Jean Burton

Integrated Water Resources Management on a Basin Level

A TRAINING MANUAL

UNESCO

ÉDITIONS MULTIMONDES

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Translated from the French book *La gestion intégrée des ressources en eau par bassin. Manuel de formation*, Institut de l'énergie et de l'environnement pour la Francophonie (IEPF), 2001, 280 pages, ISBN 2-8948-00-5 (www.iepf.org).

ISBN 92-9220-003-8

Printed in Canada

PREFACE

INTEGRATED WATER RESOURCES MANAGEMENT ON A BASIN LEVEL

To ensure their sustainability, water resources must be viewed holistically, both in their natural state and in balancing competing demands on them—domestic, agricultural, industrial (including energy), and environmental. Sustainable management of water resources requires systemic, integrated decision-making that recognises the interdependence in three areas. First, decisions on land use also affect water, and decisions on water also affect the environment and land use. Second, decisions on our economic and social future currently organised by socioeconomic sectors and fragmented, affect the hydrology and ecosystems in which humans live. Third, decisions at the international, national, and local levels are interrelated.

The concept of *Integrated Water Resources Management*—in contrast to "traditional", fragmented water resources management—at its most fundamental level is as concerned with the management of water demand as with its supply. Thus, integration can be considered in two basic categories:

- The natural system, with its critical importance for resource availability and quality, and the wide range of environmental services that it provides:
- The human system, which fundamentally determines the resource use, waste production and pollution of the resource, and which must also set the development priorities. Integration has to occur both within and between these categories, taking into account variability in time and space.

Integration has to occur both within and between these categories, taking into account variability in time and space.

At the operational level the challenge is to translate agreed principles into concrete action. The response to this is often referred to as *Integrated Water Resources Management (IWRM)*. While the concept of IWRM is widely accepted, its application is equally widely debated. Hence, regional and national institutions must develop their own IWRM practices using the collaborative framework emerging globally and regionally.

The application of IWRM requires that national socioeconomic policies take into account the management of water resources (and vice versa). It is also universally agreed that water resources must be managed at the basin or catchment level—whether this is internal to the country, across state or provincial boundaries within states, or across national borders. Often this requires the creation of basin-level institutions.

Historically, water managers have tended to see themselves in a "neutral role", managing the natural system to provide supplies to meet externally determined needs. The ongoing UNESCO/Green Cross PC→CP[1]: Water for Peace process concluded that new and existing institutions would require water resources managers with new ways of thinking. This training manual provides both a clear explanation of the benefits of the new approach and an outline of a concrete training program on the application of IWRM principles at the basin level. I welcome its translation into English after successful proving of its value in the French version in several countries and basins in Africa and Southeast Asia.

William (Bill) Cosgrove
Vice-President, World Water Council
President, Ecoconsult Inc.

1. From Potential Conflict to Cooperation Potential: Water for Peace.

FOREWORD

The international community interested in water-related issues has been very active over the last five years, and integrated water resources management has received a lot of attention. The bibliography is quite abundant and pertains to subjects as diverse as water quality, community participation, legal framework, biodiversity or funding mechanisms. Our ambition here is certainly not to present a complete synthesis of the current debate on water management on a basin level.

This manual is an introduction to the principles underlying the integrated water resources management concept: the focus will be on the approaches and management tools that facilitate its application, taking into account the size of the territory, whether it be national and international basins or sub-basins of local interest.

This manual is destined first to trainers who, through a national or a regional seminar, would bring the participants to produce a diagnosis of their basin and an action plan. A simple and field-tested framework will guide them throughout this learning process. On the other hand, those who would like to perfect their knowledge and improve their capacity to manage water uses in a more sustainable fashion can also use the manual.

In both cases, the clientele is made up of those who, within national or regional institutions, or non-governmental organisations, have to plan for and manage, on a daily basis, programmes and projects dealing with water uses and the biological resources associated with river or lake ecosystems.

The manual is divided into two sections. The first one, of a more conceptual nature, presents a review of several definitions and some of the most pressing issues related to integrated basin-wide management. Conclusions from recent international conferences will provide the overall background; we will also refer to the information base collected through our own work in the field since 1990.

The second section of the manual, definitely aimed at training, takes the reader and the trainer through the steps of the management framework. The proposed formula is a two-week seminar that has already been applied six times in the past for national and international river basins in Africa and South-East Asia. Specifically for trainers, detailed information is provided in addition to the training tools designed for participants. Above all, this is a methodological guide that puts the emphasis on an optimal use of existing information and expertise within the reach of those who know what to look for and where to find it.

We would also like to emphasise the fact that the framework proposed in this manual is not limited to management on a basin level; it is applicable to a wide range of natural resources management exercises. For instance, it was the basis of a seminar on integrated coastal zone management organised in Thailand in 1994. Indeed, with the necessary adaptations, this management framework can also be applied to a broad range of planning exercises that attempt to reconcile the needs of human communities with the sustainable use of natural resources.

Even though the title of the book is *Integrated Water Resources Management*, we have to be realistic: integration is the goal, but there are no practical management models that could really integrate all of the multiple facets of water; and the proposed framework is no exception but is nevertheless a step in the right direction.

ACKNOWLEDGEMENTS

The management framework proposed in this manual was first developed at the St. Lawrence Centre, Environment Canada, and applied to the St. Lawrence River. Then, under the Large Rivers Management Project, launched at the Summit of Heads of State and Heads of Government of countries using French as a common language held in Dakar in 1989, a symbiosis was achieved between North and South that has led to the adaptation of the framework to river basin management in tropical countries. Numerous managers from public institutions, research facilities and NGOs have been involved in the project over the years. We sincerely thank them for their support and particularly for their contribution to the network quarterly bulletin *RésEAUX*.

We would like to stress, in particular, the contribution of the participants in the first Management of Large Rivers Seminar, held in Segou, Mali, from October 21 to November 1, 1991. Those who attended were real pioneers providing us with their expertise and know-how by participating actively in the animated discussions that were typical of this seminar. To all of them, we would like to extend our heartfelt thanks:

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We would also like to thank all participants of the five seminars organised in 1992 and 1993 as part of the Large River Management Project; they have provided us with the documentation base used to illustrate this manual, in very practical and applied terms. Comments and suggestions formulated in the course of these seminars are the principal source of information for this revised edition of the 1991 training manual.

Finally, we would like to acknowledge the contribution of the Institut de l'Énergie et de l'Environnement de la Francophonie (IEPF) which has given strong backing to the project and provided funding for the French version of this manual published in 2001. The English edition is funded through a grant from UNESCO.

The Segou Seminar, October 21 to November 1, 1991.

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LIST OF ABBREVIATIONS AND ACRONYMS

ACCT	Agence de Coopération Culturelle et Technique
ADB	Asian Development Bank
AGRYMET	Centre agriculture, hydrologie et météorologie
ALG	Autorité de développement intégré de la région du Liptako-Gourma
AsDB	Asian Development Bank
BIEF	Banque d'information sur les États francophones
BRP	Bassin représentatif pilote (Guinée)
CAB	Cellule après-barrage (Senegal)
CCCE	Caisse centrale de coopération économique
CIDA	Canadian International Development Agency
CIEH	Comité interafricain d'études hydrauliques
CSE	Centre de suivi écologique (Dakar)
EDF	European Development Fund
EIA	Environmental Impact Assessment
EIER	École inter-États d'ingénieurs de l'équipement rural
GEMS	Global Environmental Monitoring System
GIE	Groupement d'intérêt économique
GIS	Geographical Information System
GWP	Global Water Partnership
IDB	Inter-American Development Bank
IDRC	International Development Research Centre
IEPF	Institut de l'énergie et de l'environnement de la Francophonie
IGB	Institut géographique du Burkina
INBO	International Network of Basin Organisations
IOW	International Office for Water
ISW	International Secretariat for Water
IWRA	International Water Resources Association
IWRM	Integrated Water Resources Management
ITC	Institut de topographie et de cartographie (Guinée Conacry)
IUCN	World Conservation Union
KBO	Organisation for the Management and Development of the Kagera River Basin
LCBC	Lake Chad Basin Commission
MAEL	Ministère de l'Agriculture et de l'Élevage (Niger)
MHE	Ministère de l'Hydraulique et de l'Environnement (Niger)
NBA	Niger Basin Authority
OMVS	Organisation pour la mise en valeur du fleuve Senegal
PEV	Programme d'éradication des vecteurs
RBM	River Basin Management
RBO	Regional Basin Organisation
R&D	Research and Development
SAGE	Schémas d'Aménagement et de Gestion des Eaux
SDAGE	Schémas Directeurs d'Aménagement et de Gestion des Eaux
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WHO	World Health Organisation
WSSCC	Water Supply and Sanitation Collaborative Council
WWF	World Wildlife Fund
ZIP	Zone d'interventions prioritaires

Song of the Djoliba

Djoliba! Djoliba! How evocative your name!

Down from the foothills of the Fouta-Djalon you come, bountiful and fruitful, to share in the life of the Guinean peasant.

It is you who, through countless meanders, quietly bring to each of our plains a message of peace and prosperity.

You have given yourself unsparingly to this land of laterite and sandstone so that a race might live.

The shepherds who lead their flocks each day along your verdant banks all venerate you
and in their solitude sing your praises incessantly.

Perched on bamboo watchtowers, in the midst of green paddyfields stretching as far as the eye can see, in the vast plains that you have fertilised, bare-chested children wield catapults every morning humming your song, the song of the Djoliba.

So flow, Djoliba, venerable Niger, wend your way through the black world and fulfil your generous mission.

As long as your limpid waters irrigate this land, the granaries will never be bare and every evening feverish chants will rise from the villages to bring cheer to the people of Africa.

As long as you live and bring life to our vast paddyfields, as long as you fertilise our fields, and our plains bloom,
our Elders, lying under the palaver tree, will always bless you.

Flow and go beyond yourself across the whole world, quench the thirst of the unfulfilled, satisfy the insatiable
and teach Humanity that only an unselfish gift has absolute meaning.

(Aube Africaine, 1965; our translation)

INTRODUCTION

Why should we pay attention, now and again, to water resources management on a basin level? At a time when water is the topic of the day on the international scene, because of a critical situation in several countries, it should be remembered that there are more than 300 large rivers and that their drainage basins cover more than half of the emerged land on our planet (Appendix 1). More than 200 rivers are international which means that they flow across borders; those countries find themselves in a special situation, that of riparian countries, because they belong to a common geographical unit that does not recognise political boundaries, the river basin. The same reality applies within the national territory, whether as a federal system or not, because of multiple political and institutional frontiers.

This entity, the basin, is of interest to us as a system that encompasses both natural resources and the human communities that depend on them. For a long time, man has seen the world as an inexhaustible resource to be used for his own profit. In this specific case, water mastering technologies have been used since Antiquity; man learned to bring water where and when he needed it. But, under the combined pressures of increased demand and the deterioration of water quality, traditional management models have failed; we have to move away from this technological mirage and develop new approaches that will allow for the satisfaction of human needs while maintaining the quality of natural systems that support the very existence of human communities.

We will have to learn to better manage the use of water under new paradigms:

- Dealing with water management in a more integrated way, moving away from the sector-by-sector approach;
- Looking for sustainable use of water, satisfying the needs of both Man and Nature;
- Moving progressively away from the centralised management models in order to adopt increased public participation processes.

