration of different aspects (institutional, political, cultural and technical).
- The process of participation demands transparency, time and adequate financial resources.
- Underground waters demand special treatment, especially when they are located in transboundary regions. The nature of the underground hydric resources, the diplomatic complexity, legal fragility, institutional disparity and the need for systematic technical knowledge all turn the project into a very complex one.

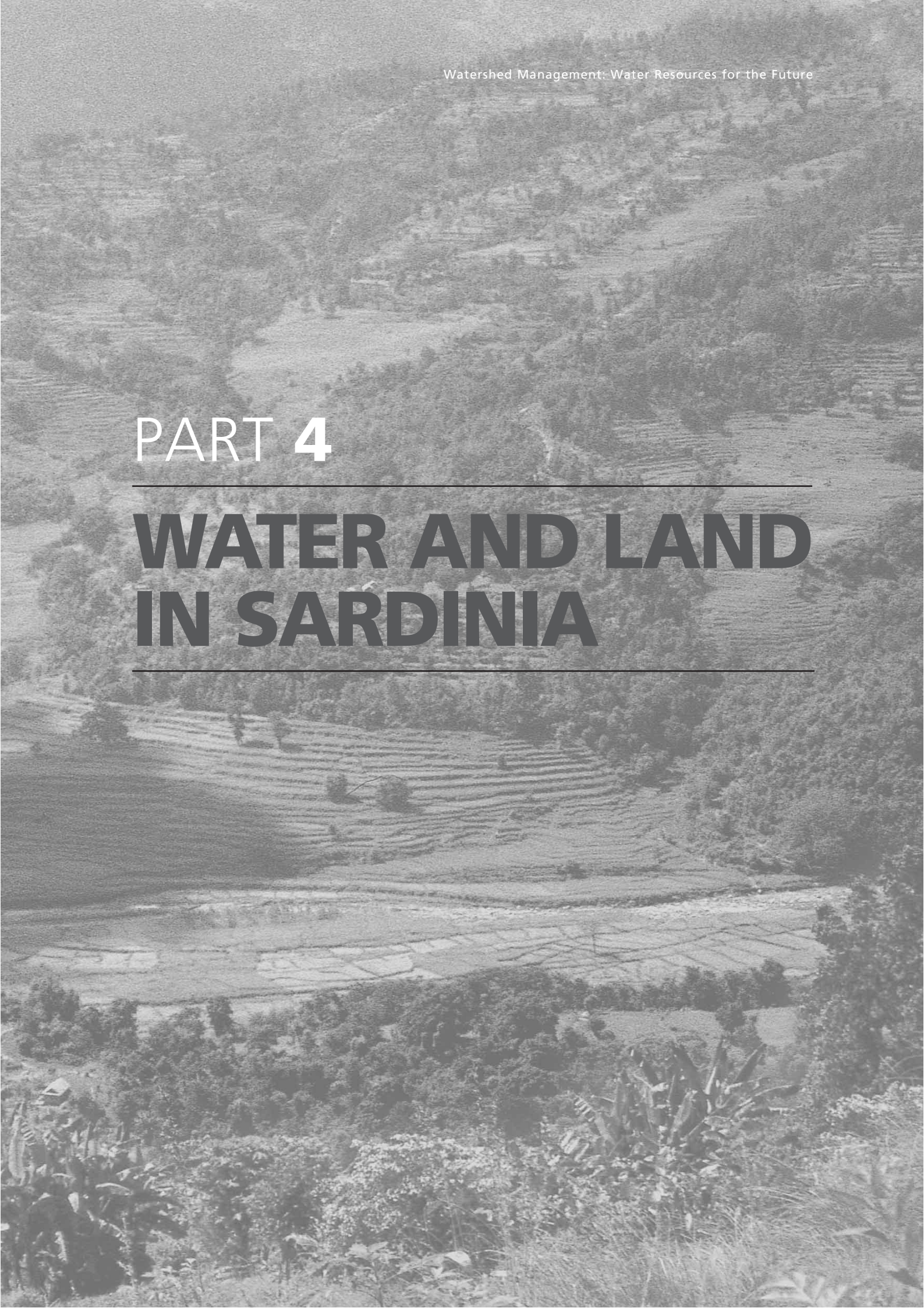
Because of these elements, this project is becoming a strategic challenge for our countries.

The common vision of the Argentine hydric community is that the use of hydric resources must be achieved in ways that harmonize the social, economic and environmental values that society attributes to water. Nevertheless, it is stressed that the actions these values require, when considered separately, may result in antagonistic or mutually exclusive effects. Thus, the only way to achieve sound water use that benefits the entire society will arise from the exact balance of the application of these three values, which guide hydric policy and which can be attained only by means of citizens' participation in decision-making.

The example of the regional management of the Guaraní Aquifer System project follows such a vision.

Some people have been persuaded that competition over water resources has prompted fears about water issues as the source of violent conflicts.

On the contrary, we think that water problems are not necessarily a cause of tension, but a catalyst for cooperation, integration, development and peace among countries. That is Argentina's hope.



PART 4

WATER AND LAND IN SARDINIA

CHAPTER 16
THE INTEGRATED WATER CYCLE IN THE CONTEXT OF WATER MANAGEMENT SYSTEMS: THE SARDINIAN EXPERIENCE

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This report looks at aspects of establishing integrated water management in Sardinia. Launched under Regional Law 29/7 incorporating the Galli Law, this establishment followed a long period of stagnation, which is typical (with few exceptions) of all Italian regions, and then gathered speed, especially in the last two years. This was basically owing to the strict time-limits of EU Community Support Framework funding for 2000 to 2006 for the Objective I regions (especially Sardinia), due to the ongoing water emergency. This speed-up took place in a context of renewed regional attention to unsolved water problems that gave rise to new or updated sectoral plans, and the implementation of a series of financial instruments. The Government Commissary adopted urgent measures to deal with the water emergency. It also sped up execution of certain aspects such as approval of the *Piano d'ambito* (regional water sector plan), the pertinent technical regulations, and management plans and modalities for assigning responsibility for the SII (Integrated Water System).

Even with the initial delays, the launching of the Integrated Water System comprises a historic turning point for water in Sardinia. Moreover, it also illustrates the opportunity represented by the regional water sector plan in the context of the regional water system. Although the plan cannot claim to solve every water management problem, we shall focus on the potential contribution of integrated management to each characteristic and crucial element of the current water scenario. We then move on to a description of the process that led to the launching of integrated water management in Sardinia, and to the future prospects linked to the implementation of the environmental plan, and to renewed vertical and horizontal dialogue between local bodies and the regional authority.

BACKGROUND: CRITICAL AREAS AND PROCESSES

An analysis of the sectoral studies, plans, programmes and area-wide planning instruments provided some background on certain special features and critical areas within the water system. This is brought out in the following points:

- quality problems for bodies of water compatible with use, especially for drinking-water, due to the prevalent eutrophic condition of reservoir waters;
- quantity problems, in terms of fully meeting requirements for drinking-water (evidenced by the frequency of water rationing and inadequate service) or for productive uses, especially the grave situation faced by the irrigation sector;

- the mainly unsatisfactory infrastructure situation, even compared with the average situation within the southern ATOs (optimal territorial catchments), with regard to both storage capacity and the efficiency of the networks and components of the system;
- the fragmented management and excessive red tape characteristic of the current institutional scenario, with a plethora of management units in need of reorganization. This became particularly urgent with the recent inauguration of the *Autorità d'ambito* (water sector authority) and the launching of the Integrated Water System.

Scenarios concerning the quality of surface waters

The Sardinian climate features a rainy semester (October to March), when both surface and groundwater are available, and a dry semester (April to September), when only groundwater is available.

In the absence of natural lakes (except for little Lake Baratz), a number of reservoirs were built as early as 1870 to meet the range of productive and domestic water requirements. Thus, while most of the need (some 80 percent) is met by surface water, the contribution of wells and springs is fairly small (about 19 percent). However, the latter contribution is often quite important from the quality standpoint.

As all reservoirs are used for drinking-water, it is essential that watershed planning and management monitor water quality. There is now a widespread decline in water quality due to the prevalence of eutrophication in almost all reservoirs, most lagoons and some coastal areas.[1] The result is generally poor or degraded drinking-water quality, mostly classified as A3 (requiring physical and chemical treatment with purification and disinfecting). Eutrophication is caused by an excessive proliferation of planktonic algae attributable to massive inflows of materials and nutrients (mainly phosphorous and nitrogen) from the catchment area. The obvious solution to the problem of eutrophication is to reduce the input of pollution from the basin from the various point and diffuse sources. Various status indicators (see below) show that the control of point sources of pollution is still partial, despite the various water improvement schemes and treatment plants and schemes put into effect over time. One fundamental observation is that monitoring should be more clearly defined with the launching of integrated water management. This is particularly true of the Water Sectoral Plan, which will be suitably coordinated with the Environmental Protection Plan so as to make the management of point sources tie in with the environmental targets for bodies of water. But, as evidenced by the experience of countries careful to maintain high water treatment standards, this cannot in itself ensure the containment of eutrophication, nor can it reverse the process.

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1. Based on available data from 1977, and confirmed by the document *Valutazione ambientale ex ante del Por Sardegna*, of the 103 bodies of water identified, including reservoirs, 36 are hypertrophic, 11 eutrophic and 56 mesotrophic. Concerning reservoirs, in particular, the following obtain: oligotrophic lakes (waters fully satisfactory from the quality standpoint, especially for drinking-water; e.g.Corongiù II); mesotrophic lakes (waters of only partially acceptable or dubious quality); hypertrophic or eutrophic lakes (very degraded or unsuitable water quality, especially for drinking; these include: Baratz, Benzone, Bidighinzu, Bunnari alto, Casteldoria, Cedrino, Cixerri, Coghinas, Cucchinardorza, Cuga, Gusana, Is Barroccus, Liscia, Monteleone Roccadoria, Mulargia, Monte Pranu, Nuovo Omodeo, Omodeo, Pattada, Posada, Surigheddu, and Simbirizzi).

These experiences, plus new and recent modelling of the phenomenon, demonstrate that eutrophication can only be reversed when the basin has been upgraded to minimize the amount of suspended and dissolved materials exported into the body of water. Hence, the other aspect of the problem (often overlooked in the past) should be considered: control over diffuse sources, which is related to releases of suspended and dissolved materials (in addition to waste waters these materials include soil nutrients, organic materials, etc.). The management implication is to look at water bodies in terms of global watershed management.

Because control over diffuse sources is mainly lost through loss of plant cover, the spread of farming, increased urbanization, vanishing wetlands and lowering of the aquifer, there is a clear need for a strategy of overall planning at the level of the watershed, in addition to integrated water management. This allows land-use planning on a broad scale for large areas, such as watershed or provisional watershed plans, provincial coordination plans, or regional land-use planning.

Quantity scenarios: the supply–demand balance

The crucial point here is the persistence since 1995 of a state of water emergency. Our analysis clearly reveals the severity of the problem; the negative aspects of not only weather and climate but also the management and infrastructure situation. These latter, however, are subject to direct improvement with the advent of integrated management.

The problem of water scarcity had already brought out the need for a water plan under the Sardinian Renewal Programme. This plan, presented in 1988 and never approved, nonetheless served as the planning reference document for a decade. Over the last 20 years, rainfall in Sardinia has dropped dramatically, by some 50 to 60 percent,[2] compared with the data from the period preceding the plan. This precipitated a crisis throughout the region, culminating in 1995 with the declaration of a state of water emergency (DPCM28/06/1995), extended to 31 December 2003 (DPCM 13/12/2001).

Taking note of the outdated forecasts of the Water Plan, the *Documento di base per la definizione dell'Accordo di programma quadro risorse idriche*[3] covering the institutional agreement for the State/Region programme was approved. It updates the estimates with reference to the current water scenario, requirements and usable water resources in the region. This is still current, and has been substantially absorbed into the Environmental Plan.

2. One study (*Studio dell'Idrologia Superficiale della Sardegna*, Eaf 1992) has shown that from 1986 to 1992, the mean annual flow dropped by about 80 percent, with peaks of 65 percent at some stations. Another study (*Studio SAR, Delitala et al., 2000*) showed that during the following period (1995 to 2000) only the 1995/96 season had average rainfall, whereas all succeeding years showed a deficit. In the most recent years, the greatest shortfalls in the last 60 years were recorded, including the crisis years of 1994/95 and 1999/2000.
3. Government Commission for the Sardinian Water Emergency, this is the base document as proposed by the Sardinian Region for the definition of the Framework Programme Agreement: *Il problema idrico in Sardegna – analisi e verifica del bilancio idrico al maggio 2000/Individuazione di interventi finalizzati al riequilibrio* 2000.

Concerning water resources, this document shows that the total estimated available supplies for 2000, was 690 million m^3/year. The amount that can actually be delivered is reduced by losses along the way to 621 million m^3/year, subdivided over the territory as in Table 2.

Based on available supplies and current population, this gives an available volume of water of 260 m^3/year/resident for the year 2000. As pointed out in the paper *Valutazione ex ante ambientale – POR Sardegna 2000-2006*, this is decidedly inferior to the threshold of 1 000 m^3 per year per inhabitant. This paints a picture of an area in which water scarcity now poses a severe limitation to the primary needs of domestic consumption, economic development and the protection of nature.[4] The index value for Sardinia is, in fact, similar to those for some areas of North Africa and the Middle East, but much lower than those for Algeria (730), Tunisia (450) and Syria (550).

Resource availability is further limited by the drop in rainfall, and because the maximum authorized capacity is less than effective capacity (owing to problems with reservoir testing). It is also lower than the gross delivery amount defined periodically by ordinances of the Water Emergency Commission.[5] These factors also lessen the chances of capitalizing on periods of heavy rainfall.

The same document shows an estimated total demand of 1 160 million m^3/year of drinking-water for 2000 (see Table 1).[6]

TABLE 1
Total demand

WATER SYSTEMS	DEMAND (million m^3/year)			
	DOMESTIC	IRRIGATION	INDUSTRIAL	Totals
Northern Sardinia	102	170	28	300
Eastern Sardinia	20	79	2	101
Central Sardinia	31	212	5	248
Southern Sardinia	140	346	25	511
Total	293	807	60	1160

4. Various authors and the Worldwatch Institute. *State of the World* 1993 and subsequent years.
5. One example is the Liscia reservoir which has a storage capacity of 68 million m^3, an authorized capacity of 68 million m^3 and a gross authorized delivery of 33 million m^3.
6. Indicatively, earlier provisions of the 1988 Water Plan gave an estimation of 2 708 million m^3/year.

Assuming a requirement of some 20 million m^3 for the transient population, primarily tourists, the average daily supply of drinking-water measured in the holding tanks of urban water networks gives some 450 litres/inhabitant. This is right off the scale and is an unequivocal indication of very high losses concentrated in the water distribution networks. There are two further critical elements with respect to requirements:

- Reservoirs generally serve a variety of users, with priority given to drinking-water. This has a major impact on other uses, especially for agriculture, and is a frequent source of conflict concerning water for drinking and irrigation purposes.
- Demand, in the absence or scarcity of dual networks for reusing treated wastewater, is not diversified with respect to the quality compatible with use.

A comparison of supply and demand shows a water supply deficit of some 600 million m^3/year, about half of the total requirement, broken down by area as shown in Table 2.

TABLE 2
Supply–demand balance

AREA	SUPPLY (million m^3)	DEMAND (million m^3)	DEFICIT (million m^3)
Northern Sardinia	176	300	-124
Eastern Sardinia	76	101	-25
Central Sardinia	137	248	-112
Southern Sardinia	232	511	-280
Total	621	1160	-549

The above data clearly show that the water deficit is mainly concentrated in southern Sardinia (amounting to 55 percent of potential demand). Central Sardinia also has a clear deficit, but less so on the eastern side. However, in the northern part of the island, certain clearly deficit areas (the Temo-Cuga and Liscia systems, and the Mannu di Pattada system to a lesser extent) are flanked by the Coghinas, part of the Mannu di Pattada and the Mannu di Ozieri systems, which have available water surpluses.

These are the problems. We have now to turn to an analysis of how the integrated water cycle management system can help restore balance in the supply–demand equation, one of the thorniest knots of the water issue. As mentioned, the SII (Integrated Water System) concerns only the drinking-water component and thus can only indirectly and partially affect supply and demand. On the other hand, the Water Authority through its watershed plan or provisional plans is responsible for the planning aspects, and therefore for ensuring the water balance for each division. Nonetheless, the Environmental Plan in its pursuit of cost-effectiveness and management efficiency also calls for interventions to reduce demand by reducing material and commercial losses within the networks, and using dual networks and water tariffs to discourage

unnecessary use of drinking-water supplies. It also acts directly on the resource (e.g. increased use of alternative sources such as wells and springs or desalination), reusing wastewaters, safeguarding small local sources, and working to improve communications between local bodies (and their needs) and the regional body through the environmental agency.

Infrastructure considerations

According to the Environmental Plan, a widespread crisis affects Sardinian hydraulic infrastructure. This is evidenced primarily by the extent of water network losses (including apparent losses due to the failure to compute the real volume of water delivered). These can be estimated by comparing the volume of water actually billed and the volumes coming into the network. The index is very high (about 60 percent), owing to the frequent failure to account for volumes delivered. As the volumes of water currently put into the network in the optimal catchment are 283 million m^3/year, some 180 million m^3 are lost each year, between physical and commercial losses. The Plan identifies the following components pointing to the critical status of infrastructure:

- 40 percent of the networks are in poor condition, and 49 percent of the internal distribution networks are poorly maintained;
- supply (including the transient population) equals 153 litres/inhabitant/day. This is less than the modal figure for southern optimal catchments of 242/litres/inhabitant/day, and is mainly attributable to insufficient rainfall recharge last year.

In addition to these problems, where action is needed to boost the efficiency of system components, connections need to be established between reservoirs so as to right the balance of water distribution and support and strengthen the water supply systems identified in the Plan.

Sewage coverage (percentage of users connected to the network) is about 75 percent, less than the average figure (85 percent) for southern Italian catchments, The extent of coverage (percentage of single and group users served by treatment plants), at about 68 percent, falls short of the average figure of 84 percent for southern optimal catchment. These data emerge from a comparison of the need for treatment and the demand met. For an equivalent population of about 5 million inhabitants, the available supply covers 2.6 million for multi-user plants and 0.5 million for single user plants.

There are many small treatment plants serving separate urban centres. This points to the still-incomplete implementation of the sewage network and treatment plants and to a system re-engineering plan developed by the relevant administration. Where implemented, it would permit the many small towns with or without treatment plants to pool their resources. Problems envisaged by this plan include:

- extension of the sewage system;
- completion of treatment plants and upgrading systems, according to norms set by Law I5/99;
- maintenance of existing infrastructure (47 percent of the sewage system is in poor condition, as are 55 percent of the treatment plants);

- incorporation of a purification cycle in treatment, allowing irrigation use of treated waters. At present, treatment is secondary[7] in 77 percent of cases. 6 000 listed[8] discharge sites need to be monitored, especially those in sensitive (mainly coastal) areas.

The infrastructure analysis clearly indicates a need for proper planning of infrastructure improvement interventions. The potential benefits and relevance of the Regional Water Plan will be most apparent in this sector. IWS objectives include enhancing infrastructure by intervening on critical sites. In this sense, the Environmental Plan has a twofold role for ascertaining the situation of infrastructure and management, and for coordinating interventions.

Management scenarios

In addition, examination of the Environmental Plan reveals management problems, related to the fragmentation of this sector. This starts with resource management, especially for watersheds involving various entities (e.g. various land reclamation consortia and industrial development consortia). This fragmentation increases when we look at the management of water abstraction, delivery and the sewage systems (see Table 3).

TABLE 3
Management

	Abstraction (% municipalities)	Distribution (% municipalities)	Sewage system (% municipalities)	Wastewater treatment (% municipalities)
ESAF (regional water supply and drainage instutution)	71	59,9	48	51,2
Govossai Consortium	5	5	1,9	3,2
Siinos	0	0,3	0,3	0,3
Municipality of Cagliari	0	0,3	0,3	0
Municipal management	19	33,4	46,7	36,1
Land reclamation and industrial consortia	5	1,1	2,9	9,/year

7. At present three plants have purification treatment: Cagliari Arenas Is., and the Municipalities of Villasimius and Palau (Sassari). The first two reuse treated waters for irrigation.
8. Regional cadastre of discharge sites (updated December 1999).

Table 3 reveals the widespread presence of ESAF. This body was set up by the Region in 1957 to provide directly (or through conventions drawn up with municipalities) for the management, maintenance or expansion of water supply and drainage systems, with a focus on water system management. A considerable share of management also fell to the municipalities, generally for economic questions, and sometimes acting as consortia, for both water abstraction and distribution, and especially for sewerage and treatment networks. Subsequently management responsibility for water systems and for sewage and treatment plants is frequently highly dispersed.

The launching of the SII (Integrated Water System) had a direct impact in that it delegates responsibility for the entire water cycle to a single manager in the ATO. It reduces service costs through integrated management and the increased scale of the area concerned. Indeed the priority objective of the Environmental Plan is to overcome existing economic imbalances through organizational and infrastructural interventions

THE INTEGRATED WATER SYSTEM IN SARDINIA

As a premise to our illustration of the situation, the implementation of the national water sector reform has failed to produce impressive results in Sardinia, and, with few exceptions, elsewhere. However, following a fairly stagnant period (by mid-2001 only 23 ATOs had been organized), the process has steadily and satisfactorily advanced in the past two years. Of the 91 optimal catchments under the Plan, some 84 have been inaugurated, reaching 96 percent of the population concerned. Of these, 66 have completed their survey, and 47 have approved the Environmental Plan. The conclusion of the first phase of application of the law (the attribution of responsibility), now totals 2 510, including in Sardinia.

This reform has the (not exclusively economic) goal of overcoming fragmentation and the division of economic management among individual municipalities. It adopts a business-oriented organizational model to ensure integrated water services. This means integrated management of the public services of abstraction, collection and distribution of water for domestic purposes, sewerage and treatment at optimal territorial coverage to justify the high investment costs inherent in the sector. Thus the reform has admittedly economic objectives, but there is also an official policy whereby all waters are declared to be in the public domain, and considered “common goods of present and future humanity”. The role of local entities in decision-making is also recognized.

In Sardinia the objective of water reform is also reorganization for a more efficient infrastructure and enhanced quality of service with closer attention to the environment and territory. A special feature of the Sardinian management situation is the direct, provisional (under art. 35 of Law 28/12/2001, n. 448) attribution of managerial responsibility to a single-manager joint-stock consortium responsible for the sector, as a means of aggregating existing managerial bodies within the Sardinian optimal catchments

The reform also demands a more selective official stance *vis-à-vis* the regionally based institutional powers vested in local bodies and agencies responsible for management within the region as administered by the Environmental Authority. We can thus identify three levels, corresponding to the division of resource planning, resource management planning, and management implementation.

The identification of the various entities and instruments is complicated in Sardinia by both the lack of watersheds plan, and ongoing water emergency. To summarize, and to delineate the scope of the Environmental Authority, we should highlight that resource planning, programming, monitoring and attribution are partly the responsibility of the Region and partly the responsibility of the Watershed Authority, while implementation is the responsibility of a single manager under the terms of a standard agreement and set of regulations based on the Environmental Plan.

We next describe the individual phases of implementation of the integrated water system as specified by regional and national law.

Definition of the target area: the identification of target areas generally aims to do away with fragmented management and optimize the sector on the basis of physical, demographic, technical and administrative parametres. The watershed or sub-watershed are respected, as are customary attributions of water resources.

Definition of the draft law: the Municipalities and Provinces reviewed the draft law put forth by the Regional Council. They highlighted critical points with respect to the system of representation. In its final form, the law was adopted by the Regional Council and approved by Municipal Councils in 2002.

Establishment of the environmental authority and approval of the Environmental Plan: The Water Emergency Commissioner assumed the leadership of the Environmental Authority, at the same time approving the Environmental Plan and the standard convention. The establishment of the Environmental Authority specifies an obligatory consortium of Municipalities and Provinces within the ATO, which was completed in September 2003.