These profound changes are widely discussed in the international arena and seem to be gaining some consensus, in theory at least.

This manual is designed to assist those who have to make decisions on a daily basis to apply these new approaches to river basin management. We should bear in mind that there is no single approach that can be applied to all cases. Quite the contrary; solutions will emerge through the sharing of diverse experiences, first at the basin level, but also on a larger scale.

THE INTERNATIONAL SCENE

The World Water Vision

Before delving into the proposed river basin management framework, it is important to clearly define the water issue and its recent evolution in the collective mind of those who move it ahead, as demonstrated by recent international events. In fact, over the last 20 years, the debate on water has shifted from the purely technical level, focused on water resources evaluation and allocation between major uses (resource management), to a more integrated approach that includes a broader range of domains, among which social and political aspects (demand management, including the needs of nature). The recognition of the multiple values of water is certainly the most significant milestone of the 20th century in terms of sustainable development.

Several major events have influenced the evolution of views on water resources management. In 1977, the Mar del Plata Conference initiated the international debate on water and proposed the International Water Decade (1980-1990). Then, at the Dublin Conference in 1992, the international community adopted several basic principles on the sustainable use of water resources:

- Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment;
- Water development and management should be based on a participatory approach, involving users, planners, and policy makers at all levels;
- Women play a central role in water supply, management and preservation;
- Water has an economic value in all its competing uses and should be recognised as an economic good.

Agenda 21, Chapter 18, adopted at the Rio Earth Summit of 1992, deals in detail with the water issue; three objectives were defined and they include some elements on quality in water management:

- Maintenance of ecosystem integrity by protecting aquatic ecosystems from degradation on a drainage basin level;
- Public health protection, including safe drinking water and disease vector control;
- Human resources development.

Since then, the Dublin and Rio principles have been adopted internationally and constitute the basis for the debate on water resources management. Then, in less that 10 years, several international water organisations were created: the Water Supply and Sanitation Collaborative Council (WSSCC), the Global Water Partnership (GWP), the International Network of Basin Organisations (INBO), the World Water Council (WWC), the International Office for Water (IOW), and the International Secretariat for Water (ISW) to name but a few. During the same period, major international conferences were instrumental in supporting the debate on water issues.

The First World Water Forum organised in Marrakech in 1997 is a landmark in the revival of the international debate on water. Following this forum, the WWC initiated an innovative international task, the development of the World Water Vision; this exercise guided the debate in 1998 and 1999 to culminate at the second World Water Forum in The Hague in March 2000. More than 10 000 people from all continents took part in this unprecedented consultation where they shared their recommendations and expectations for a more sustainable use of water. Several discussion papers were produced, dealing with issues at country, region or large theme levels (Water and Food, Water and Nature, etc.). The overall result was presented in *World Water Vision: Making Water Everybody's Business* published in March 2000 by the World Water Vision Unit which was the guest of the United Nations Educational, Scientific, and Cultural Organisation's International Hydrological Programme at its headquarters in Paris.

It is important to present, at the very beginning of this manual, the main results of this international consultation process; the ideas developed during the course of the Vision exercise, along with the vocabulary, will certainly influence the water debate for years to come.

Numerous findings occurred in the course of the Vision exercise, with proposals for major orientations in terms of water resources management on a basin level and their uses; the three following statements should be kept in mind, while reading this manual, since they constitute valuable markers along the pathway we are proposing.

The first statement may come as a surprise given the high level of media coverage which tends to associate water shortages more often with catastrophes and natural events (desertification, El Niño, climate change) than with human errors:

> There is a water crisis today. But the crisis is not about having too little water to satisfy our needs. It is a crisis of managing water so badly that billions of people — and the environment — suffer badly. (World Water Council, 2000, p. xix.)

One portion of the solution to the serious current water crisis lies with a better management of water uses. The first goal of this manual being to contribute to the development of capacities in water resources management on a basin level, we also believe that part of the solution lies in the way human beings use water, and most of all, that we should be able to learn from past experiences.

The second statement has to do with sustainable development of water resources and integrated management, two principles at the very base of the management framework proposed in this manual:

> Our vision is a world in which all people have access to safe and sufficient water resources to meet their needs, including food, in ways that maintain the integrity of freshwater ecosystems. The Vision exercise's ultimate purpose is to generate global awareness of the water crisis women and men face and the possible solutions for addressing it. This awareness will lead to the development of new policies and legislative and institutional frameworks. The world's freshwater resources will be managed in an integrated manner at all levels, from the individual to the international, to serve the interest of humankind and planet earth — effectively, efficiently, and equitably. (World Water Council, 2000, p. 1.)

The third statement which caught our attention deals with the sharing of roles between different levels of interested parties, from the individual to public authorities, including the role of professionals.

> The Vision recognises that people's roles and behaviours must change to achieve sustainable water resource use and development. The main actors will be individuals and groups in households and communities with new responsibilities for using water and water-related services. Public authorities will need to empower and support them and carry out work that households and communities cannot manage for themselves. Water professionals and environmentalists will provide these stakeholders with the information they need to participate in decision-making and will help implement their decisions. Working together, these groups can achieve the Vision. (World Water Council, 2000, p. xiii.)

The Vision, as the title suggests, provides scenarios for the future of water resources in the medium term. It is not the purpose of this manual to enter into the details of these debates; nevertheless, we should be aware of an important warning regarding the overall context in which the management process will have to be developed. What is of particular interest for us are the uncertainty and interacting trends notions; we will have to keep these in mind while developing a framework for integrated water resources management on a basin level.

> Given the wide range of uncertainties affecting the water futures, there is also a wide range in possible uses and stress. This range presents the potential for influencing the outcome through actions focused on key issues that may prove to be turning points. […] Whether the water crisis will deepen and intensify — or whether key trends can be bent and turned towards sustainable use and development of water resources — depends on many interacting trends in a complex system. (World Water Council, 2000, p. 23.)

Then the Vision proposes a list of issues, called "turning points in water futures". Some are in line with river basin management and will be presented in this manual. Among the issues we will deal with are: reforming water resources management institutions, increasing cooperation in international basins and valuing ecosystem functions.

THE PRIMARY OBJECTIVES OF INTEGRATED WATER RESOURCES MANAGEMENT

The three primary objectives of integrated water resources management are:

- Empower women, men, and communities to decide on their level of access to safe water and hygienic living conditions and on the types of water-using economic activities they desire — and to organise to achieve them.
- Produce more food and create more sustainable livelihoods per unit of water applied (more crops and jobs per drop) and ensure access for all to the food required to sustain healthy and productive lives.
- Manage human water use so as to conserve quantity and quality of freshwater and terrestrial ecosystems that provide services to humans and living things.

Five primary actions are required to achieve these objectives:

- Involve all stakeholders in integrated management.
- Move to full-cost pricing of water services for all human uses.
- Increase public funding for research and innovation in the public interest.
- Recognise the need for cooperation on integrated water resource management in international river basins.
- Massively increase investments in water.

(World Water Council, 2000, p. 2-3.)

The Action Plan

> For the World Water Vision to be achieved, concrete and realistic programmes of action will be needed. A first step towards such programmes of action will be the Framework for Action (FFA), which is being developed in parallel with the World Water Vision. It will be a route map of how to reach the Vision objectives and will identify key milestones along the way. The final outputs will establish which combinations of policy measures, management instruments, investment priorities and implementation strategies will be needed in order to reach those milestones. (GWP, 2001, p. 2.)

Several components of this FFA touch directly upon the main theme of this manual, Integrated Water Resources Management (IWRM); this new abbreviation is everywhere in recent publications dealing with water management and we will deal with it in Definitions and Approaches, along with other principles related to basin management.

A New Water Ethic

The water debate was also conducted at another level, ethical this time, with the publication of the "water manifest" by Petrella (1998), a document that played a role of catalyst in the renewal of the water debate. The economic value of water, recognised since Dublin 1992, was considered as a way to charge the costs of services and, too often, under the sole scenario of the privatisation of water services. The manifest considers access to water as a fundamental right. Water has a value but cannot be treated as a simple economic good because water is essential for life. Interestingly, the first consideration in the European Union Directive on Water, enacted in October 2000, holds to this principle: "Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such" (European Union, 2000). The social contract proposed by Petrella (1998) is based on two principles: access to water for all, and sustainable management and solidarity. The debate between the tenants of water as a collective good, with an access for the poorest, and those who sustain cost recovery through a tariff and fee approach, has certainly contributed to making the general public aware of the water issue; this debate was previously limited to specialists and was centred only on privatisation modalities for urban water services.

We should also mention the Social Charter for Water, an initiative of the Water Academy that was largely debated in The Hague in March 2000. This charter makes three recommendations that can be considered a summary of the general consensus developed in the course of recent international conferences:

WATER MANAGEMENT PRINCIPLES

- Manage water for all human beings and their descendants, while preserving the environment through a sustainable development policy (Rio, 1992).
- Closely associate users to the development choices (Dublin, 1992).
- Consider water as an economic and social good and allow for an access for all (Paris, 1998).

(Académie de l'Eau, 2000, p. 2.)

THE LARGE RIVER MANAGEMENT PROJECT

Context and Issues

In 1989, when Canada launched the Large River Management Project at the Dakar Summit, the situation of many large rivers was already serious; the combined pressures from desertification, increased salinity of irrigated lands, pollution and overexploitation of water resources were causing some serious impacts on water allocations in several large river systems. The situation was rendered even more complex by the fact that management instruments developed in the North had to be adapted to the specific needs of the South, but in a context of very limited resources.

The principal objective of the project, capacity development on river basin management, is still valid today; how can we develop the capacities of managers who, within national or regional institutions, are involved in decision-making on a daily basis in a complex environment and with limited means. Conflict resolution between users requires the gathering of a wide range of expertise and, of course, resources that are not available to national or regional institutions responsible for these tasks, mainly in the South.

As the French-speaking countries were at the origin of the project, activities were conducted first in West Africa before spreading to South-East Asia and East Africa. While favouring the use of the French language, this has never limited the participation of managers coming from countries where French was not spoken within a given river basin. In fact, most training activities were delivered simultaneously in French and English.

Clientele and Objectives

From the very beginning of the project, managers working within regional and national river basin organisations have been our main clientele. The project objectives are as follows:

- Identify capacity development needs;
- Develop, in collaboration with managers, management instruments well adapted to their needs;
- Facilitate the circulation of information and sharing of experiences;
- Conduct training and experience-sharing activities.

Results

The Large River Management Project is funded by Canada through the Agence Intergouvernementale de la Francophonie (an intergovernmental organisation grouping more than 40 French-speaking countries) and operated by the St. Lawrence Centre; this research institute is part of Environment Canada (Burton, 2001).

The project was initiated in West Africa on the Niger and Senegal Rivers. The first needs analysis was conducted through a workshop organised in Bamako (Mali) in 1990. Then a training manual was developed in cooperation with 12 Sahelian managers at a workshop organised in Segou (Mali) in 1991; the manual was published in both French and English (Burton and Boisvert, 1991). At the same time, some support was provided to the three documentation centres from the Organisation pour la mise en valeur du fleuve Senegal (OMVS), in collaboration with the Banque internationale d'information sur les États francophones (BIEF).

During the same period, the Réseau francophone de gestionnaires d'écosystèmes fluviaux et lacustres (Network of French-speaking Managers of River and Lake Ecosystems) was created, as the territory covered by the project had expanded within Africa (East and West) and Asia. The network was officially created in 1991 as part of the Orleans Forum (France); the author has been network coordinator from the outset.

In 1992-1993, 5 two-week seminars were organised:

- In Rwanda, with the Organisation for the management and the development of the Kagera River Basin (KBO);
- In Viet Nam with the Mekong Secretariat;
- In Chad, with the Lake Chad Basin Commission (LCBC);
- The Comité interafricain d'études hydrauliques (CIEH) organised the seminar on the Niger River in Burkina Faso;
- The Senegal River seminar was held in Senegal with the assistance of the Organisation pour la mise en valeur du fleuve Senegal (OMVS).

Each seminar was organised in collaboration with an international river basin organisation for a group of approximately 20 participants using the 1991 manual as a guide for an applied river basin management exercise. Participants formed a group representing most sectors and all countries within the basin. During the seminars, a diagnosis of the basin was produced using information provided by the participants themselves, the basic elements of an action plan were defined and the resources required for its implementation were identified. At the same time, a 15-member international orientation board was created for the network; members represented river basin organisations and funding agencies from both North and South. A quarterly bulletin was published (*RésEAUX*).

In 1994-1995, a workshop on integrated river basin management was organised in France in collaboration with the Seine-Normandie Water Agency. More than 50 participants from Europe, Africa, Asia and Canada took part in the exercise; several case studies were presented to illustrate the most interesting approaches to river basin management (Agence de Coopération Culturelle et Technique, 1995). A synthesis of the five 1992-1993 seminars was also presented (Burton, 1995). The quarterly bulletin was published along with the first directory of network members, some 400 managers from 45 countries. Alongside the project's regular activities, CIDA funded a seminar in 1995 on the River Nile as part of a bilateral programme. The same framework was applied with some 20 participants from several ministries from the national administration (Burton, 1995).

In 1996, the project funded the participation of six managers from the South in a workshop organised in Tulcea (Romania) by the IOW to discuss the importance of action plans. Also in 1996, CIDA provided funding for a major capacity development needs analysis in West Africa, conducted by the network coordinator. More than 200 managers from 6 countries, attached to the Senegal, Niger and Gambia River basins, were interviewed (Burton, 1996). In 1997, the project funded the participation of 7 managers to the World Water Congress held in Montreal. The quarterly bulletin was published and the members' directory re-edited.

In 1998-1999, the project activities were limited to the publication of the bulletin and the development of an Internet site (www.reseaux.org). Nevertheless, new requests for international experience sharing came from Latin America; two workshops, on the Rio Colorado (Argentina) and on Lake Chapala (Mexico) provided excellent opportunities to build on the experience gathered through the network. The same situation prevailed in 2000, with the publication of the bulletin in hard and electronic copies.

The results of more than 10 years of the Large River Management Project, both on river basin management approaches and capacity development, were summarised at several international conferences during the past two years (Burton, 1999; Burton, 1999a; Burton, 2000; Burton, 2001a).

Major Players

The Large River Management Project and the Network of French-speaking Managers of River and Lake Ecosystems (*RésEAUX*) have evolved in parallel since 1991 under the ACCT. Both the project and the network are managed by the same institution: the St. Lawrence Centre. Funds were provided originally by Canada with other partners joining. France made a contribution in 1995. We would like to recognise the significant contribution made by the members of our international orientation board during the development phase of the network. Finally, participation by the network coordinator in international missions in several countries was funded by CIDA and Environment Canada.

Part One of the manual will introduce the basic concepts related to integrated water resources management on a basin level. It will be presented in general terms, as the subject is much too vast to be addressed in detail. We will first present definitions and approaches, and then we will describe the basis for river basin management: knowledge, partnership and public participation. Then, the conditions that have to be present for the success of integrated river basin management will be analysed. Finally, a conclusion will provide a synthesis of Part One of the manual.

DEFINITIONS AND APPROACHES

We present, as an introduction, a few basic notions that are essential to understanding the issues related to water resources. Then we will briefly review a few river basin management models already in use, as a reminder only, since the reference list on the subject is very broad; the institutional model characterised by the Water Agency applied in France and several other countries around the world; the "integrated water resource management" approach proposed by the GWP; a practical definition on an ecosystem approach; a brief look at the existing links between water management and land use, before concluding with the framework for integrated water resources management on a basin level we propose in this manual.

BASIC NOTIONS

At the outset, it is important to remind the reader of some basic notions, mainly for those who are not familiar with the hydrological field. Even for the initiated, it is useful to be more precise with regard to the significance of some of the terminology used in this manual. A glossary is presented in Appendix 2 with some of the most common terms used in this vast domain of water management and uses.

The Water Cycle

The following information, and figures 1, 2 and 3 are from the Web site of the French Ministry of the Environment (France, 2001); it is the summary of a document produced in collaboration with the Quebec Ministry of the Environment (Canada).

FIGURE 1

The Water Cycle

"Water travels on the surface, underground and in the atmosphere in a well-known cycle.

1. Clouds provide precipitation in the form of rain, snow or hail.
2. Water runs on the surface. Part is captured by vegetation. The rest flows to rivers or infiltrates the soil to form underground water bodies.
3. Surface water from rivers, lakes and oceans evaporates under the effect the Sun and finds itself in a gaseous form in the atmosphere.
4. Water vapour condenses in contact with cold air masses, which creates clouds."

The Invisible Phenomena: 1, 2, 3, 4, 5, and 6

1 Evaporation: all water surface

2-3 Absorption: by vegetation roots and evapo-transpiration through the leaves

4-6 Water vapour (gas) and transport by winds

5 Energy for the whole cycle: the Sun

The Visible Phenomena: A, B, C, D, E and F

A Condensation (clouds, haze)

B Precipitation (rain, hail, snow)

C-D-E Snow melt, run-off, infiltration

F Superficial and underground flow

http://www.environnement.gouv.fr/dossier/eau/bassin/bassin2.htm (our translation).

This cycle has neither beginning nor end, water quantity remaining more or less the same since its apparition on planet Earth. Nevertheless, in the course of the history of our planet, major climate changes have created deserts or covered entire continents with ice. Water and climate are closely linked; it takes only a short-term regional variation in the hydrological cycle of a few days, months or years to cause floods or drought. This is why climate changes associated with greenhouse gases can have a direct effect on the annual flow of rivers and its seasonal or annual variability.

> It is generally accepted that the natural world is in a relatively comfortable stage of dynamic equilibrium, maintained by constant flux, change, adjustment, rebalancing, growth and decay, and recycling. In the natural environment, most water (65 per cent) cycles back to the atmosphere through the transpiration of trees, and another 25 per cent infiltrates the soil, recharging the ground water below. (Ontario, 1993, p. 1.)

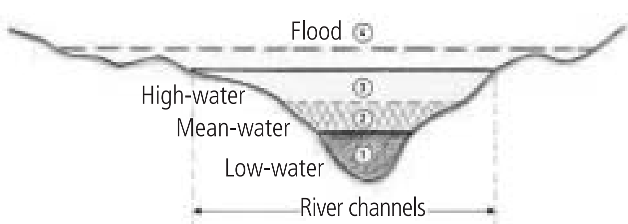
> Each river is characterised by its flow regime. The flow is calculated in cubic meter per second (m^3/sec). This is the representation of the volume of water moved over a period of time. It varies with seasons. […] This annual variation cycle reminds us of a natural respiration. The river normally flows within its low-water channel, but can sometimes overflow in the mean-water channel and more rarely in the high-water channel. The limits of the high-water channel correspond to the "high-water line" which is reached by the river under exceptional floods. (France, 2001; our translation.)

These are the concepts and the terminology at the base of a river-basin management framework. Nevertheless, in spite of the noticeable simplicity of the processes described above, much remains to be understood: how, in fact, to correctly evaluate the "renewable" portion of water resources, the one that can be used in a sustainable manner, taking into account the complex relations between surface and ground waters? We use three terms to differentiate water resources:

- *Blue water:* renewable water resources, the portion of rainfall that enters streams and recharges groundwater;
- *Green water:* the portion of rainfall that is stored in the soil and evaporates from it;
- *Fossil water:* groundwater that has accumulated over a long period of time, often in previous geological periods, and is not or barely recharged. It is not a renewable resource.

FIGURE 2

The River Residence

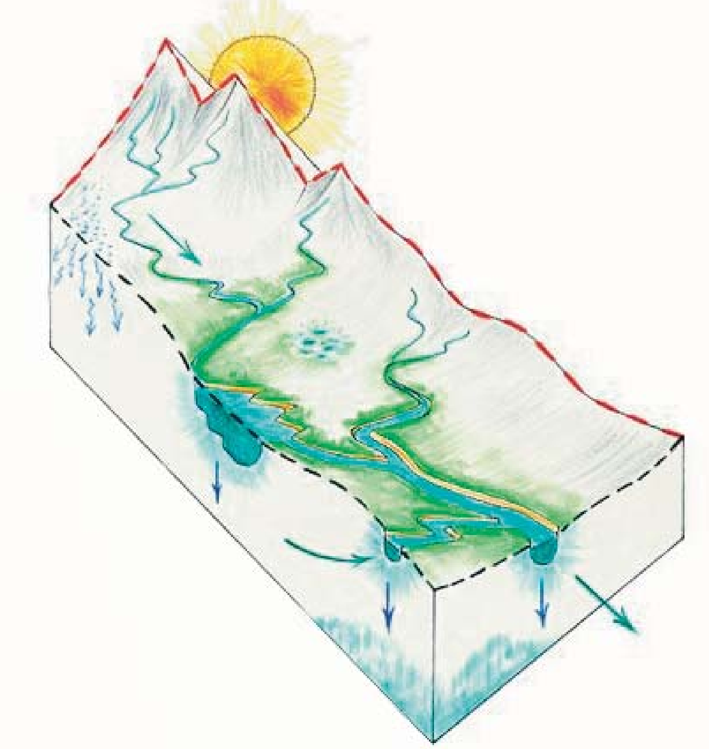


The River Residence

1. Low-water and normal situation
2. Flood; snow-melt and heavy precipitation
3. High-water level: exceptional situation
4. Flood

The high-level line defines the risks for urbanisation.
http://www.Environnement.gouv.fr/dossier/eau/bassin/bassin2.htm

FIGURE 3
The River Basin



"Like a country, a river basin has frontiers; these are natural boundaries. They follow mountain crests and we call these boundaries 'water parting line' or 'divide'. Rainfall that falls on one mountain slope will reach the river below; the rainfall on the other slope will flow to the neighbouring river. The river basin has the shape of a valley. Rain may also infiltrate the soil and form underground reservoirs. In this event, there is underground circulation of water." (France, 2001; our translation.) [http://www.Environnement.gouv.fr/dossier/eau/bassin/bassin1.htm]

It should also be noted that watersheds come in different sizes and include both river and lake basins; some of the larger lakes are fed by several rivers and constitute important natural systems for management, as is the case with the Aral Sea and Lake Chad. Another reminder: the natural limits of the basin do not follow political or administrative boundaries; a basin will be "national" if it is within one country or "international" if it covers several countries.