Attribution of responsibility for the Integrated Water System: By regional ordinance, the company "Acqua Sarda," a joint-stock consortium, became the single manager. The company is responsible for implementing the investment plan called for under the Environmental Plan, in accordance with the procedures set by the convention to develop management-related activities for the integrated water system.

The ***Environmental Plan*** represents the base document for technical specifications for integrated management of the various aspects of the water system, as indicated above. This Plan defines the strategy for efficient, cost-effective management. Under the Plan, local bodies determine interventions and management procedures for implementation by the single manager in accordance with Plan objectives. The Plan includes:

- an annual workplan focusing on selected targets;
- a financing plan indicating available external resources and taxable resources, and setting water tariffs for the entire management area; and
- the management plan.

Critical points in the water system currently addressed by this Plan, include:

- resource scarcity in terms of quality and quantity, due also to reduced rainfall and water use conflicts;
- ageing water infrastructure due to low investments in recent years;

- need to adjust treatment plants to the provisions and schedules of the law;
- fragmentation and severe economic imbalance in existing management.

The Plan recognizes the need for substantial investment in infrastructure. The resources of the EU Community Support Framework will be insufficient for this purpose, and therefore additional funds are needed. This will be provided by an increase in tariffs of 1.07 Euro for the first year.

The analysis and especially the severe financial and infrastructural status of the current management led to the following terms of Plan strategy, over a timeline of 26 years:
- immediate intervention of all physical and commercial factors to maximize recovery of financial resources;
- a massive investment programme of 775 million Euro in the first six years (corresponding to the Community Support Framework programme period. This is backed mainly by public funds, and is aimed at enhancing the infrastructure capital;
- pursuit of infrastructural improvement in the years following with smaller investments of 250 million Euro and preference to maintenance interventions.

This strategy gave rise to the following guidelines for intervention, which identify a series of interventions needed to achieve specific strategy objectives:
- enhanced efficiency of distribution networks and reorganization of commercial relations;
- upgrading treatment plants by the end of 2005 as per Italian law;
- reclamation, protection and tapping of all significant underground sources;
- interventions in the high-risk water emergency areas;
- maintenance of treatment plant electrical and mechanical systems;
- upgrading water supply systems serving tourist areas;
- implementation of the programme of interventions under the PRGA.

Plan objectives also include the development of the information system for monitoring hydraulic networks and management, a new policy for saving water, and quality control of the system.

CHAPTER 17
ASPECTS OF ENVIRONMENTAL DEGRADATION IN SARDINIA

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ENVIRONMENTAL DEGRADATION RESEARCH ACTIVITIES

The concept of a research project on land degradation-linked issues was tackled in Sardinia in the early 1980s. The objective was to use the island as a project area illustrating the much broader area of southern Europe. A series of factors that have been and remain causes of desertification emerged from a small meeting of EC officials and Italian experts, held in the early 1980s. Prominent among these factors were fires, overgrazing, erosion, and both planned and unplanned urban growth.

A larger meeting met in Mitilene, Greece at the invitation of the European Community (EC) to discuss the issue and review examples of land degradation problems in the various Mediterranean regions. The findings were published in *Desertification in Europe* (Fantechi *et al.* 1986).

The issue was not again reviewed until the birth of the MEDALUS Project in 1991. The author worked in Sardinia to identify processes leading to land degradation (as described above) and ways of mitigating them. Problems of degradation primarily arise out of the management of environmental resources. Where natural resources are overestimated, it was found, they are also degraded.

Policy and market decisions are often the fundamental causes that expose an area to the decline if not the actual disappearance of its resources. In Sardinia, for example, overgrazing due to an abuse of the livestock carrying capacity of the land, combined with the inherent nature of pasturelands, led to an expansion of open grazing on the land. Here, the practice of setting fires and then ploughing to produce grasslands in sloping areas favoured soil degradation. This is visible even in the two soil maps of Sardinia drawn up in the 1960s and 1990s, which show a substantial increase in bare rock and areas of very thin soil cover.

One possible way of slowing and reducing the processes of land degradation is to promote a changeover in stock-raising methods in favour of stabling stock at certain periods, producing hay and grasses, and adding concentrated feedstuffs to the diet. This would also lead to less wear on land areas and would have obvious social and environmental benefits.

The market did and still does demand increasing amounts of cheese, the sale of which is a major factor in reducing the import/export deficit. Economic calculations that fail to factor resource degradation vs. rational resource management into the equation can easily give a false picture.

Similar considerations apply to tourism and afforestation solely for productive purposes, often with exotic species. These are common practices over much of the Mediterranean area, and demand a joint search for technical and political solutions. The most common lack is a study of resource susceptibility based on a comparison of user demands and the specific characteristics of an area, plus a study indicating possible future development of user activities.

The objective of our research on causes of desertification in Sardinia was therefore to develop technical, economic and policy strategies designed to mitigate the decline of resources of fundamental importance to humanity, through changes in how the land is managed.

The number of cases reviewed places Sardinia squarely in the middle as representative of almost all problems concerning the consumption of non-renewable resources, as well as some highly significant examples of the correct utilization of environmental resources.

Our research in Sardinia covered the following aspects of land degradation:
- experimental research into erosion, at points in a catchment and in the catchment as a whole, involving basic patterns of land-use;
- consumption of developed soils on recent alluvia as a result of quarrying;
- impact of fires on plant cover degradation and on processes of desertification;
- soil contamination by heavy metals in mining areas;
- excessive tapping of aquifers, and saline intrusions;
- consumption of soils due to urban growth and the impact of tourism on coastal areas;
- impact of exceeding livestock carrying capacity on soil compaction and degradation;
- impact of exotic species on soil degradation;
- causes and processes of soil degradation in forest areas;
- causes and processes of degradation in cork forests.

SARDINIA'S CLIMATE

Climate, soils and vegetation should be considered before deciding watershed management strategies. In Mediterranean environment, climate differs very greatly from one year to the next.

One constant is irregular rainfall. Thermometer readings tend to be more constant. Wind can vary from year to year in terms of wind direction, intensity and the number of windy days. The following diagrams show the variability from the mean, reflecting both rises and falls. Very dry years are often followed by short periods of heavy rainfall. This has a disastrous effect on erosion and flooding at the local level (see Table 1). Gaining a grasp of weather and climatic variability implies very important issues concerning land management, especially watershed management.

A review of some of the stations reveals the extent of the problem, as is the case for Cagliari and Escalaplano.

FIGURE 1
Annual rainfall in Cagliari, 1853 to 1999

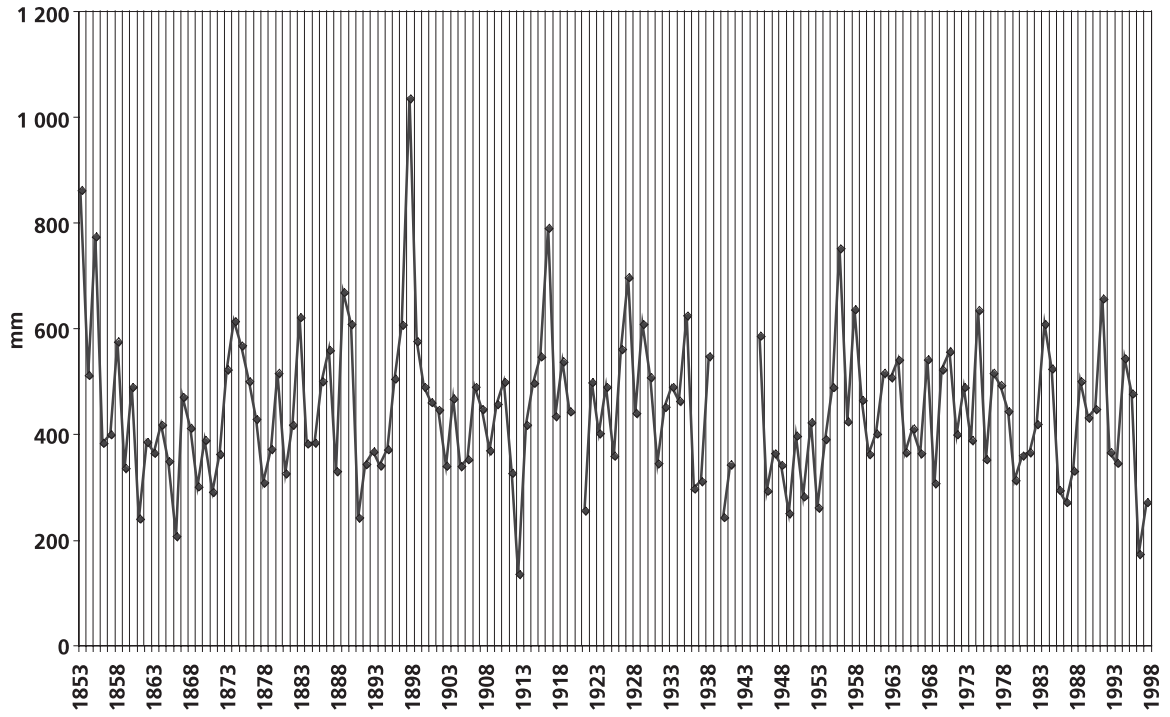


FIGURE 2
Monthly rainfall and temperature in Cagliari, 1996 to 2000

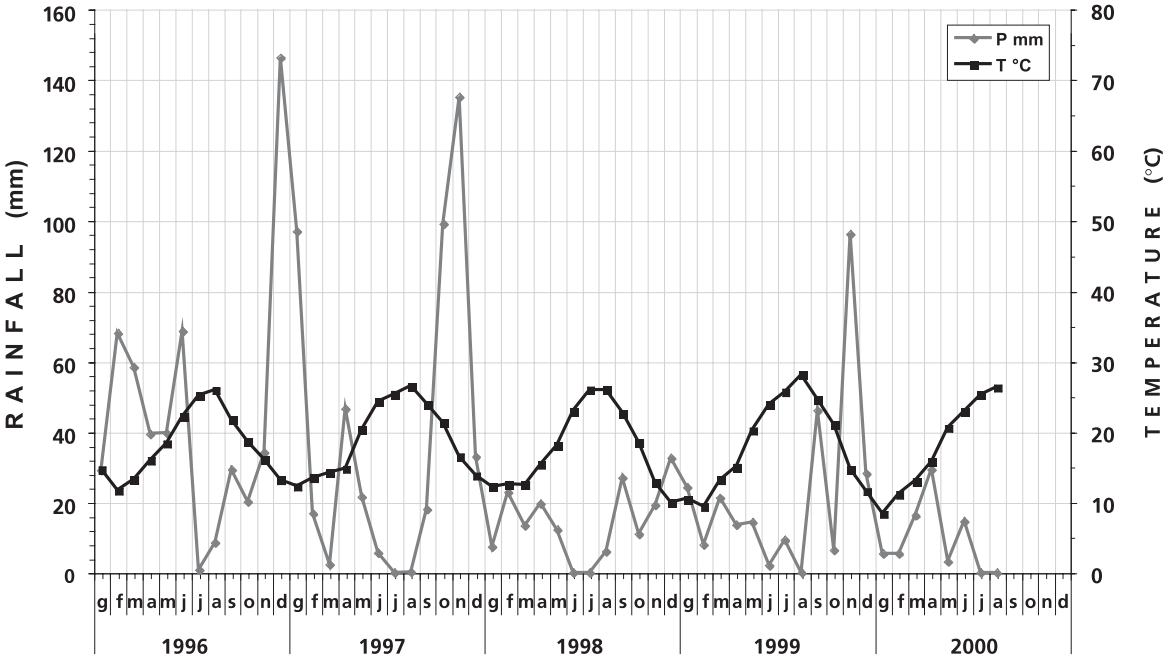
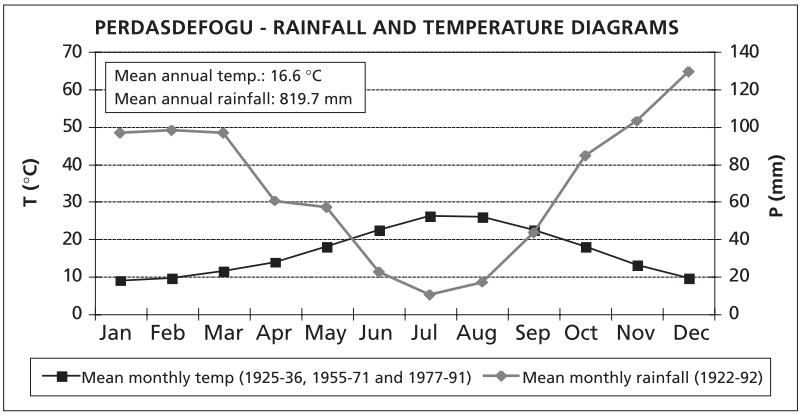
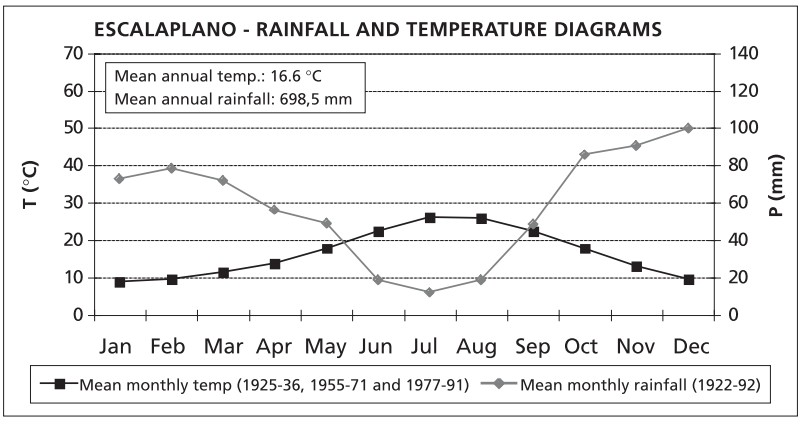
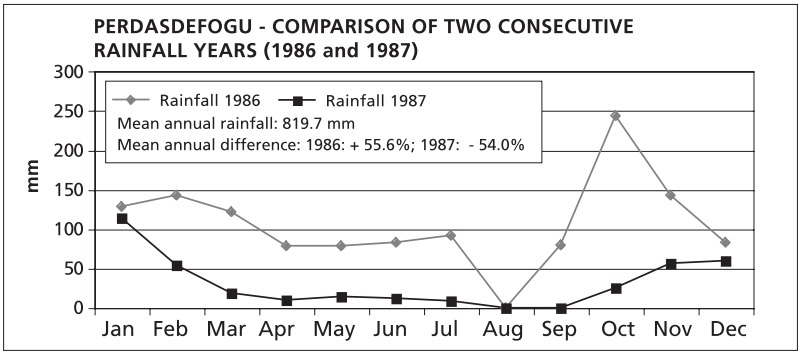