Water Quality

"The very notion of water quality is linked to the intended use of the water: swimming, drinking and cooking, irrigation, industrial process water, etc. Whatever we use it for, its quality must be preserved. As the natural content varies considerably, we must define average conditions for natural and safe waters. Above a predefined threshold, water will be declared polluted. […] Water pollution results from the addition, in an ecosystem, of a substance that modifies the equilibrium. Water pollution is a harmful modification of water caused by the addition of substances likely to modify its quality, aesthetic aspect and use for human purposes. The polluting agent may be physical, chemical or biological in nature and cause discomfort, nuisance or contamination." (IOW, 2001; our translation.)

It is essential not to restrict the debate on water resource management to quantitative dimensions only. There is still an important aspect missing in the definition provided above: the very needs of the ecosystem itself. Any sustainable management approach will have to ensure that water can, by its quality, both satisfy the needs of human beings and maintain the natural functions of the ecosystem which shelters them.

The Ecosystem

This brings us naturally to a key notion to be included in any framework aiming at the sustainable management of water resources, the ecosystem. It is an organised system, including physical, chemical and biological components; man and his activities are part of this system.

BASIC CONCEPTS FOR AN ECOSYSTEM DEFINITION

- Sustained life is a property of ecosystems, not species. Individual species cannot survive indefinitely. The smallest unit of the biosphere that can support life over the long term is an ecosystem.
- Ecosystems are open systems of matter and energy (composition) in various combinations (structures) that change over time (function). Ecosystems undergo continuous change in response to pressures from component populations (human or otherwise) and the physical environment.
- Everything in an ecosystem is related to everything else. These interrelationships underline another important characteristic of an ecosystem — it is more that the sum of its parts.

- People are an important part of ecosystems. As noted above, sustained life is a property of systems, not individual species. This implies the necessity of maintaining the health and integrity of natural systems to ensure our own survival.
- Ecosystems possess various spatial and temporal scales. The choice of scale depends on the problem to be addressed or the human activities to be managed.
- Any ecosystem is open to “outside” influences (Allen *et al.*, 1991). Consideration of outside influences complicates efforts to predict or model cause and effect relationships and highlights the need for flexibility and adaptability.

(Canada, 1996, p. 1-2.)

We will use the term “river ecosystem” throughout this manual to keep reminding the reader that the only possible approach to sustainable management of water resources is one that considers both man and nature as part of the same natural system. We may consider, for management purposes, that the limits of the river ecosystem correspond to the basin; however, several ecosystems of different sizes are nested within this vast ensemble; as they influence local conditions, they will have to be accounted for in our management approach. Finally, the term “river ecosystem” is often used as a synonym for “environment”, which should be avoided entirely; in fact, the term ecosystem encompasses environmental but also social and economic dimensions.

BASIN-WIDE MANAGEMENT

An in-depth reflection was conducted on the general theme of basin-wide management at the Second World Water Forum. A technical workshop was organised at The Hague in 1999 in preparation for the Forum; the workshop proceedings are of particular interest, first by the diversity of the case studies presented, but also as a remarkable summary of the current debate on river basin management (Mostert, 1999). The results of these discussions were presented as recommendations at the Forum in March 2000 (The Netherlands, 2000). These are two very important documents that present both theory and practical applications. A worldwide overview of basin-wide management was completed in 1999 and 2000.

The use of the river basin as the most appropriate management unit is not new but it is now an internationally accepted principle. The Ministerial Declaration of The Hague on Water security in the 21st Century, part of the Final Report of the Second World Water Forum, presents basin management as a challenge associated with security:

> Sharing water resources: to promote peaceful cooperation and develop synergies between different uses of water at all levels, whenever possible, within and, in the case of boundary and trans-boundary water resources, between states concerned, through sustainable river basin management or other appropriate approaches. (World Water Council, 2000a, p. 26.)

It is interesting to note the flexibility given to managers regarding the approach to be used; river basin management is not presented as an absolute but as an interesting approach to promote cooperation. This political dimension, closely associated with peace, is another dimension put forward by several international forums during the past two years.

River basin management, under its formal institutional definition, has been applied in several countries. The Water Academy conducted a comparative analysis of river basin management in 2000 looking at nine case studies from Europe, Latin America and Indonesia. These cases applied the model developed by the French Water Agencies. The conclusions are quite interesting as they summarise the results from one of the best-known river basin management models.

THE WATER AGENCY MODEL

"**Major tendencies.** The basic principle of managing water resources and the environment on the basin level is unanimously recognised. In most cases, this principle is formally applied; the limits of the management territory are those of the basin. When the change in the use of the basin limits required institutional modifications that were too important, which could retard the reform of the water management system, the preservation of existing management institutions was the preferred option. The second important principle, which consists in the introduction of an economic dimension to water management (polluter-user-payer principle), is also generally considered as the necessary base to ensure the viability of the system. But, in the case studies, the implementation is quite timid because, in most countries involved, it is necessary to modify the water act or some aspects of the fiscal acts first. […]

"**The difficulties.** The most important difficulty, already encountered or foreseen, is naturally of a financial nature. After the dialogue and decentralisation stages, how to proceed with the development and maintenance of the new river basin organisation and to implement activities for the restoration and the protection of water resources and the environment? Theoretical simulations have shown that, in most cases, the users and polluters could sustain the fee system. But cumulated delays in environmental protection require massive investments and force regions to resort to state budgets, whenever possible, or to external funding sources. So, in the process of creating new river basin institutions, simply proclaiming the polluter-user-payer principle may well be insufficient; it is never too early to analyse the financial aspects of the decentralisation of decision-making powers.

"**The necessary reorientation.** Improvement of drinking water supply and sanitation is, in general, the first priority for the population of the basins under study. But the price of water and the sanitation tax is not sufficient for a healthy management and the development of the services, while protecting the environment at the same time. Inevitably, river-basin authorities and municipalities will be faced one day with the need to "professionalise" the service and fix tariffs. This is the sector where European systems may bring about a significant contribution."

(Académie de l'eau, 2000a; our translation)

INTEGRATED WATER RESOURCES MANAGEMENT

A new concept was introduced in 2000: "integrated water resource management" (IWRM). This concept is widely used both in the Vision and the Action Plan. In the Action Plan, specific conclusions were identified, translated in terms of needs to be met in order to meet the objectives of the Vision; "Defined targets: Comprehensive policies and strategies for IWRM to be implemented in 75% of the countries by 2005 and in all countries by 2015." (World Water Council, 2000a, p. 57.)

To reach these objectives, there is a need for:

- National integrated water resource management (IWRM) policies, taking into consideration river basin management.
- Transparent and flexible national laws as a prerequisite for IWRM policy development.
- The participation of all stakeholders at all levels of IRWM, with special attention to gender and youth.
- The improvement of consultation structures and processes at all levels, especially at the local level.
- Better co-ordination and institutional strengthening to overcome fragmented responsibilities in the field of IWRM.
- The provision of additional financing, especially at the community level.
- Increased awareness and communication.
- More involvement of women in water management as important stakeholders, especially in developing countries.
- The formation of an inter-ministerial committee on gender. The reallocation of budgets in water projects and representation of women was discussed.
- Looking at models of IRWM, it is necessary to recognise the existing diversity present between different countries. In order to create conditions in which such models can work, appropriate incentives and the right balance between public and private sectors are needed. (World Water Council, 2000a, p. 56.)

The technical Advisory Committee (TAC) of GWP found it necessary to clarify certain principles associated with IWRM. A special document analyses the whole question (GWP, 2000a). IWRM is also addressed in the "ToolBox" developed by the GWP (GWP, 2000b): "The aim of the ToolBox is to bring together the global experience in an accessible and helpful compendium of optional approaches, to support the practical and effective development of IWRM."

But what is different with this IWRM concept compared to the traditional river basin approach and why was it introduced? The traditional river basin models tend to focus on water supply and pollution permits both associated with fees, according to the polluter-user-payer principle; this approach has some merits but also limitations as seen above.

> A second line of argument against the term "river basin management" is that often areas other than the river basin are important and, therefore, that integrated water resources management (IWRM) is a better term. In fact, as used in this paper, RBM is almost synonymous with IWRM. However, the term RBM emphasises the relation between water and land resources and the geographical and often international dimension (upstream-downstream). Moreover, the term RBM does not imply that all management should take place at the basin level or that river basins are closed systems or the only relevant geographical areas. It does imply, however, that river basins are important units that should be managed carefully, for the benefit of present and future generations. (Mostert *et al.*, 1999, p. 25.)

In order to better understand, but also to apply the IWRM concept, one should read some remarks formulated at the 1999 River Basin Workshop held in The Hague (Allan *et al.*, 1999). The authors insist on the fundamentally political dimension of water resources management; even though some of their comments may come as a surprise to some, this hidden face of water management is not often discussed as clearly. According to Allan *et al.* (1999), there are two requirements for the sustainable management of water resources:

> The first requirement of sustainable integrated water resources management is that the interest of the using sectors and communities are taken into account. Institutions that enable communication, contention and compromise are essential. Inputting hydrological and other scientific information is important but it is a relatively minor element in the process. Water managing outcomes are sometimes achieved without information and frequently through the political suppression of technical information. Political contention in not a medium in which technical information — hydrological, environmental and economic — will be given their proper due but this is the only medium there is. […] A second requirement of effective IWRM is that the role of water be considered in wider hydrological, ecological, economic, trading and socio-political contexts than the river basin and its hydrology. Water resource planning inspired only by the hydrological cycle, and the capacity of engineers to modify it, is a lethally narrow inspiration and a very unsafe foundation for water resource planning and policy making. (Allan *et al.*, p. 127.)

According to these authors, the concept of IWRM is solid but poses a real challenge for its implementation. The term "integration" will have to be clearly defined, mainly because results will be quite different according to the different scales to which it is applied. Moreover, "If the debate on integration is confined to the scientific and the engineering communities, the chances for integrated water management taking place will be small. Water is allocated in a political world where political logic prevails […]." (Allan *et al.*, p. 136.)

The IWRM concept introduced in 2000 focuses on the necessity to deal with water management from several angles at the same time, including the technical (surface and underground water) and the political, economic and social dimensions. This is a very global concept, maybe too global: the intention is quite valid as it forces the debate out of purely technical circles, but concrete implementation of IWRM, over and above the recognition of the value of the concept, may prove very difficult.

THE ECOSYSTEM APPROACH

Another approach, not directly linked to river basins, has been part of the debate on water for a few years now; even though the ecosystem approach is not limited in its application to aquatic ecosystems, it is considered as one of the holistic approaches and is frequently used in the context of sustainable development of natural resources. We will apply the ecosystem approach to river-basin management in this manual; it will even be our main integration platform.

In the Vision, a principle for water resources management, taking into account the integrity of ecosystem, is very present:

> All agreed at the outset that ecosystems must be conserved and restored in order to ensure sustainable water resources for humanity. However, water is not just a physical substance essential to human life, but is also the environment that supports all other living things. […] We must change thinking to recognise that ecosystems are the source of water. It is not a question of how much water to put back to conserve nature and biodiversity but how much not to take out in the first place. (World Water Council, 2000a, p. 52.)

The recognition of this principle represents not only a net progress towards the sustainable use of water resources, but it is the only possible pathway; however, it requires profound changes in the traditional technological approaches by which water was viewed exclusively at the service of humans.

In 1996, Environment Canada conducted an in-depth study on the ecosystem approach. This approach is largely applied in all major action plans dealing with Canadian large river and lake ecosystems.