FIGURE 3

Rainfall and temperature diagrams







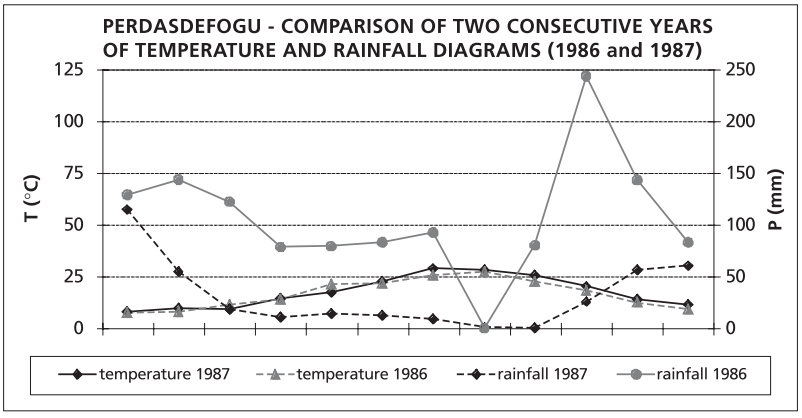


TABLE 1

RIO S. LUCIA: Flooding 12-13 Nov 1999 (EAF data)						
	R (mm)	start		end		interval
24 h	599.8	19.00.00	12 Nov. 1999	19.00.00	13 Nov. 1999	24.00.00
12 h	581.2	19.00.00	12 Nov. 1999	7.00.00	13 Nov. 1999	12.00.00
6 h	493.0	20.37.05	12 Nov. 1999	2.37.03	13 Nov. 1999	5.59.58
3 h	332.4	20.31.07	12 Nov. 1999	23.31.03	12 Nov. 1999	2.59.56
1 h	133.4	20.41.29	12 Nov. 1999	21.41.27	12 Nov. 1999	0.59.58
30'	73.0	21.19.02	12 Nov. 1999	21.48.54	12 Nov. 1999	0.29.52
15'	44.6	21.25.56	12 Nov. 1999	21.40.48	12 Nov. 1999	0.14.52
10'	32.8	21.29.35	12 Nov. 1999	21.39.33	12 Nov. 1999	0.09.58
5'	19.0	20.44.19	12 Nov. 1999	20.49.15	12 Nov. 1999	0.04.56
9 h	572.8	19.25.00	12 Nov. 1999	4.25.00	13 Nov. 1999	9.00.00

PRECIPITATION FOR 12 NOVEMBER 1999 IS OLIAS - CAGLIARI (UniCA data)		
Total in 24 hours	302.0	
	Duration (min.)	Amount (mm)
Rain event characteristics	35	17.6
	50	40.2
	180*	273.2
60 minutes	Interval	Amount (mm)
Peak rainfall	From 22.05 to 23.05	133.8

*Including the first 40 mins of 13 Dec.

Data clearly show that demand always outstrips supply and that there is need for a new strategy for water use and watershed management. Figure 4 concerning the Flumendosa system shows the following.

- Rainfall is so highly variable as to make it difficult if not impossible to rely on mean annual rainfall as a guide. In planning terms, there is no such thing as an average year of highs and lows.
- Variations from the mean show that climate and weather are not reliable, especially in terms of water storage for both surface and groundwater resources.
- Extreme rainfall events are more regular than most people and most projects and plans realize, especially as concerns irrigation.

- The frequency of very heavy rainfall is particularly high in the autumn months, when the soil is at its most vulnerable.
- Soil vulnerability is dependent on the type of land use and the soil type.
- Future land use needs to give prime consideration to the compatibility of climate, land cover and land use.
- Water use needs to be evaluated in terms of years of lightest rainfall.
- The duration of the dry period affects pasture production, and therefore the per hectare livestock carrying capacity of the land should be evaluated in terms of minimum rainfall years.

FIGURE 4a

Flumendosa – Campidano hydraulic system: net volume supplied for irrigation

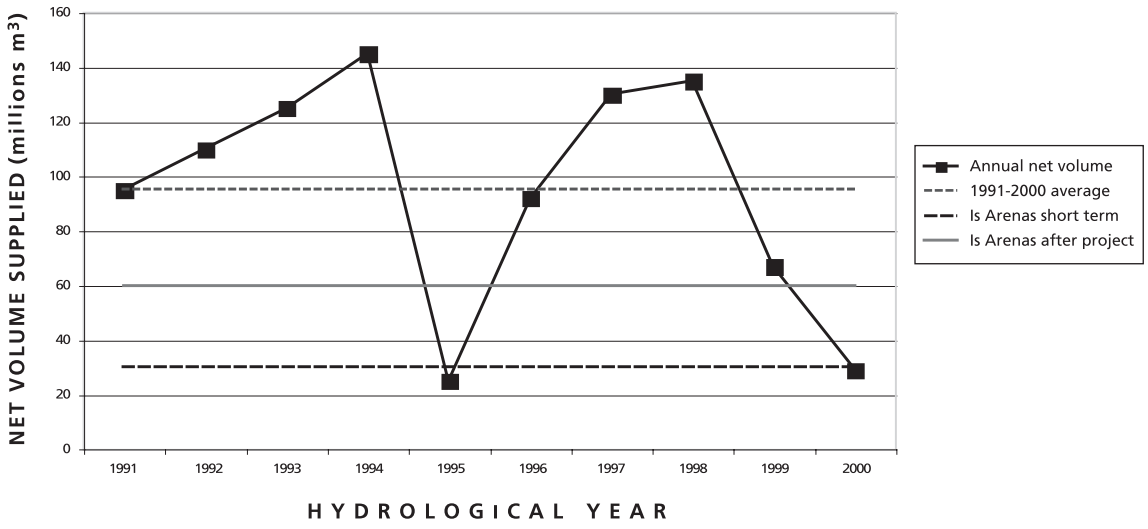
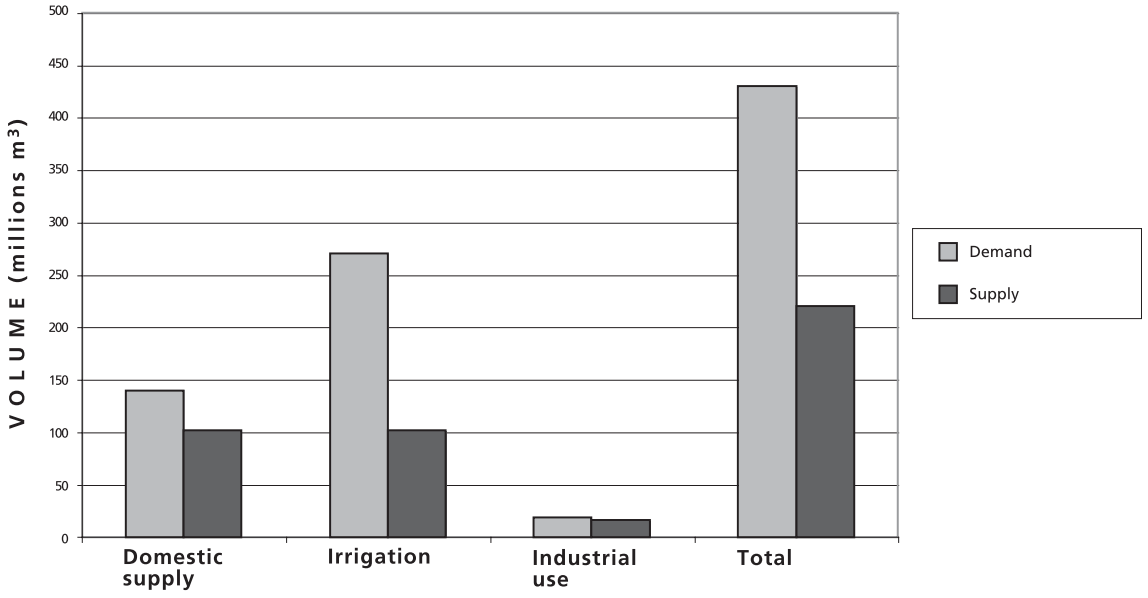


FIGURE 4b

Flumendosa – Campidano – Cixerri: five-year average demand and supply



DEGRADATION PROCESSES AFFECTING SOILS

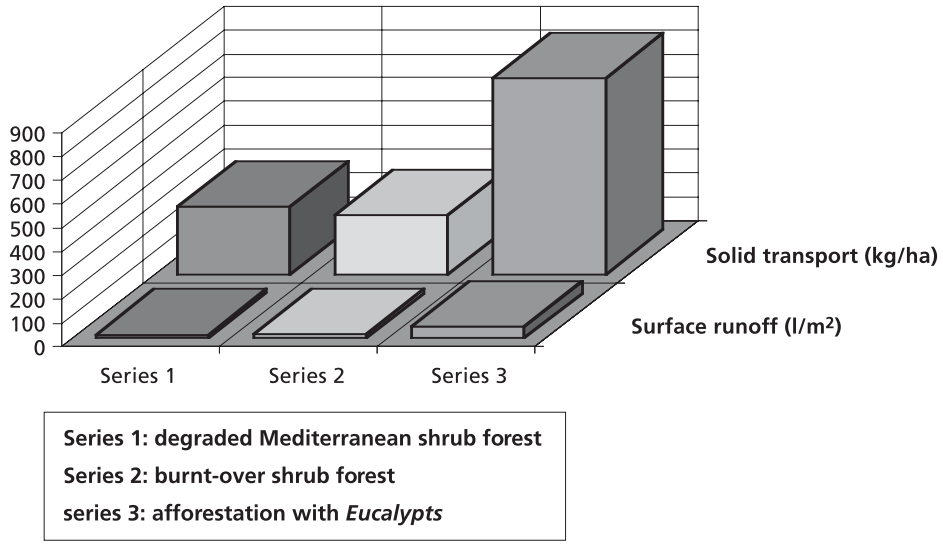
An experimental study on erosion processes due to land use was carried out in 1992 in an area of southern Sardinia representative of environmental contexts found throughout the island.