Key Concepts of and Advantages to the Ecosystem Approach

The following are the key concepts of an ecosystem approach:

- Given that all components of an ecosystem (physical, chemical, and biological) are interdependent, 'resources must be managed as dynamic and integrative systems rather than as independent and distinct elements. Its practice means that all stakeholders understand the implications of their actions on the sustainability of ecosystems' (Wrona, 1994).
- The dynamic and complex nature of ecosystems requires that the ecosystem approach must be flexible and adaptive.
- The complex nature of the problems and issues within an ecosystem can be addressed only by the integration of scientific, social, and economic concerns; environmental research, planning, reporting, and management must become even more interdisciplinary.

Numerous advantages to the ecosystem approach have been identified in the literature […]:

- the focus is on the interrelationships among ecosystem components, which encourages integrated management of those components.
- the focus is on long-term and/or large-scale issues, which permits a more 'anticipate and prevent' strategy to management, rather than the more common 'react and cure' mode.
- the role of culture, values, and socioeconomic systems in environmental and resource management issues is recognized;
- and a mechanism is offered for integrating science and management.

(Canada, 1996, p. 2-3.)

One will find in the European Union Directive on Water a direct reference to the ecosystem approach: "(16)Further integration of protection and sustainable management of water into other Community policy areas such as energy, transport, agriculture, fisheries, regional policy and tourism is necessary." (European Union, 2000, p. 2.) This is a clear illustration of the fact that the principles of the ecosystem approach are now part of the international agenda.

We can conclude once more that the sustainable management of water resources will have to take into account the complexity of the systems themselves; simplistic approaches will not be sufficient.

LAND USE PLANNING

IWRM, as described in the Integrated Water Resources Management section, calls for coordinated management of natural resources within a given territory. In parallel with water management, a whole set of processes and approaches has been developed that we will group under the name of "land use planning". Is it possible to reconcile the two models, one terrestrial and one aquatic, superimposed within the same territory, the river basin?

The Province of Ontario attempted an experience in Canada; a series of practical guides was published in 1993 dealing with sub-basin management in the context of municipal land use planning. The excerpt quoted here presents a six-step framework designed for municipal planners:

> Municipalities have the legislative authority and political responsibility to undertake comprehensive land use planning which considers environmental issues. […] When ecosystem considerations are integrated into the planning process, it is more likely that land use decisions will not jeopardise ecosystem and human health. An ecosystem approach can result in economic savings by avoiding the need for costly remedial actions. An ecosystem approach to land use planning requires that boundaries for land use planning be based on biophysical boundaries as the context for examining the relationships between the natural environment and human activities. The primary boundary for an ecosystem approach to land use planning should be the **watershed**. This is based on using the hydrological cycle as the pathway that integrates physical, chemical and biological processes of the ecosystem. (Ontario, 1993, p. iv.)

The interest of this example among several others is that it reinforces the principles put forward by GWP and presented in the Integrated Water Resources Management section; the implementation of approaches based on integrated water resources management is only possible if concrete experiences are largely shared and adapted to the peculiarities of individual contexts. One might always think that both land use planning and IWRM could be reconciled at the basin level; but this also means an increased level of complexity because of the larger number of interested parties (institutional, political, social and financial) that will have to be dealt with.

INTEGRATED BASIN-WIDE MANAGEMENT

Before we move directly to the framework described in this manual, we would like to propose a definition of "integrated river basin management" used in the 1991 manual.

INTEGRATED RIVER BASIN MANAGEMENT

Integrated basin-wide management means that informed decision-makers take into account all uses and resources of the watershed, following an ecosystem approach. The overall goal is to ensure that human communities will benefit forever from the watershed through the development of harmonious relationships between users themselves and between man and river. Locally, integrated management requires the participation of all users, at appropriate levels; at the national and, even more so, at the international level, integrated basin-wide management has to take into account political and legal considerations.

(Burton and Boisvert, 1991.)

As mentioned earlier, the notion of integrated river basin management has been widely discussed, first at the Dublin Conference in 1992 and then at several international conferences, most notably, within the Vision exercise:

> To ensure the sustainability of water, we must view it holistically, balancing competing demands on it — domestic, agricultural, industrial (including energy), and environmental. Sustainable management of water resources requires systemic, integrated decision-making that recognises the interdependence of three areas. First, decisions on land use also affect water, and decisions on water also affect the environment and land use. Second, decisions on our economic and social future, currently sectoral and fragmented, affect hydrology and the ecosystems in which we live. Third, decisions at the international, national, and local levels are interrelated. (World Water Council, 2000, p. 1.)

We believe that the definition proposed in 1991 is still valid in 2000 and its basic principles are:

- *The river ecosystem notion*: this is a system built on multiple interrelationships that evolves over time following its own rules. All actions within this system will cause reactions of a more or less complex nature. Water is limited both in terms of quantity and quality; the allocation to multiple uses, including nature's needs, is the real management challenge.
- *Man is part of and depends on the system*. We have to find ways to ensure sustainable development while avoiding conflicts between humans but also between man and nature. We must bear in mind that man does not manage the river basin but, at best, manages his activities with respect for existing resources and constraints of the basin.
- Finally, *users participation* must be ensured in order to achieve a sustainable use of natural resources, notably water. For international basins, the political and legal dimensions are particularly important.

But what about the integration of surface and ground waters? Links do exist between these two worlds, particularly through the aquifers; but, on a daily basis decisions are rarely made by the same institutions, and, moreover, information is generally not sufficient to establish clear links between these two realities. In the course of the seminars (Part Two of the manual), we will limit ourselves to surface waters using a basin-wide approach. Nevertheless, ground water will have to be taken into account in terms of the satisfaction of population needs, mainly for water supply and agriculture; moreover, ground water is important for the integrity of wetlands distributed throughout the basin.

Finally, here are a few attitude changes required for the application of an integrated river basin management approach:

- Integrated management implies taking into account all users and resources of the basin.
- We cannot manage resources on a sectoral project basis any longer, one at a time, every funding agency acting independently from another within the same basin.
- A more global framework is needed if we are to avoid the negative impacts of a project on other resources and in order to take into account upstream-downstream aspects.
- This is even more important for international basins where development choices may differ from one country to another.
- This kind of "master plan" approach does not require that everything be defined in detail; rather, it should focus on global considerations and development choices accessible to political decision-makers.

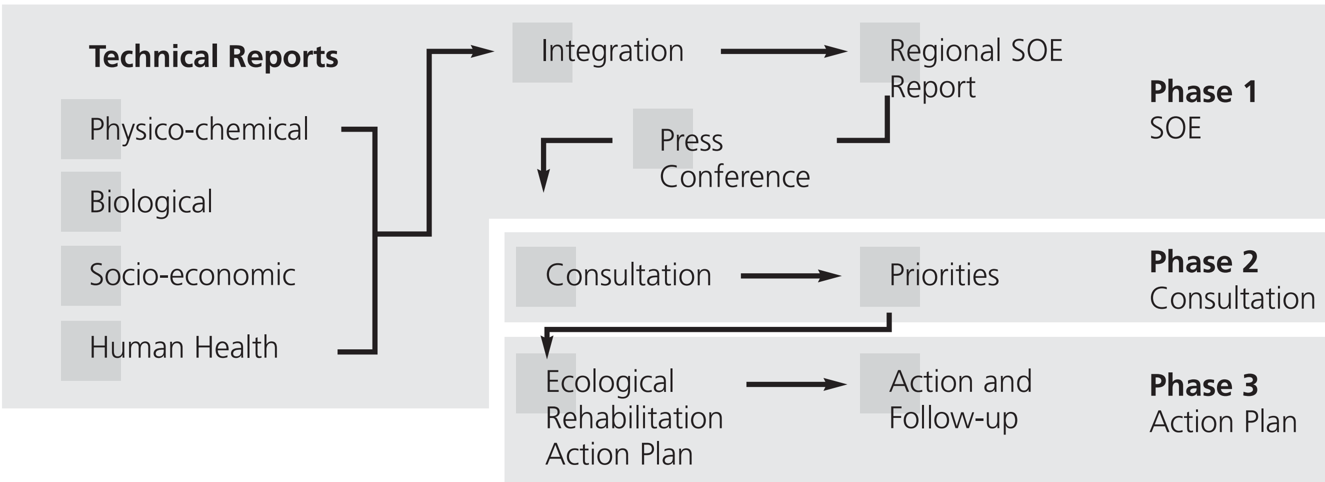
The Origin of the Framework

The river basin management framework proposed in this manual was originally developed for the St. Lawrence River, as the basis for the collection and integration of information for a programme called "Zone of prime concerns" (ZIP: the French acronym). The ZIP programme is above all an awareness programme aimed at the development of public consultation and participation processes as a support for actions on a local scale. This programme is part of a much larger programme — the St. Lawrence Action Plan — in place since 1988. The challenge was to design a framework for the gathering of existing information distributed among several governmental institutions and to integrate this information in a coherent synthesis useful to local communities; a framework was designed for this very purpose and applied in the field (Burton, 1991).

The first task consists in the definition of the limits of the territory for each ZIP. Three types of limits are used: the hydrological limits (hydro-zones), the biological limits (biogeographical regions), and the administrative limits. The final definition of the ZIP takes into account the limits of the riparian municipalities in order to be able to include socio-economic information from municipal sources. Within each ZIP, technical reports are produced for the specific area so as to present a diagnosis of the current situation. Four technical reports are prepared dealing with the following aspects: physical and chemical, biological, social and economic, and human health. These sectoral documents are finally integrated to produce an integration paper presenting a synthesis of the state of the ZIP. This is the document submitted for public consultation at a public hearing; the community is invited to comment the state of the environment report, to identify its own priorities and to define the roles of each group of stakeholders for future action. A local action plan is developed by the community to be implemented according the available resources. (Burton, 1997; Figure 4.)

FIGURE 4

The ZIP Programme



This process is applied on successive river stretches, from upstream to downstream; the river continuum is taken into account by the inclusion of the mass balance of inputs (water quality) at the entrance of each stretch of river.

The Proposed Management Framework

From the model applied to the St. Lawrence River, we developed a broader, more comprehensive framework that was subsequently adapted to the African river ecosystems (Figure 5; Burton, 1995b). The management framework will be described in detail in Part Two of the manual.

Available information is the cornerstone of the process. The challenge is to establish a diagnosis of the current situation and define issues without waiting for everything to be known. This framework is based on sound scientific judgment and common sense.