Eighteen experimental plots were established on three slopes with three different types of land use (Mediterranean scrub forest, burned scrub forest, *Eucalyptus* afforestation). The plots were distributed evenly over each of the three land use types on each of the three slopes, on all of which grazing had been banned. Data were taken on runoff and solid transport, and a weather station collected weather data.

The resulting erosion figures, while below acceptable limits, appear high with respect to the environmental situations under review, in which the speed of alteration of the substrata and soil formation are extremely low.

Erosion in the area under *Eucalyptus* (Figure 5), is higher than the erosion recorded under shrub and grass cover.[1]

FIGURE 5
Erosion data 1992 to 1996



1. This shows that Eucalypts are not effective soil protectors. This was revealed by the presence of linear erosion phenomena, reduced biodiversity and lowered organic material content in the superficial soil horizons. And because plants also grew more slowly, afforestation with exotics proved unremunerative in economic terms as well.

Quarrying activities

Quarrying of inert materials takes place even on recent alluvia with highly fertile soils. The study done in the alluvial plain of Rio S. Lucia revealed how the first four classes of soil use capacity are affected, i.e. those with the highest farming potential. Quarrying activities cause irreversible losses in soils that are both highly productive and scarce in Sardinia.

TABLE 2

Soil consumption due to quarrying activities in the alluvial plain of Rio Santa Lucia

SOIL USE CAPACITIES	PARTIAL CONSUMPTION FOR EACH UNIT			
	Ha	Relative%	m^3	m^3/ha
VII - VI	8.40	3.24	25 200	3 000
III - IV	2.60	1.01	19 500	7 500
I - II	248.00	95.75	1 860 000	7 500

Source: Modified from Puddu and Lai, 1995.

Fires

Fire is often used to clear brush and increase pastureland, especially in marginal areas. But the continual use of this practice, combined with overgrazing on the same areas, is a source of soil degradation and even the eventual disappearance of soil.

The total area of pasture in Sardinia is estimated at 1 500 000 ha. This figure must be halved if we also reckon in areas degraded to the point of desert by fires and erosion.

The most highly degraded areas overlie fairly unalterable substrata such as quartzite, granite and dolomite, on which reconstitution is impossible except over an excessively long period of time.

Table 3 clearly illustrates how grazing areas coincide with burnt-over areas, demonstrating the effects of overgrazing.

TABLE 3
General statistics of recent fires in Sardinia

YEAR	NUMBER OF FIRES	AREA (Ha)			
		Forest	Pasture	Other	Total
1984	2 155	1 563	n.d.	n.d.	17 327
1985	4 895	9 121	45 227	2 635	56 983
1986	3 282	4 229	31 035	6 133	41 397
1987	3 809	7 607	27 141	1 001	35 749
1988	3 239	9 433	40 417	3 925	53 775
1989	1 770	6 883	18 006	1 125	26 014
1990	2 911	6 309	26 823	939	34 071
1991	4 382	5 462	37 859	5 572	48 893
1992	4 937	5 775	25 686	1 711	33 172
1993	4 558	24 378	50 162	4 678	79 218
1994	3 857	17 064	48 208	5 907	71 176

From the Environmental Protection Authority of the Autonomous Region of Sardinia.

Contamination by heavy metals

The problem of heavy metals as soil and water contaminants was reviewed in both qualitative and quantitative terms in three areas with varying degrees of contamination.

Mining activities ceased many years ago in these areas. The management and protection of sludge flotation ponds has been abandoned, entailing serious consequences in terms of stability, accelerated erosion and sludge transport, with sediment intrusions into streams, recently flooded areas, dams and the sea.

The soils involved, initially highly fertile, have been irreversibly contaminated. The superficial horizons now show high values of lead, and significant amounts of zinc, manganese and cadmium.

TABLE 4
Values of heavy metals in selected soil profiles

ELEMENT	TOTAL AMOUNTS (PPM)	EXTRACTIBLE AMOUNTS (PPM)
Lead	2 000 ÷ 7 625	0.09 ÷ 10
Zinc	4 000 ÷ 9 425	26 ÷ 61
Manganese	3 500	
Cadmium		40 ÷ 70

Aquifer overuse and soil salinization

As in all arid or semi-arid areas (or in any case areas with severe water deficits), Sardinian agriculture, especially intensive agriculture, needs artificial inputs of water for cultivation.

The geography, morphology and soil characteristics of Sardinia, combined with climatic variability, make irrigation essential in Sardinia, not only in the summer months but also at other seasons of the year.

The tapping of aquifers in coastal areas, which has skyrocketed with the boom in tourism, is not properly managed. Unfortunately, the excessive drain on underground water has altered the balance with marine waters, provoking saline intrusions that contaminate aquifers and cause saline deposits on soils.

Steadily rising soil contamination in Sardinia has been recorded in parts of the Gulf of Cagliari, the lower Flumendosa Valley and other coastal plains. Studies done on the Rio S. Lucia have shown higher figures for salinization in areas around the coasts and lagoons, with peaks of 9.29 g/l.

This phenomenon is common to all Mediterranean coastal areas.

Urbanization

Urbanization in Sardinia has been intensively studied in terms of direct soil consumption in the last 15 years. The study on urban expansion in the Cagliari hinterland done in 1982 under the finalized CNR (National Research Council) Project Soil Conservation laid the groundwork for further contributions on the subject of changing land use and land management in Sardinia from historic times to the present. It turns out that the major impact of soil consumption has been on the most fertile soils.

The MEDALUS Project inaugurated a phase of in-depth research into these issues. It has now been demonstrated that urbanization in coastal areas — mainly due to the development of tourism and the expansion of industrial areas — has been unplanned and uncoordinated. The last 30 years have witnessed a spontaneous building boom with serious consequences for soil and water resources. The impact of urbanization on farmlands is not limited to the simple removal of land suitable for agriculture. It also entails a series of modifications in the physical and chemical nature of the soil, with ensuing losses or reduction of their intrinsic properties and a subsequent loss of fertility. Contamination of aquifers from saline intrusions and metals of various origins has had a highly negative impact.

TABLE 5

Consumption of agricultural land in the Cagliari hinterland

SOIL USE CAPACITY CLASSES	% CONSUMPTION 1954 - 1977
I	37.19%
II	23.07%
III	52.06%
IV	6.62%
VIII	35.12%

Source: Aru *et al.*, 1983.

The municipalities most affected by resource consumption in southern Sardinia include Cagliari, Quartu S. Elena, Capoterra and Assemini. Those most affected in the northern part of the island include Sassari-Porto Torres and coastal areas from Siniscola to Santa Teresa di Gallura.

Many soil and land use studies have been done in Quartu and Assemini, focussing on land assessment from the standpoint of both use capacity and the susceptibility of soils to specific uses (agriculture, building, grazing and livestock production) (Fantola and Lai, 1994; Aru *et al*. 1995).

The extent of the damage to agricultural areas is particularly high in the Quartu area.

TABLE 6
Extent of damage to farmlands in the municipality of Quartu S. Elena

EXTENT OF DAMAGE	AREA in m^2	PERCENTAGE
Inhabited area	3 378 335	19%
Severely damaged area	1 395 413	8%
Moderately damaged area	2 710 251	15%
Agricultural area	9 120 539	51%
Dumps	121 893	1%
Excavated areas	1 060 875	6%
Total	17 787 306	100%

Overgrazing

Overgrazing is a major source of land degradation in the semi-arid parts of the Mediterranean. Sardinia, with its age-old tradition of livestock farming, is particularly concerned. Grazing is the most common use of land in Sardinia, covering an area of 789 499 ha, or 33.14 percent of the national territory. The livestock carried by this area of land total 3 131 467 sheep, 286 831 head of cattle and 228 275 goats, plus horses, pigs and buffalo. The application of the land capability assessment methodology to the Soil Map of Sardinia shows that only 19.31 percent of the region is suitable for intensive agriculture (Classes I to IV), whereas some 65.86 percent of the territory is partially suited to extensive farming.

The major impacts of exceeding livestock carrying capacity include:
- defoliation and destruction of plant cover;
- removal of nutrients;
- mechanical impact on soils and subsequent compaction of the superficial soil horizons;
- variations in the entire hydrologic soil cycle.

Research in Sardinia mainly focussed on: a) defining a direct connection between the agro-pastoral system and land degradation; and b) assessing the impact of grazing on soil compaction.

The problem could perhaps be solved by enhancement of fodder resources and careful programming of livestock production.

Degradation of forest soils

Observations made in 1995/96 on forest soils in the montane sector of the Rio S. Lucia catchment clearly show alterations of various kinds and varying degrees of intensity. These are more apparent in areas where the original forest cover has been degraded (or is gone altogether), owing to direct or indirect human intervention.

Degradation of the original oak forest into its current form primarily involves the transformation of tree forests into coppice. It is safe to assume that openings caused by earlier felling allowed the installation of negative processes such as accelerated mineralization of organic matter and destruction of the clay-humus complex, further amplified by steep slopes. Even in those areas that are thickly covered by vegetation the signs of diffuse erosion are clearly visible. This is mainly attributable to the thinness of the organic horizons (mainly neoformations), and the raised necks of plants and stumps.

The complete elimination of the forest cover (especially downstream) by tree-felling and fires determined major changes in the floral composition and physiognomy of the vegetation, turning it into thermoxerophilous scrub, with obvious impacts on soil formation.

Grazing, primarily by sheep and goats, causes indirect damage by reducing renewal. Direct impacts include the formation of animal trails and the ensuing soil compaction, reduced permeability and qualitative alteration of litter, and hence the slowdown or (localized) halt of the processes of renewal.

Reduction of cork oak forests

Forests where *Quercus suber* is prevalent have long undergone modification of their vegetation structure, owing to the removal of cork bark plus practices such as grazing, with the ensuing regression of these highly vulnerable ecosystems, which are particularly susceptible in soil terms.

The principal causes of imbalances in Sardinia's cork forests have been clear for a long time now, especially as concerns the soil and vegetation aspects. Humans are the main agents in all typologies of cork oak forest. The primary causes of imbalance are forest fires, overgrazing and farm practices, aggravated by pest attacks by defoliators, and root rot.

Cork forest mortality in Sardinia is mainly the result of fires, which are often linked to the conflict between grazing and forest, but also to the practice of intensive farming in cork groves, and occasionally to severe drought.

The basic components of soil degradation in cork forests are reduced biodiversity, reduction or absence of natural renewal and the loss of humified organic matter and its function of promoting soil and slope stability through water retention and runoff control.

Impact of afforestation with exotic species

Meeting regional needs for wood has been a Sardinian target for many decades, involving major financial outlays for industrial-scale afforestation with exotic species.

Rapid-growth plantations of Eucalypts and *Pinus radiata*, the major exotics, often produced discouraging results in terms of wood production, or were wiped out by the premature destruction of forest cover by fire.

Soil conservation problems under such plantations are severe due to the impact of mechanized reforestation operations (brush clearing and ploughing) and subsequent silvicultural practices.

The municipality of Siliqua (Cagliari) has a vast eucalyptus plantation, now under study. The trees were planted on sloping, fairly impermeable, skeleton soils. Any profits from this operation need to be set against the ensuing environmental damage (erosion, alteration of pre-existing plant cover, loss of biodiversity). Additional evidence for this can be found in the I. Olias study area (Capoterra, Cagliari) under the MEDALUS Project.

There has been a slight drop, however, in the use of exotics in human-made plantations recently; especially those financed by the European Union in favour of autochthonous species. Even here the absence of reliable land capability assessments can easily lead to failure.

The above discussion clearly points to the need to develop future land use strategies designed to mitigate the phenomena described. These should not be based on policy decisions, and are sufficiently differentiated to match the range of environmental settings. There is no "one size fits all" solution for the European Union as a whole: nor even for the Mediterranean region.