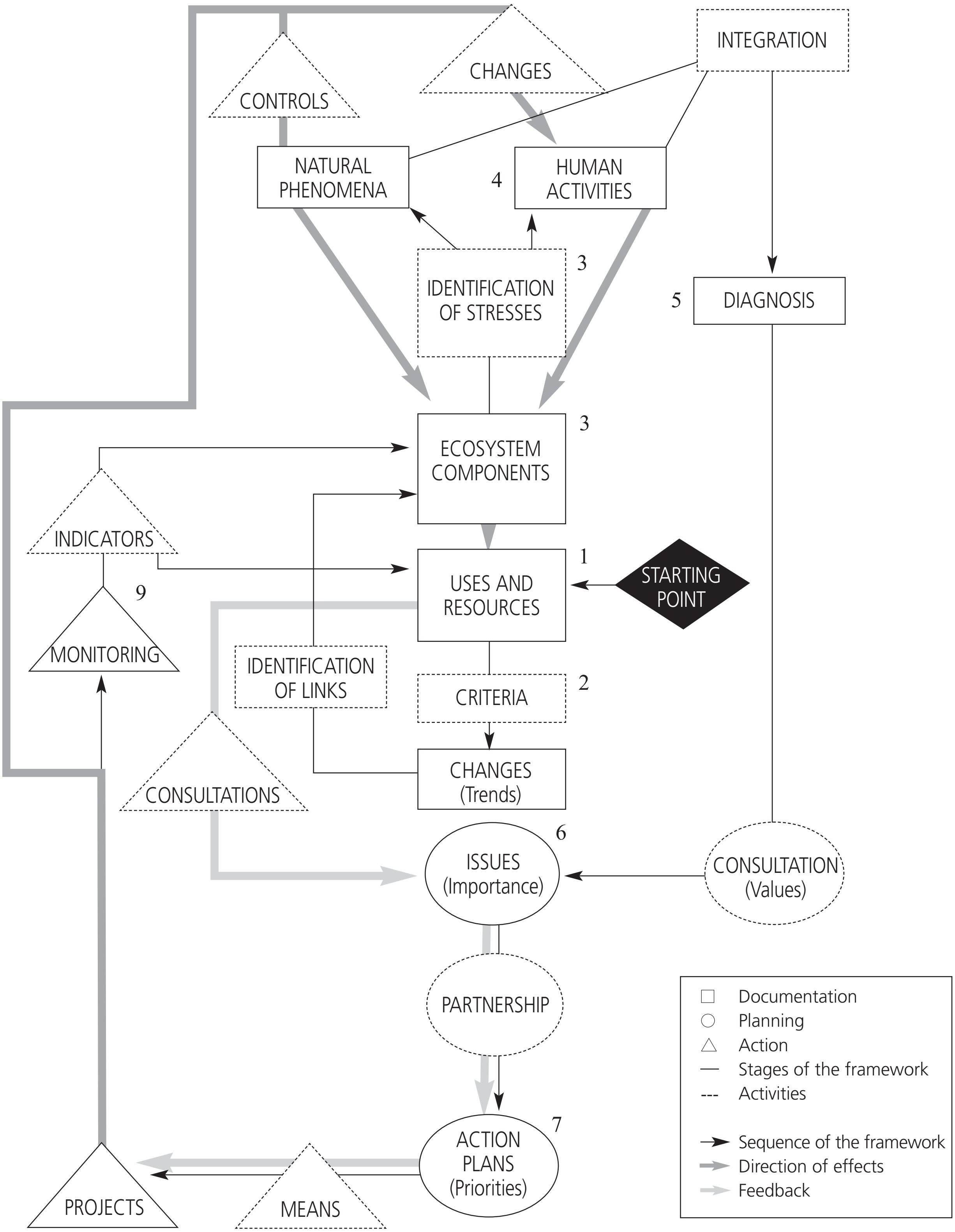
The process is in three phases: documentation, planning, and action (Figure 5). We will not attempt to analyse the framework in detail for the moment; what must be remembered is that it consists of three phases illustrated graphically by a different geometric figure. The complete framework consists of nine successive steps with a loop at the end allowing for some feedback once all steps have been completed.

The first phase, Documentation, seeks to gather and evaluate the relevance of information that can be used to identify the problems specific to the uses and biological resources of the territory under study. It takes place in several stages, from the description of the current state of uses and resources to the establishment of a diagnosis (Stages 1 to 5).

The second phase, Planning, seeks, through public consultation and dialogue among partners, to define the action to be taken to solve problems deemed to be high priority. It is in two stages: identification of issues and definition of an action plan. The process now moves away from the closed circles of government and research and opens up broadly to society itself (Stages 6 and 7).

The third phase, Action, puts in place the necessary means and ensures that the projects yield the anticipated results, with planning and projects being revised, if this is not the case. Action consists of two overlapping stages: the projects themselves (whose scope can vary in time and space), and monitoring, which measures the effects of the action (Stages 8 and 9).

FIGURE 5
The Integrated River Basin Management Framework



We now present two basic concepts that underlie the entire framework.

Starting point

Uses and biological resources are the starting point for the overall management framework for four reasons:

- They are the real reasons for action, an attempt to maintain or recover uses while conserving resources;
- These notions involve a very broad range of players who have to share common resources;
- Numerous administrative structures are defined on the basis of the management of uses or resources;
- These notions are concrete, easy to document and of direct interest to managers and users.

The more traditional starting point would have been the water resource inventory, before planning, and once all allocations have been made in the most important sectors (agriculture, domestic uses and industry, etc.). We have decided to initiate the thinking by paying attention to the diversity of water uses, in order to project a more realistic image of the complex relationship between man and water within the basin. The sensitive issue of defining priorities is not resolved as such, but it will be more easily addressed with a better understanding of the diversity of those implications. We should point out that an exhaustive inventory of all water uses could be quite fastidious if one tries to describe everything in detail. But completed at the right level of detail, the inventory of uses will allow for the identification of non-predicted consequences of allocation decisions for specific user groups; indeed, whatever the abundance of water, conflicts can emerge in a particular region or at a given time of the year.

Ecosystem

This level of synthesis is essential: it is not enough to limit oneself to uses and biological resources, for the following three reasons, at the very least:

- Changes cannot be explained without sound knowledge of ecological phenomena;
- By undergoing this level of synthesis, several phenomena may be explained at once;
- By putting in place some measurement tools, ecosystem changes can be identified before the effects are felt in terms of uses or biological resources.

We refer here to the definition of the ecosystem provided earlier (see section on Ecosystem Approach), that of an organised system made of physical, biological and chemical components. The system is very complex and it will not be possible to analyse it in details, but we know some of the basic components. This first level of integration allows us to pool a wide variety of water uses within a functional system that has evolved over time.

Finally, depending on the complexity of the project and the scale of the management task, the framework can be shortened. Here are two remarks on this subject:

Minimum path

In each of the three phases of the framework, certain controls are essential if the process is to remain valid:

- In the Documentation phase, the list of problems must provide, for each use or resource affected, an explanation of the causes of these changes;
- In the Planning phase, the action plan must provide possible solutions for each problem identified;
- In the Action phase, the monitoring of effects must make it possible to assess whether the objectives are attained.

Avoid an impasse

During the process, certain circumstances may represent an impasse for the overall framework. In some cases there is no choice; we will have to use data from elsewhere and adapt it (margin of error). The missing information will have to be collected as quickly as possible, without postponing the planning exercise excessively. Data on quality is often harder to obtain than that concerning the quantity of a use or resource. Data acquisition programmes should be put in place from the start of the exercise, once the deficiencies are identified.

- In the Documentation phase, there is an impasse if the information is lacking (criteria, valid quantitative data). In this case, we are left with "opinions" rather than verifiable facts.
- In the Planning phase, the impasse may stem from the absence of consensus with respect to the issues (consultation) or priorities (partnership). Negotiating agreements brings solutions in the longer term rather than imposing choices; urgency is often the only rallying point.
- In the Action phase, the lack of means is an impasse requiring immediate attention. At the same time, the lack of concrete results, despite the means provided, represents an impasse that must be rectified as soon as possible through revised planning and a reallocation of these means.

We should keep the discussion on the two previous points (minimum path and impasse) for the end of the planning exercise (or the end of the seminar). This comes as a global observation flowing from the intrinsic limits of the basin management framework, either because of the scale and complexity of the project or the limited means available.

KNOWLEDGE

We use the term "knowledge" in the broader sense, including scientific information (research and monitoring), traditional and popular knowledge, and stakeholders' experience. The main foundation for integrated water resources management is existing knowledge of water resources, both quantity and quality, water uses, and characteristics of the aquatic ecosystems within which human activities and natural phenomena should coexist in a sustainable manner.

> River basin management is a complex task. Therefore, instruments that help to assess the present situation and assist in the development and evaluation of solutions may be important. Two types of support can be distinguished; support of operational management and support of strategic policy-making and planning. A second distinction is between (support) systems for monitoring, data collection and processing, oriented towards making facts and figures about the "as is" situation available; and tools and systems to support decision-making with a view to the future, typically oriented to the "ex ante" identification, analysis and evaluation of alternative allocations, policies or plans. (Mostert *et al.*, 1999, p. 36.)

As we can see, information needs are varied and do correspond to different management processes. In fact, the management framework proposed in this manual is less focused on operational management than on strategic planning exercises and policy development. We will pay special attention to the knowledge sources that will allow us to produce a diagnosis, the operation at the very base of the framework, in a basin-wide planning exercise.

Even though the importance of knowledge is unquestionable as part of such a management framework, information gathering is not an end in itself; the importance given to information has to be put into the context of all other inputs in the management process.

> Inputting hydrological and other scientific information is important but it is a relatively minor element in the process. Water management outcomes are sometimes achieved without information and frequently through the political suppression of technological information. […] Political contention is not a medium in which technical information — hydrological, environmental and economic — will be given its proper due but this is the only medium there is. (Allan *et al.*, 1999, p. 128.)

We will discuss knowledge under five aspects: definition of information needs, monitoring programmes, information management, integration of information and the use of expertise.

DEFINITION OF INFORMATION NEEDS

> A successful and acceptable watershed plan need not collect extraordinary amounts of information on the watershed ecosystem. The planners, in conjunction with the technical resource experts, need to determine what information is needed to meet the planning and management needs of that watershed. This means what kind of information and <u>at what level of detail</u>. Before this can be done, the planning team needs to know, in broad terms, what they are looking for. They can limit information gathering on the basis of a <u>realistic</u> assessment of the biophysical information on the watershed required to formulate <u>realistic</u> goals. This is not really a tall order. […]
>
> Next, an important exercise for the planning team is to determine a) what information is already available, and b) what must still be collected. Much valuable information exists in previous watershed studies and as results of provincial agency activities; it is recommended that these sources be consulted.
>
> If it is determined that further information is required for a proper picture of the watershed, the following questions may provide useful criteria for limiting the scope of information gathering:

> What information is really needed to:
>
> – Further refine the watershed management goals?
>
> – Improve knowledge of the watershed ecosystem?
>
> – Ascertain management practices that will be effective?
>
> – Define and prioritize sub-watersheds?
>
> To what extent could decisions be made better by what improvements in the information available?
>
> How might information be improved through different types of monitoring and studies? What are the costs and time required for such studies?
>
> This is an important exercise. Scoping or focusing the information gathering required can significantly reduce the costs of plan development. It can lead to a better plan because all the information is relevant to the formulation of goals for the watershed. All this can result in more efficient management and thus less cost later.
>
> Participants should bear in mind that it is not necessary to gather as much information as possible, but rather to determine the knowledge that is required **to get the job done**. (Ontario, 1993, p. 18-19.)

This is one of the main foundations for planning, and in the case of river basin management the necessary information will come from a large variety of fields and sectors. In view of this reality, results will be uneven, some sectors or fields being better known than others; this aspect of the reality was clearly described in the case studies presented at the 1995 Cabourg Workshop (ACCT, 1995). Human uses and activities within the basin are generally quite well known; information on biological resources is more superficial. In the case of water, quantitative aspects are better described than qualitative aspects. There is very little information on sediments and natural habitats, also described in a superficial manner. Rainfall is the best described of the natural phenomena. Finally, there are generalised deficiencies in terms of spatial and temporal coverage of the basin.