Sardinia is the region with the greatest soil variability in the Mediterranean. There is a great diversity among the single components of Mediterranean landscapes, especially with regard to soil, climate and plant cover. What is needed, therefore, is a community-level strategy with a different thrust for different countries, regions and communities. There needs to be constant feedback between the needs of a plan targeted at the community level, and local or multilocal planning in terms of practical application. This has been the underlying rationale of Sardinian planning for Quartu S. Elena and Assemini. For the first time in Italy local urban planning here included not only urban planning *per se*, but agricultural and forest planning as well.

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CHAPTER 18
CONFLICT MANAGEMENT IN SUPPORT OF DECISION-MAKING FOR WATER USE

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Uncertainty and vulnerability are two characteristic elements of modern society, influencing the behaviour of opinion leaders and the general public alike. Many factors underlie this trend:

- the dynamic of development with the ever-swifter pace of change and the concomitant development of modern technology;
- the steady growth of entrepreneurial competition, not only as a typical characteristic of the new market place, but also as the appearance of new actors;
- the fact that markets and economic, social and cultural behaviour are increasingly interdependent, fostering imbalances;
- the search for a new social order able to reconcile industrial civilization with pre-existing peasant society and with environmental protection;
- the lack of environmental resources (especially water) due to both natural factors and steadily growing demand, especially from the developing countries.

CONFLICT: ACTORS AND OBJECTIVES

The management of water use conflicts demands steady and hard work by all actors in seeking consensus. It requires the participation of the various stakeholders in devising and choosing among a range of alternatives. However, it should also be understood as a tool for education and awareness raising for the general public and institutions.

A genuine, ongoing exchange of information allows the public to get involved. This entails empowering the public.

However, public empowerment may meet with scepticism on the part of those who see that the real interests of the population are not represented by opinion movements and "ideal" environmental solutions. Technical solutions are often quite political, mirroring the way values and resources are distributed within society. Technology therefore needs to be, above all, politically correct and realistic. In this way public involvement becomes a tool for managing the process of making political and technical choices.

What objectives should we pursue in the course of a process of involving the various actors in conflict management?

First of all we need to ensure that both the proponents of decisions and those affected by them have credibility. This is true both of those implementing financial measures and of final users.

There has often been an insurmountable credibility gap between decision-makers and the public.

We therefore need to identify the problems and values in play, and to develop consensus among those directly concerned, financing agents and users.

There is also need to involve the right parties at the right time and in the right discussions.

TYPE OF CONFLICTS

The decision-making process involves policy-makers, technicians and the public. These diverse actors represent different interests. Policy-makers, technical experts and civil servants do not always speak the same language nor do they share the same views on decision-making. There is abundant controversy even among technicians, and we often speak of the public in generic terms, whereas it would be more accurate to speak of various social groups or publics.

Agreement or disagreement among these various social groups may involve the nature of the problem, the objective pursued or both. Most often this is an iterative process ranging from the discussion of objectives to the definition of the nature of the problem, and vice versa.

Conflicts can be divided into four main categories. Data conflicts have mainly to do with information gaps, misinformation, differing interpretations of data, and different viewpoints. Technical reports are not always written so as to address all possible requests. They often provide data in accordance with prevailing norms, but leave out information that would be important for an understanding of the issue involved. Conflicts of interest have psychological and cultural components. Value-centred conflicts are bound up with the diversity of ideologies, belief systems and the fundamental, moral values of individuals and peoples. Relational conflicts have an emotional basis, but they are also mainly founded on a lack of information and negative individual behaviour patterns.

CONFLICT MANAGEMENT

Many disagreements involve all the above. A careful, patient examination of a set of values leading to the emergence of alternatives designed to achieve consensus is needed in this connection.

While “extreme” positions must be isolated, there is also a need to find incentives for participants to identify some common ground for action. This substantially involves moving from an examination of the underlying reasons for a given conflict to the definition of solutions. The public sector should facilitate the identification of solutions, alternatives and recommendations, fostering interaction in which a compromise becomes acceptable to all.

Cooperation that builds on alternative stances to arrive at creative, impromptu solutions, without necessarily ruling out earlier views, is what is needed. The important thing is that extreme views need to be expressed and acknowledged. Adherence to an extreme view should be clearly identified and expressed, not so as to exclude it but in order to arrive at reasonable alternatives. Many decisions taken in the environmental sphere are the fruit of a search for a reasonable solution rather than the application of a rational decision.

Once extreme stances have been isolated, we need to turn our attention to the identification of the interests involved, and not simply examine solutions that involve abstract benefits. This approach to the problem is also interactive. Values as points for discussion alternate with interests as rationale for action and positions as a springboard for intervention. In this kind of negotiation players inform each other about their respective interests, generating a series of options which no single player could have imagined at the outset. Negotiation thus becomes a means of arriving at a joint solution to the problem at hand as opposed to seeking a compromise solution between opposing parties.

It is a good idea for conflict management to proceed from the starting-point of interests rather than hard and fast positions. However, what needs to be put on the table are interests that can ensure stability. Substantial interests (procedural goods, in practice) involving the material and non-material interest concur to resolve conflicts.

THE PARTIES INVOLVED

Many techniques are used in conflict resolution. But they all involve establishing a dialogue among those concerned. This process usually makes a clear distinction between communication and content, and implies engaging in dialogue while effectively communicating. Mediation is the most apt solution for facilitating dialogue among the parties and focussing on content.

Before choosing a "mediator", all actors must be clearly identified, including:
- parties with formal responsibility in the decision-making process;
- parties wholly or potentially affected by the outcome of the decisions;
- parties in a position to block or hinder the decision-making process.

The mediator must not have any sort of stake in the final outcome.

Facilitating discussion and proposing conflict resolution is a creative task. It must be designed to allow interested parties to participate in a forum where their respective interests will find expression.

A preparatory phase to resolve in advance issues that could prevent the parties from sitting around the same table is usually a prerequisite. A well-planned table for discussion is a precondition for coming up with the right incentives for all involved to work together to reconcile their separate interests.

THE ROLE OF THE PUBLIC ADMINISTRATOR

The role of the public administrator, and especially that of the technical support unit, is important. The identification of many of the factors in play is not just a question of policy decisions and choices. It depends more on the process of providing information, technical backup and the capacity to lead the discussion. This demands long and continuous experience with some institution working to disseminate information and choose solutions that are not only environmentally sustainable, but also sustainable for the public that will bear the consequences.

All this is made possible by a new philosophy, which implies a complete turnaround in the quality of the product offered (intervention, teaching, project), as well as the level of service. This can restore the real value of goods (especially those held in common) while linking these goods to their functional characteristics, re-qualifying their use values, ensuring resource access to all, eliminating their purely outward significance and, most of all, ensuring environmental and health safeguards.

Management, including conflict management, is therefore tending increasingly in the direction of "lean management" in the private sector. This gives rise to a shift from "organizing by area of expertise" to "organizing by objectives", which is increasingly now used by organizations to manage highly complex and critical problems.

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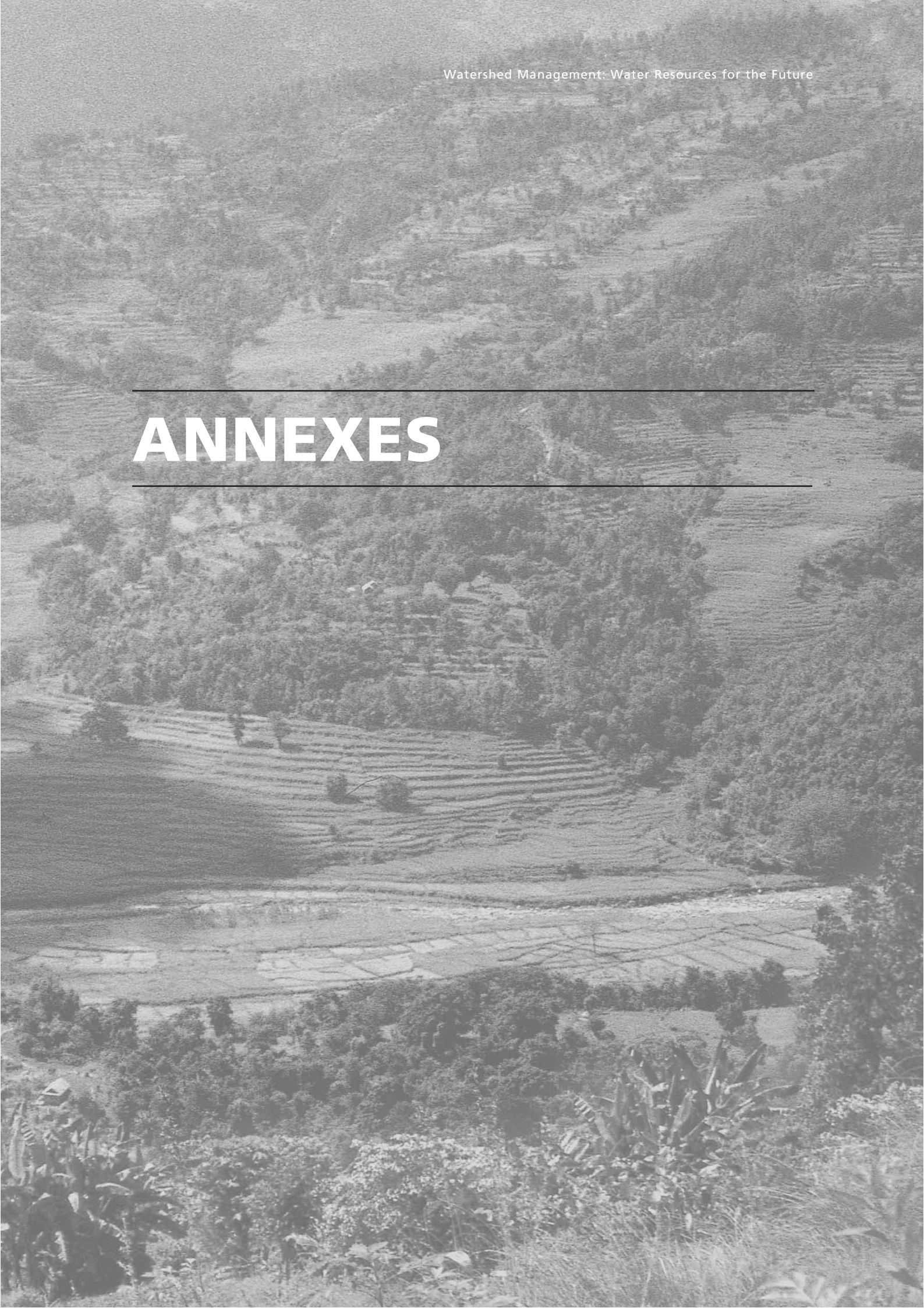
ANNEXES



ANNEX A
OPENING AND WELCOME ADDRESSES

Tage Michaelsen
Chief, Forest Resource Conservation Division, FAO

It is a great pleasure and an honour to address you on behalf of the Food and Agriculture Organization of the United Nations (FAO) at the opening of this culminating global event of the partnership to design the next generation of watershed management.

I would like to extend my sincere thanks and gratitude to the Province of Sassari, the Region of Sardinia and the Government of Italy for hosting and sponsoring this important conference. I also wish to thank all our partners, especially the European Observatory of Mountain Forest (EOMF), involved in the preparation and organization of this conference – in particular the local organizers for their support and kind assistance in making this conference a reality.

This is also a great opportunity to thank the Government of the Netherlands for their financial support through FNPP for the implementation of this highly significant initiative.

Watersheds are vital for our survival. Watersheds supply freshwater – the freshwater that more than half of humanity depends on to grow food, generate energy and, more important, to drink. Yet over the last few decades, these watersheds have come under increasing threat. Pressures from population growth, deforestation, mining, unsound agricultural practices, global warming, tourism and urbanization are all taking their toll on watersheds – and putting the supply of the world's freshwater at risk.

The need to manage these precious water resources efficiently and sustainably has never been greater. This was the clear message of FAO's Director-General, Dr Jacques Diouf, in his inaugural speech at the recent World Forestry Congress in Quebec, Canada, when he highlighted the need to seek new approaches to managing the world's watersheds.

This is also the main concern of this landmark conference.

Today, in more than 40 countries, more than 2 billion people are affected by water shortages: of these, 1.1 billion have insufficient drinking-water and 2.4 billion have inadequate sanitation. And, if current predictions come true, by 2050 at least one in four people will live in countries affected by chronic or recurring shortages of freshwater.

The conservation, use and sustainable management of watershed resources are therefore crucial if we are to meet the demands of ever-growing populations. And over the last few decades, it has become a matter of the highest priority in many countries around the world.

Watershed management is more than a technical fix. Watershed management means integrating various aspects of forestry, agriculture, hydrology, ecology, soil science, physical climatology and other sciences to provide guidelines for choosing acceptable management alternatives that suit specific social and economic conditions and needs.

People are at the centre of integrated watershed management. Indeed, it is now widely accepted that only the participation of people can ensure the sound and sustainable management of the natural resource base and improve the rural economy – in both upstream and downstream areas.

Furthermore, it is also widely understood that the integrated watershed management approach is a key ingredient in tackling poverty and achieving food security for those living in both uplands and lowlands.

But, as we fight to improve water resources in degraded upland areas, we have to ask ourselves: are we winning or are we losing the battle? Standing here today it seems to me that we have scored many victories, but there is still much to be done to develop the next generation of watershed management programmes and approaches.

Many high-level political fora have stressed the need to improve the management of the world's watersheds. This began with the 1992 Earth Summit in Rio and Chapter 13 of Agenda 21. And similar – no less urgent – calls for improved watershed management have come variously from the CSD at the World Summit on Sustainable Development in Johannesburg in 2002 and from the Third World Water Forum in Japan earlier this year.

The importance of water to life and the need to protect and manage its precious sources are increasingly on agendas at the national, regional and global levels. I see this as part of an expanding global chain of awareness and understanding. Consider for a moment the combination of the International Year of Mountains in 2002 and this year's International Year of Freshwater – and it is tempting to call this the "Watershed Management Biennium". Consider also that next year will be the International Year of Rice. It is clear that the concern for water is a common key element linking this sequence of UN international years.

So, why we are here for the next few days?

In 1985, FAO saw that despite the progress made in watershed management over the previous decades, there was no clear picture on what was really working and what could be done to improve watershed management programmes and practice in the future. For this reason, FAO, together with key partners, began an in-depth analysis of the achievements – and existing gaps – in watershed management.

This involved us looking more closely at key issues. Issues such as participatory processes, technologies, sustainability and replicability, institutional and legislative arrangements and required policies and strategies. All were identified as requiring in-depth analysis and review.

And we identified some key steps in the process: identifying key actors in watershed management and taking stock of activities; preparing case studies; organizing regional workshops; synthesizing our findings in an international conference; and formulating guidelines and disseminating results.

We are proud of the series of successful regional workshops that we have already undertaken, many in collaboration with some of you sitting here today: the European Workshop in Megève, France; the Near East and North Africa workshop in Aleppo, the Syrian Arab Republic; the Latin American Workshop in Arequipa, Peru; the Asian Workshop in Kathmandu, Nepal; and the African Workshop in Nairobi, Kenya.

These workshops have marked a crucial first step in allowing watershed management interest groups from around the world to share visions, exchange best practices, highlight emerging issues, voice common concerns on existing gaps in knowledge and, most important, identify innovative approaches and strategies that will bring real improvements to watershed management in the future.

The present international conference is a unique opportunity for us to assess where we are now and to focus on the findings and recommendations of our review, so that these can be disseminated beyond this room and shared on a global scale.

Over the next few days, I believe that this conference will further strengthen support and advocacy for effective watershed management at the local, national and regional levels. And, most important, it will help shape guidelines for the design and implementation of the next generation of watershed management programmes.

As such, our meeting marks a milestone in follow-up to the International Year of Mountains and is a major contribution to this year's International Year of Freshwater.

I would like to finish by congratulating you all on the partnership of shared learning, support and negotiation built around the sciences of watershed management. I believe that this solid base of commitment and support can make a valuable and lasting contribution to another partnership – the International Partnership for Sustainable Development in Mountain Regions, otherwise known as the Mountain Partnership. I invite you all to learn more about this important initiative in the information folders distributed at this meeting.

Thank you

ANNEX B
WORKING GROUP DISCUSSIONS

WORKING GROUP 1: WATERSHED MANAGEMENT INNOVATIVE APPROACHES TO COPE WITH EMERGING ISSUES

Facilitators: Larry Tennyson and Marco Salis
Rapporteur: Peter Besseau

Major issues identified

- Water management (WM) and rural development;
- Water and poverty alleviation: funding; applied research (CGIAR Challenge Programme for Water and Food);
- Upstream–downstream linkages;
- Myth-based policy vs. evidence-based policy;
- Short-term vs. long-term commitment;
- Knowledge and information networking;
- Developing tools and instruments to communicate to policy-makers and influencers;
- How to use information technology for awareness building, exchange of data and best practices, and for training and increasing capacity;
- Watershed governance;
- Operationalizing land and water governance;
- Water management in arid regions;
- International river management;
- Definition of integrated watershed management (update?);
- Political declarations;
- Integration methodology;
- Proactive planning for emergencies with respect to water scarcity, including clear objectives and indicators of scarcity;
- Better use of the water we have, including proper maintenance of existing infrastructure;
- Interventions linked to scale and target stakeholders;
- Role of scientific knowledge in public perceptions;
- Stakeholder involvement in the definition of strategies;
- Move from stakeholder to shareholder;
- Equity among shareholders;
- Capacity building;
- Watershed management as a planning and coordination framework;
- Watershed markets;
- Participation: roles, responsibilities and limits;
- Adaptation to climatic variability;
- Water for environmental services;
- Lack of decision support systems (DSS);
- Managing natural disasters;

Input on the issue of poverty alleviation

- Access: ensure that the poor have access to water, including consideration of flexible price structures.
- Appropriateness: need to consider carefully if and how watershed strategies from one area are appropriate to other areas. Context, setting, culture, religion and other considerations will affect uptake and success.
- Best and most modern technology, although often demanded, is not always the most appropriate. The intervention should be scaled and considered based on the target stakeholders and local conditions.
- Awareness and engagement: a major problem (cited from Latin America) is that people are not interested in water *per se* but rather in improving their own material well-being. It is necessary to find a way to interest people and include them in the processes for change.
- Awareness raising for developing local plans with local human resources to negotiate in a way that shows their role in planning and management.
- Employment and economic opportunity: the problem is not distributing money but creating a labour market. Water management should generate new jobs (distribution, purification, etc.).
- Define poverty in the context of integrated water management (IWM): it is necessary to frame poverty alleviation explicitly within the context of IWM. For example, we need to link poor people to access to safe water. This needs to be done at the level of regional or city-based utilities. Can the water agencies specialize exclusively in providing safe water, with national government providing the full means to get it to the poor people?
- Aggregating voices and views: recognize and respond to the fact that the poor often do not have a voice. Work to build "intercommunalities", and structure civil society into interest groups.

Innovation

- Networks: we do not need to know everything about hydrology. We need rather to know those who know about it and other necessary aspects.
- Move from single target household to multistakeholder approach, including the non-poor.
- Address labour markets not only in the agriculture sector but also within all relevant sectors. Recognize that rural labour markets are often highly mobile within and beyond a given region.
- Much higher focus on capacity building for institutional change at the group level and at the municipal, regional and other levels.
- Learn to consult and listen not only to the executive branch, but also to the legislative branch, the judiciary (claim and appeals) and civil society.
- Concede that we cannot do the job exclusively on our own, we need to link with others.
- IMFN: model forest approach, a global programme, designed specifically to develop fully inclusive partnerships to arrive at shared objectives and undertake shared action on issues such as poverty alleviation, policy-level feedback, effective participatory processes and best management practices at the watershed scale.
- UNDP Community Water Initiative provides small grants to help local communities meet water and sanitary challenges. The initiative, which is modelled on the similar GEF Small Grants Programme, will initially benefit eight to ten countries in 2003 in the pilot phase.
- IIED's work on markets for environmental services has reviewed international experience of forests and watersheds. The aim is to increase the understanding of the potential role of market mechanisms to promote the provision of watershed services for improving livelihoods,

especially regarding whether market mechanisms can help water managers to connect better with water users.
- Lao People's Democratic Republic's example of integrated watershed management being used by the Ministry of Agriculture and Forestry as a planning framework for sustainable natural resources management and poverty alleviation. This approach has resulted in multisectoral discussions with subsequent actions that were incorporated into operational plans and implemented by the sectors themselves, under district and regional governor coordination.

Comments and observations

- Water management agencies need to be brought into the culture of participation.
- Executive water management agencies need to be educated.
- Water management agencies should have contractual obligations, with enforcement of what they are obligated to do.
- There are significant knowledge gaps. It is necessary to give higher priority to knowledge issues, including the question of how interventions should be made.
- Integrated river basin management means integrated for all values within the basin. River basin management should include all land-based resources, including human inhabitants.
- Strengthen DSS in order to strengthen scenario planning for the future.
- Need to define parameters of reliability and resilience of a water system, as these have an effect on management decisions and on what are described to stakeholders as the costs and benefits.
- Too many goals can easily lead to a conclusion that it may be better to do nothing. Goals must be ranked according to importance.
- Most people are unaware of the interdependencies of water with other sectors, resources and problems. These interdependencies must be made known to all stakeholders. GIS and other tools and applications can and should be used to demonstrate these interdependencies.
- Big gaps between science and knowledge, theory and practice, and desire for participation and knowledge of how to participate. Need to focus on innovative approaches.
- European experience is highly varied. Surface versus groundwater considerations, for example, are critical in defining the fundamental nature of the problems to be addressed.
- Much of the technology and expertise that is needed exists (noted in the European context).
- European water directive from 2000 describes water as being freely available to all and as an economic commodity.
- European water management guidelines include surface, ground- and coastal waters, the last of which appears to have no or low profile.
- Need to educate people about water issues in a coordinated way, including strong focus on how to manage in times of scarcity.
- Latin America: Water management for farmers is an extra workload – it needs to be demonstrated that the extra effort will realize extra benefits.

Governance

- Former focus was on engineering – focus now required is to generate good science, integrate that science, and be able to work with communities, irrigation districts and different stakeholders.

- We are stuck with aged and inappropriate management structures (e.g. engineering institutions and border management agencies).
- We need new governance structures because there are so many ministries involved with inadequate or absent integration. Water councils are a type of entity that should be promoted. They are a necessary but insufficient variable in a broader equation, which should include sub-catchment/basement areas and basin-wide aggregation. There are examples of councils without resources, which are impotent entities.
- "Water Use Planning", an approach that obligates stakeholders to regular (three-year) reviews of strategies, present uses, etc.
- Compensation systems for those whose watersheds have been tapped into.
- Understand water as a human right rather than a political element.

Sardinia's situation

- Available: 800 million m^3 of water per year, providing 500 m^3/annum/per capita, or 50 percent of optimum for developed countries.
- 1.2 billion m^3 potential demand.
- 31 artificial water reservoirs throughout island, with little groundwater owing to the island's geology.
- Lack of policy/government action on source and demand issues, climatic factors, inefficient distribution system, inefficient pricing system.
- One of oldest rainfall stations in Italy – 1868 – strong oscillations among years, but mean values have been falling over the past 20 years.
- Watercourses have experienced decreases in flow of 50 percent, coinciding with decreases in rainfall of 20 percent.
- There is concern about reliability, vulnerability and resilience of water resources.
- The present-day management process includes: engaging institutional and social stakeholders, sharing information, clarifying assumptions, roles and responsibilities, costs and trade-offs, managing conflicts, aiming for win–win as much as possible; "evaluation" of options development is employed; e.g. clarification of alternatives to submitted plans, comparative analyses, priority ranking exercises in context of desired impacts; decision-making process has been put in place, including role of public; roles and interactions have been mapped, including the important interactions with the agriculture sector, which leads in turn to the issue of community choices.