MONITORING PROGRAMMES

Monitoring programmes can be put in place for several reasons: to provide information on the status and trends of the aquatic ecosystem, to offer real-time information for decision-making, to ensure that water quality meets prescribed standards for several uses, or to control the efficiency of interventions. Monitoring may have a single objective (acid rain monitoring) or it may monitor several aspects at the same time as with the general ecosystem health monitoring. The territory to be monitored can correspond to the whole basin or to any segment, since monitoring activity is designed to satisfy the needs of the institution in charge. In all cases, monitoring implies the gathering of data based on a predefined list of parameters, according to standard protocols, with fixed time frames and at fixed sampling stations, etc. In order to gather the data considered necessary according to the monitoring programme's objectives, we will pay special attention to water monitoring programmes and, more specifically, to water quality monitoring programmes. But let us keep in mind that monitoring is conducted in a wide variety of sectors associated with the environment and also within social and economic parameters.

Water monitoring programmes were analysed by Ongley (1997), particularly through his work with the GEMS/Water programme.

> A common observation of water quality programs is that they tend to be inefficient, the data is of uncertain reliability, program objectives are poorly linked to management needs for data, the analytical technology is often old and inefficient, the focus is on water chemistry even though water is known to be a poor monitoring medium for toxic chemicals, and databases are incapable of mobilization for management purposes (Ongley, 1993). The concept of program efficiency includes consideration of all these factors, ranging from appropriate selection of parameters and sampling medium, to institutional inefficiency. It has legal and regulatory implications, especially when the regulatory framework imposes rigidity and prevents the use of more cost-effective field and analytical methods. However, the greatest inefficiency tends to lie in the assumption that conventional water quality monitoring programs produce data that can be used to make managerial decisions on pollution control, water resources planning, and related investment decisions. The fact is that such programs are designed mainly for descriptive rather than prescriptive purposes, with the result that nations tend to spend a great deal of money producing data not closely linked to decision-making and, not infrequently, not used at all! (Ongley, 1997, p. 2.)

Ongley (1997) proposes a whole list of activities aimed at monitoring programme modernisation; these activities touch upon the legal and institutional dimensions (role of governments, management commitment to change, regulatory standards modification) and more technical aspects (laboratory programmes, new diagnostic tools, quality assurance and control).

On the issue of monitoring relevance, Ward (1996) quite judiciously argued that we should define the information needs first and then proceed with the design of the monitoring programme. It is unacceptable to gather information, then to ask ourselves what it means. Even though this approach is quite logical, the author points to the fact "that some monitoring programs are unable to document the water quality information produced in a manner that will satisfy the public and its elected representatives". An ill-conceived monitoring programme focuses on data gathering not on information generation; on the other hand, in a well-designed programme, information objectives guide the definition and execution of all monitoring activities.

Ongley (1997) has observed similar situations:

> Database and information systems in most monitoring agencies in developing countries are not efficient and are not effectively used for information processing, analysis and visualization of data, and decision-support functions. This has two types of implications – one is that data is not easily accessible for management purposes. The second is that water quality programs remain largely invisible because of the lack of highly visible data products; the result is often that such programs fail to win managerial and political support. (Ongley, 1997, p. 7.)

Monitoring programmes can provide more than an information base for planning; they can also be used to evaluate the relative success of interventions conducted in the course of river basin management.

> There are two major components to monitoring: monitoring the success of the plan, achievement of its goals and objectives (response of the system to the implemented plan); and monitoring the performance and success of the tools used to achieve the objectives developed by the plan. Implementing the watershed management plan will require monitoring data for a variety of uses. It is important to remember that **monitoring programs need not all be sophisticated or highly technical**. Sometimes, observation will suffice. Local citizens can be enlisted to watch for and report the status of changes in environmental conditions. This will provide the public with a tangible opportunity to participate in achieving the watershed plan's ecosystem objectives, and thereby, the integrity of their own surrounding environment. It will also probably reinforce and maintain interest in the plan's success in achieving its management goals. […]
>
> As well, it is important to note that **monitoring need only be applied to issues or conditions in the watershed that the plan has identified**. […] If monitoring reveals successful initiatives, these should be documented and shared with agencies that might benefit from this knowledge. (Ontario, 1993, p. 29-30.)

Two major books have been published to cover in detail the whole question of water monitoring; this results from the collaboration between UNESCO, UNEP and WHO: Chapman (1992), and Bartram and Ballance (1996). We should also mention the water quality monitoring programme under the Global Environmental Monitoring System (GEMS/Water):

> The GEMS/Water programme is a multi-faceted water science programme oriented towards understanding freshwater quality issues throughout the world. Major activities include monitoring, assessment, and capacity building. The implementation of the GEMS/Water programme involves several United Nations agencies active in the water sector, as well as a number of organizations around the world. (GEMS/Water, 2001.)

Moreover, in 2000 UNESCO announced another initiative, the World Water Assessment Programme (WWAP), with a prototype report released in 2003. The objective of this vast project is to establish the state of the world water resources. Database from the United Nations, national agencies, universities and research centers, and of commercial sources will be integrated in a vast data management system in order to develop indices applicable both at global and local levels.

One will also find in the European Community Framework Directive on Water (European Community, 2000) a complete monitoring programme to establish the status of water resources (Article 8 and Annex V). This programme implies the characterisation of water quality based on physical, chemical and biological parameters and concludes with a classification of the ecological status of water bodies using standard definitions. Clearly, the list of parameters will have to be adapted to local conditions; nevertheless, the classification of water bodies according to general quality (high, good and moderate) provides all member states with a valuable approach to decision-making and is applicable in a larger context (Appendix 3).

Finally, we would like to mention that technology has revolutionised this sector of activity, mainly by changing the spatial levels at which it is now possible to design monitoring programmes. Remote sensing now allows for the monitoring of phenomena at levels unthinkable before, at very reasonable cost; either through satellite imagery or with airborne surveys, we can observe rapid changes (bushfires) or slower-paced phenomena (coastline erosion) on a national, regional or even global scale. An introduction to remote sensing is available in Canada (2001); in a language that non-specialists can understand, the tutorial presents basic principles, techniques for image acquisition and diverse utilisation of remote-sensing data.

INFORMATION MANAGEMENT

This is one of the problem areas most often brought up by managers interviewed during the 1996 West African field mission (Burton, 1996, p. 16-17). We will use this as an example of the point to be made, while being convinced that the same situation exists elsewhere as it has been discussed at every meeting held under the Large River Management Project since 1990. Under the heading "information", we will be referring to scientific data (databases, maps and GIS, government documents, national statistics, etc.) and to the local knowledge that is an often-neglected source of information.

As a general observation, we can say that even though information is abundant in West Africa, it is hard to obtain and, moreover, not well synthesized.

On the local level, Senegal's CAB is a good illustration of this type of need. The goal is to create an information unit to bring together basic information on selected territories and give local decision-makers and technicians working with local populations access to the essential elements thereof: land registry; soil maps, vegetation maps, maps of sub-drainage basins; and topographical maps with administrative boundaries and infrastructures.

Needs were probably most clearly expressed at the national level. The first consideration is the general condition of water databases. Even for major rivers, data gathering and processing networks need to be rebuilt. Several of them, using automated data collection platforms installed by ORSTOM, broke down for lack of money to maintain them. In Mali and Mauritania, consideration was given to installing a limited number of measurement stations where a local observer would make daily radio contact to send in data. There is solid expertise in the various water resources departments and an approach well set to the needs and means of the region could be developed by convening a forum of all concerned.

The quality and availability of cartographic media vary considerably depending on the country and the subjects being dealt with: the scale is often inappropriate for a particular application; and especially the information is generally out of date. What is equally regrettable is that there is no directory of maps already produced by the various projects. In some parts of West Africa, there is no dependable geodesic base; a project called AFRICOVER was launched by FAO to overcome this difficulty, but no funding source was found for it in West Africa. However, several national mapping centres have already been set up: CSE in Dakar, ITC in Conakry, IGB in Ouagadougou and AGRHYMET in Niamey have all developed expertise with international aid. The challenge now is to capitalise on these achievements and to encourage the greatest possible use of services available through these centres before considering developing new capacity in GIS, which is scattered throughout the national and regional administrations.

West African documentation centres do have large collections, but these do not circulate very much beyond their walls. Librarians must be trained and computer equipment acquired, notwithstanding the large investments made by IDRC and BIEF over the years. The chief hindrance to document circulation, apart from the librarians' extreme caution in lending them, is that no efficient communications network has yet been implemented to link all the centres; they do, however, all use the same software (UNESCO's CDS-ISIS), so that exchanges should be possible.

To conclude this section on information management, we could refer to Mostert *et al.* (1999, p. 36):

> At the level of operational management many analytical tools have become available. In most river basins ambient monitoring is carried out on a routine basis and the results are stored in databases. A major challenge is the homogenisation of the monitoring and analysis methods used by different institutes, especially in international basins. A second challenge is to make the information available to anybody involved or interested. Developments in database technology, often in combination with Internet applications, can provide powerful tools for data retrieval. The application of such technical possibilities is, however, often severely constrained by institutional/political reasons, especially in the field of water quality monitoring.

INTEGRATION OF INFORMATION

Nowadays, there are several worldwide technological developments that facilitate the integration of information for management purposes. Geographical Information Systems (GIS), for instance, have seen accelerated development over the last few years. This data processing system can illustrate and analyse a wide variety of phenomena as long as all data is geo-referenced. It is then possible to integrate land, sectoral and environmental maps. The GIS will then develop several layers of information and calculate overlapping areas.

But beyond a technical support system like the GIS, the integration of information for management purposes is still a methodological challenge. Nevertheless, some progress is being made; for instance, in West Africa, the "State of the Environment Report" approach is being developed in Senegal and Burkina Faso at the national level.

The "master plan" seems to be the tool most used in natural resource management; it may be sectoral (agriculture, fisheries) or multi-sectoral (master plans for the basin, the sub-basin or administratively delimited territories). For some years now, however, master plans have been proliferating (National Action Plan on the Environment, National Anti-desertification Plan, etc.) and have resulted in some degree of confusion; various plans overlap, are generally frozen in time, and subject to oversight by a large number of administrators and donors. As a planning tool, the master plan is, in theory, very well understood. This was clearly demonstrated by the case studies presented at the Tulcea Workshop (Romania) on "Master Plans to Better Manage Rivers" (Réseau International des Organismes de Bassin, 1996). Several models have been developed over the years: for instance the model developed by the French Water Agencies at the river basin level (SDAGE); this model is then adapted at the sub-basin level (SAGE), complemented by the "river contract" model (France, 2001a and 2001b).

Our findings in West Africa point out the difficulty of integrating information in the same management document at a national level (Burton, 1996). The needs identified at the regional level are similar. It should be noted here that standardised information support must be used within a given river basin, and ideally throughout West Africa. Information collected by the RBOs comes mainly from the member countries and they can only produce an analysis if data sets can be integrated. In mapping, standardised scales and classifications are needed; hydrometric networks need to be designed to basin scale to be really useful; and basin master plans, too, will be based on approaches defined by states. Therefore, it is vital that RBOs work closely with the states. More rigorous approaches are needed to harmonise all of the sectoral plans prepared within a given river basin in order to develop a genuine management instrument at basin scale.

In order to apply an IWRM approach, let us not forget that it is necessary to integrate not only environmental information but also information from the social and economic sectors. This aspect of the integration challenge is rarely addressed by scientists but is a reality that managers must deal with daily.