WORKING GROUP 2: MOUNTAIN FORESTS MANAGEMENT: EVALUATION OF VALUES AND SERVICES, AND IDENTIFICATION OF MECHANISMS FOR PAYMENT FOR SERVICES

Facilitators: Pier Carlo Zingari and Sergio Vacca
Rapporteur: Roger White

Recent initiatives related to the topic were reviewed

- During the 2002 International Year of Mountains, mountain forests and forest-related ecosystems (agro-silvipastoral and agroforestry systems, trees and other wooded lands)

received special attention in relation to their place and role in watershed management: one major conclusion is that although forests' contribution to water balances or against floods can be limited, the role of overall hydrological regulation and the socio-economic benefits are many and relevant.

- Shiga, Japan, 20 to 22 November 2002 hosted an International Expert Meeting on Forests and Water providing a scientific and expert-level basis for the importance of considering forests and water with an integrated and cross-sectoral approach, total economic valuation, an incentive-based policy and collaborative mechanisms, and increased efforts in the assessment of forest and water interactions.

- Chambéry, France, 5 and 6 June 2003 hosted the International Workshop on Forests and Water with a view to opening a discussion among all stakeholders, based on the expert-level recommendations of Shiga. As a complement to the Shiga outcomes, stakeholders highlighted the need for continuous and determined efforts of all actors in shared responsibility to integrate the management of these vital resources for sustainable development, through national and subnational policies, programmes and strategies based on relevant data that should be made available to facilitate assessment of the results. Networking pilot sites across regions and worldwide is helpful in this sense.

The main topics of discussion are listed in the following.

Knowledge: is it sufficient? Is it used properly?

- Importance of indigenous knowledge and culture, and also how to use it as a necessary complement to more scientific and technical expertise and data;
- Sharing (networks) and exchange experiences and outcomes, including through pilot sites, i.e. permanent reference points;
- Lack of data to develop knowledge, i.e. indicators providing assessment, valuation and monitoring;
- Sorting myths from facts about water, soil and climate interactions and influences, i.e. to what extent forests and forest-related ecosystems can benefit in quality, quantity and risk control;
- Networking in areas of similar agro-ecology (rather than sectors), i.e. again consider watershed pilot sites with a large set of problems;
- Capacity building (human resources and institutional), learning by doing, listening, laughing and lunching, i.e. integrated watershed management is implemented and supported by everyday people, not solely by expertise.

Definitions, terminology and characteristics

- Variability of mountain forest issues not defined or understood in terms of function, i.e. what are the real hydrogeological functions of different forest types?
- Need of indicators and data to support monitoring and policy development, at different levels. We need recent, reliable, cheap and comparable data.
- There is need for improved impact assessment approaches (assessment and strategic approaches).

Pilot sites

Pilot sites are needed to:
- fill data gaps economically and quickly;
- develop innovative approaches and networking, i.e. pilot sites that link hydrological aspects to human influences and involvement;
- consolidate methodology;
- create awareness.

Participation

- Consider inhabitants' views, aspirations, livelihoods, governance, culture, gender, equity, etc.
- Consider stakeholder diversity, empowerment, partnership, negotiation, consultation and continuity.
- Provide mechanism for conflict resolution.

Economics

Some important points to consider include:
- competing land uses;
- benefit sharing mechanisms, e.g. by establishing contractual agreements;
- the long-term perspective;
- links to policy and legislation.

Decentralization

It is important to address the following:
- governance;
- partnership;
- opportunity for organizational structure based on territory;
- local planning, but within national frameworks;
- multisectoral approach at different institutional levels.

International conventions and agreements

- Need locally adapted guidelines, support and political will for effective implementation.
- Mountain forests should not be isolated in space and time, and should be managed from a watershed perspective with a multifunctional approach and upstream–downstream linkages, within the context of land use and interdisciplinarity.
- Next step: there is need to move from theory to practice.

WORKING GROUP 3: INTEGRATED WATER RESOURCES MANAGEMENT: UPLAND–LOWLAND LINKAGES AND INTERACTIONS

Facilitators: Gilles Neveu, Thomas Hofer and Nicola Sechi
Rapporteur: Ian Calder

Issues

- Sardinia – institutional involvement – homogeneous pricing of water among users;
- Conflict between upstream water providers and different downstream water users;
- Conflicts within and between watersheds;
- Upstream–downstream and coastal conflicts;
- Inappropriate institutions;
- Proper valuation of water;
- Alps – value of uplands if preserved intact;
- China – importance of ecology in watershed management – concern that dam construction has adversely affected downstream ecology;
- No incentives for upstream countries to be sensitive to downstream country interests;
- Watersheds as appropriate management units?
- Philippines – development projects not integrated, projects implemented within administrative rather than catchment boundaries, concerns about sustainability of projects;
- Need for diversified policies; economic considerations essential to engage policy-makers;
- Poland – consequences of upstream upland water management costs, water retention, flood mitigation infrastructure;
- Multisectoral conflicts, management model needed to identify costs from different sectors;
- Indicators and baseline information for water management needed;
- Need to evaluate costs of downstream impacts;
- There is gender imbalance in IWRM;
- Myth-based/evidence-based policy – need to improve existing policies;
- Need to consider past investment in development projects;
- Need to link water pricing to financing of watershed development projects;
- Need for capacity building – particularly for multistakeholders;
- Striving for evidence-based policy not necessarily relevant – no universal truth; "perspective-based" policy captures views of stakeholders;
- Scale and landscape considerations important, e.g. Hofer – forest and floods; productivity aspects important;
- Improve knowledge of environmental impacts, improve transfer of knowledge: how to implement IWRM concepts?
- Inappropriate technical solutions have destroyed credibility of experts, need for experts to assist with locally defined problems;
- WM must take into account other interests, e.g. tourism, industry, agriculture (indicators required for each sector);
- Need to mix bottom-up with science view;
- Importance of eco-economics;

New paradigm shift/recommendations

- Need to rethink scale issues within upstream–downstream issues: across temporal and spatial scales; biophysical and socio-economic linkages; consider transboundary issues.

- Embed economic valuation in multisectoral WM: management and policies that take account of all multisectoral supply, demand and environmental costs and benefits; incorporate viable and appropriate downstream–upstream or upstream–downstream payment for environmental services (PES) schemes; consider return of investment in WM projects; appropriate time scales for investment; include equity issues and right of access to water: "human and ecological reserve".

- More inclusive approach to WM required: technology alone does not provide the solution; need to live with uncertainty; move from coercive to non-coercive policies; develop multistakeholder process; move from management to adaptive management; include health issues.

- Move from sectoral policy to integrated policy – multisectoral watershed management: need for multisectoral baseline information; respect landholders' interests; education needed from school age, covering multistakeholder issues.

- Improved dialogue and information sharing: between science and policy (and science and stakeholders); Web-based communication, two-way; need for better sharing of WM information within sectors; GWP toolbox.

ANNEX C
INTERNATIONAL CONFERENCE PROGRAMME

TUESDAY, 21 OCTOBER

16:00 **Pre-registration**

WEDNESDAY, 22 OCTOBER

08.30-09:30 Registration

09:30-10:15 **Session 1: Opening/Welcome address, plenary**
Chair: Dr Sebastiano Sannitu, Councilor for Environment, Province of Sassari

Arzachena Municipality: Prof. Pasquale Ragnedda, The Mayor
Province of Sassari: Dr Franco Masala, President
Sardinian Region: Avv. Italo Masala, President of Regional Council
Government of Italy: H.E. Altero Matteoli, Minister of Environment
FAO: Dr Tage Michaelsen, FAO Service Chief

10.30-13.00 **Session 2: Key-note speeches, plenary**
Chair: Michael Bonell, UNESCO
Rapporteur: Pier Carlo Zingari, EOMF

10:30-10:50 Hans Schreier, University of British Columbia, Canada: *Innovation in integrated watershed management*

10:50-11:10 Ken Brooks, United States: *Restoring hydrologic function and productivity to altered landscapes: an integrated watershed management approach*

11:10-11:30 Luís Sanchez, Istituto Nacional de Recursos Naturales (INRENA), Peru: *Integrated management of Latin American and Caribbean watersheds*

11:30-11:50 Martin Haigh, University of Oxford, United Kingdom: *Role of headwater regions and the contexts of the Nairobi Headwater Declaration for the International Year of Freshwater 2003*

11:50-12:10 Gilles Neveu, Office International de l'Eau (OIEAU), France: *The international network of OIEAU*

12:10-12:30 Peter Besseau, Canada: *The Canadian Model Forest Concept*

12:30-13:00 Discussions

14:30-16:45 **Session 3: Presentation/discussion of technical papers, plenary**
Chair: Angelo Aru
Rapporteur: Ken Brooks

14:30-14:45 Moujahed Achouri, FAO: *The Process of the FAO initiative on the next generation of watershed management programmes*

14:45-15:00 Larry Tennyson, FAO: *The FAO initiative on the next generation of watershed management programmes: Preliminary results*

15:00-15:15 Pier Carlo Zingari, EOMF: *Integrated watershed management and forests*

15:15-15.30 Mike Bonell, UNESCO: *UNESCO–HELP programme on Hydrology for the Environment, Life and Policy*

15:30-15.45 Sebastiano Sannitu, Provincia di Sassari: *Watershed management in Sardinia*

15:45-16:00 Peter Greminger, BUWAL, Switzerland: *Watershed management in the Alpine context*

16:15-16.45 Discussions

17:00-19:00 **Session 4: Presentation/discussion of technical papers, plenary**
Chair: Sebastiano Sannitu
Rapporteur: Hans Schreier

17:00-17:15 Brent Swallow, ICRAF: *Outcome of the African regional workshop*

17:15-17:30 Kumar Upadhyay, Nepal: *Experience in the Himalayan watershed management*

17:45-18:00 Luc Dassonville and Luca Fé d'Ostiani, Plan Bleu-FAO: *Mediterranean watershed management*

18:00-18:15 Patrick Duffy: *Towards effective watershed management in low forest cover countries*

18:15-19:00 Discussions

THURSDAY, 23 OCTOBER

08:30-10:00 **Session 5: Presentation/discussion of technical papers, plenary**
Chair: R. Silvano, Province of Sassari, Italy
Rapporteur: Martin Haigh, United Kingdom

08:45-09:00 Gernot Fiebeger and Michaela Leitgeb, EFC/WP: *IUFRO and watershed management*

09:00-09:15 Thomas Hofer, FAO: *Upstream–downstream relations in watershed management*

09:15-09:30 Angelo Aru, University of Cagliari: *Planning and management issues in water resources in the framework of current climatic situations*

09:30-09:45 Luís Sanchez, INRN, Peru: *Outcomes of the Latin American regional workshop*

09:45-10:00 Claudio Gutierrez, Argentina: *The Guaraní Aquifer System: Water resources for the future*

10:00-10:30 Discussions

10:00-13:00 **Session 6: Parallel working group discussions**
Chair: S. Sannitu, Province of Sassari, Italy
Rapporteur: Martin Haigh, United Kingdom

Working Group 1:
Watershed management: innovative approaches to cope with emerging issues
Facilitators: Larry Tennyson, FAO Consultant and Marco Salis, Sassari
Rapporteur: Peter Besseau

Working Group 2:
Mountain forests management: Evaluation of values/services and identification of mechanisms for payment for services
Facilitators: Pier Carlo Zingari, Director EOMF and Sergio Vacca, Sassari
Rapporteur: Roger White, ICIMOD

Working Group 3:
Integrated water resources management: Upland–lowland linkages and interactions
Facilitators: Gilles Neveu, OIE; Thomas Hofer, FAO, Rome; and Nicola Sechi, Sassari
Rapporteur: Ian Calder, CLUWRR

14:30-15:30 **Session 6: continued**

15:30-16:30 **Session 7: Working group reporting, plenary**
Chair: Kumar Upadhyay
Rapporteur: Carmen de Jong

17:00-18:00 Discussion of working group findings, plenary

FRIDAY, 24 OCTOBER

08:30-09:30 Drafting Committee

09:30-11:00 **Session 8: Synthesis, debate and conclusions, plenary**
Chair: Sebastiano Sannitu, Sassari, Sardegna, Italy
Rapporteur: Brent Swallow, ICRAF

Synthesis of working groups
Ing. Giorgio Cesari, General Director APAT: *Synthesis for debate*

11:00-12:00 Open debate with local actors
12:00-13:00 Conference Declaration and closing session

ANNEX D
CONFERENCE PARTICIPANTS

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