> Integration means developing the capacity to gather and disseminate transparently hydrological data that are gathered by methods of sufficient precision to be legitimate. Transparent hydrological information will be subject to interpretation by professionals from political entities with very different interests. Integration of these contending views will be brought about by a (political) process involving contention and compromise over how water is allocated. (Allan *et al.*, 1999, p. 135.)

EXPERTISE

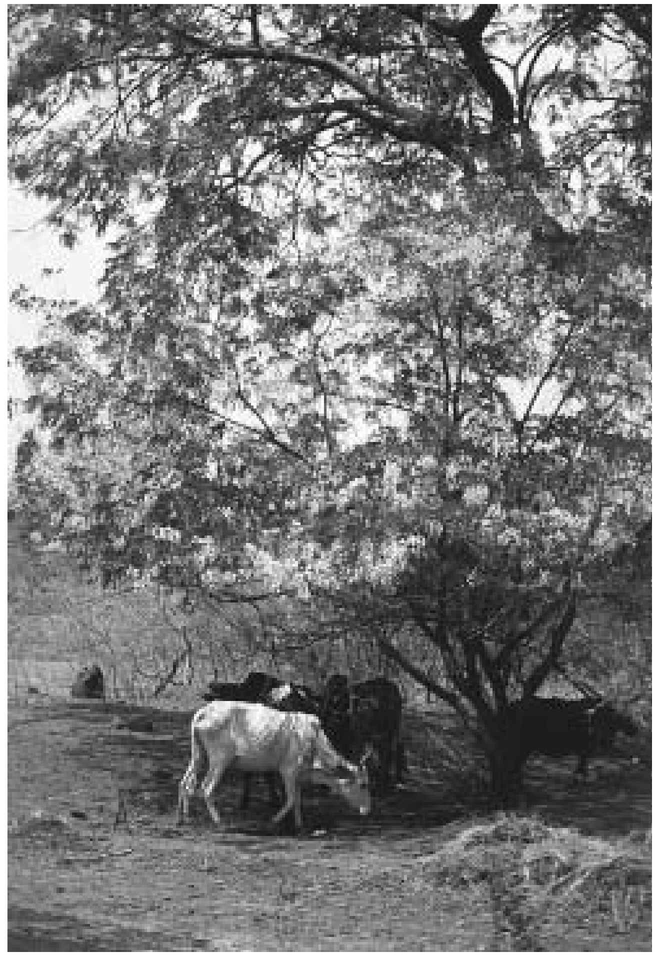
The necessary knowledge to apply an IWRM approach is not limited to scientific data gathering and technical reports published by government institutions. In several areas, particularly at the local level, "official" scientific and technical information may be seriously lacking. On the other hand, a large knowledge and know-how base exists but is not readily retrievable through traditional information research methods; this includes popular and traditional knowledge, but also the expertise of professionals involved in projects and programmes at local, national and regional levels. We will focus for now on the professional expertise, as the traditional knowledge issue will be dealt with in Chapter 4 as part of the discussion on users' participation.

We believe that high quality expertise exists in local, national and regional institutions. We have been able to verify this throughout our own fieldwork over the years. Moreover, results of the six seminars organised in 1992, 1993 and 1995 clearly demonstrate this; in cases where information is not complete, disparate and poorly integrated, a group of experienced managers can produce a valid diagnosis, identify priorities and design a realistic action plan within a short period of time, if a simple framework is provided to guide them.

Why is it then that this large basin of professional expertise that exists within public institutions and NGOs is not better used? The first difficulty resides with the identification of keypeople, those who have an expertise that can be shared. A directory could be prepared but this is not an easy task. Inevitably, the list would be incomplete, the entry in the directory could not be considered an official recognition of individual competence and designation of the field of expertise would prove challenging since one individual could very well be identified under several categories. The concept of an evolving list of contacts, managed by an independent organisation through service contract allocation, could be used as a starting point for the recognition of local expertise. Most likely, because of the vast mobilisation of professionals in the Vision process, contacts have been established and an international movement in favour of the recognition of local expertise will be initiated, mainly for developing countries.

The second issue has to do with the use of expertise on a daily basis. An increased presence of national expertise in internationally funded projects is necessary. Networks could be set up, by sector or by region, to provide an interesting list of experts that could be called on for planning and implementation of local, national or regional projects, in collaboration with international experts and funding agencies.

This problem was widely discussed by most of the professionals interviewed during the 1996 needs analysis mission to West Africa (Burton, 1996). It was also discussed more widely on several other continents (Burton, 2000; Burton, 2001a). In fact, this is one of the orientations from the GWP Action Plan in terms of IWRM that aims at a better exchange of experiences at the international level (GWP, 2000a). This question is at the very centre of the capacity building notion and we will get back to it in the chapter on Conditions for Success.



PARTNERSHIP

Integrated water resources management calls for, as seen earlier, taking into account a wide range of uses which have to be reconciled while maintaining the natural functions of the river ecosystem. Until now, management has been shared between multiple actors and is generally conducted by sector of activity; IWRM requires rethinking the institutions but also other parties who will have to be part of the unavoidable consensus.

> The challenge is to promote peaceful co-operation and develop synergies between different uses of water at all levels, whenever possible, within and, in the case of boundary and trans-boundary water resources, between states concerned, through sustainable river basin management or other appropriate approaches. (World Water Council, 2000a, p. 53.)

This chapter will deal first with the institutional aspects, at the national and regional levels, before looking at international actors. We also touch upon, though very briefly, the legal aspects associated with the creation of river basin organisations.

DEFINITION OF ROLES

> Effective institutions are essential for the planning and implementation of water policy reform. However, water institutions tend to be too numerous, unwieldy and resistant to change. In many countries, water management is dispersed over several ministries and agencies without adequate mechanisms to co-ordinate and reconcile needs and uses. This fragmentation reinforces the potential for conflicts between sectors over the use of water resources. Reviewing and evaluating water institutions is a major challenge, complicated by the fact that they are enmeshed with many other agencies and political groups. (GWP, 2000, p. 31.)

As we saw earlier, water resources management is also a political phenomenon, and in this sense

> […] there must be a voice for water at the highest political table; water resources must be an area where senior statesmen are active and informed, as they are when it comes to other natural resources of major significance to the national economy. (Allan *et al.*, p. 133.)

So, the role of governments is to create an environment which is favourable to integrated water resources management. Governments alone can formulate national water policies, enact water resources legislation and encourage the dialogue with the neighbouring countries in the case of international accords (GWP, 2000c, p. 6).

We then have to ask ourselves the following question: Does IWRM require the creation of an institution specifically dedicated to this purpose? The answer is, not necessarily.

> Nationals from some countries often argue that there is no basin management in their country. What they really mean is that no river basin organisations and no integrated, basin-wide, planning exist in their planning. However this paper does not treat river basin organisations and planning as synonymous with RBM (river basin management), but rather as a means to implement RBM, together with for instance informal co-operation. (Mostert *et al.*, 1999, p. 25.)

This issue was also largely discussed at the 11th Stockholm Water Symposium at a workshop dedicated to river basin management. The consensus is that it is not necessary to create an institution to implement the IWRM, as coordinating bodies are able to achieve the same goals in some countries.

> Integrated management requires that some functions be permanently assumed in a complementary and coherent fashion over the whole territory. […] It is all these functions as a whole that need to be organised in a durable manner and for which funding for investments and operation has to be mobilised and guaranteed whatever the modalities. All these functions are never taken on by one single organisation and the most frequent formula, within a given territory, is the coexistence of multiple mandates and initiatives, individual or collective, public or private. A consensus has to be reached. (Donzier, 2001; our translation.)

Therefore, we should think in terms of "functions" before we discuss the structure of a river basin institution.

INSTITUTIONS

Several collective water management formulas have been implemented, based on cooperation principles, in different regions of the world, some dating back to the 12th century in Europe, and some even earlier in pre-Colombian America and the Middle East. At the very base of these arrangements is a management function for a common resource and which guarantees its longevity. Based on these successes, is it possible to envisage that IWRM could be adopted more widely nowadays?

Alaerts (1999) has produced a detailed analysis of different types of river basin institutions. The author very clearly indicates that

> The arguments for a win-win situation are rationally convincing, and one could expect that the current dramatically increasing scarcity of water of good quality would only lead to a precipitous establishment of more basin institutions. Yet, this is not the case. Clearly, the broad introduction of river basin management hits a number of fundamental institutional constraints. The fact that there are examples of (sub-basin) water management may obscure the effort required to achieve that goal. Many of the collective arrangements often had an exceedingly long and problematic development history. (Alaerts, 1999, p. 141.)

The same author concludes:

> In short, despite the demonstrable gains that can be obtained through river basin management, in most situations this cooperative mechanism does not develop automatically. An institutional disconnect appears to exist where "conservative" forces manage to delay the establishment of institutions for collective action. (*Ibid.*, p. 142.)

Therefore, there are constraints to the implementation of collective management mechanisms and they should not be underestimated. But this is no reason not to move ahead with actions. Institutions responsible for river basin management can take different forms; several hundred basin organisations, created using a large variety of models that clearly illustrate the variability of roles and structures, exist around the world. There are some 20 institutional arrangement models currently in use. According to Alaerts (1999, p. 149),

> Depending on the external variables, the basin agency could assume a minimal set of functions or a maximal one. Most existing basin arrangements fall broadly into two categories: (i) those where the agency has a small staff complement (50 to 100) and is concerned primarily with policy, planning, and coordination; and (ii) those where the agency in addition assumes substantial executive and (infrastructure) operational tasks, and disposes of a large technical staff.

The author then presents in table format an interesting comparison of the functions of the two basic institutional forms, the "Secretariat" and the "Authority".

We should not look for an ideal model suitable to all situations; moreover, what really counts is the implementation of efficient mechanisms for cooperation. In a given context, this coordinating function will be better assumed by a single organisation, while, in other environments, the very establishment of such an institution would create such opposition that the primary objective could not be reached. The recognition of this diversity principle is clearly applied in the European Community Water Directive (2000, p. 8):

it is the responsibility of the member states to designate the "appropriate competent authority" that will be charged with the implementation of the requirements of the directive within individual river basins. There are no mandatory models but rather a list of defined functions to be assumed by these organisations that will have to be described in terms of their territory, legal status and responsibilities.

INTERNATIONAL BASINS

It is estimated that two thirds of rivers are trans-boundary, roughly 263 around the world, not including rivers that cross jurisdictions within federal countries. We could establish a parallel with the challenge at the national level; it is not because several organisations have been in place on large international river basins, sometimes for several decades, that the importance of disagreements on water sharing can be underestimated. Here again, the sharing of water resources will result more from cooperation than conflicts.

COOPERATION IN INTERNATIONAL BASINS

- *Confidence building*. Countries that share international rivers usually start with low-level technical cooperation that focuses on exchange of data, or jointly gathered data. International river commissions, with regular meetings of national representatives and a small technical secretariat, often serve this purpose.
- *Cooperation*. As mutual trust and confidence increase, and as issues appear that concern all parties and can be more effectively addressed through collective action, the level of cooperation gradually grows to a point where countries are willing to undertake joint action or allocate more significant resources.
- *International agreements*. After years of successful cooperation, lengthy negotiations are usually required to reach bilateral or regional agreements. Such agreements seldom address the (theoretically desired) comprehensive integrated management of water resources, but focus on specific issues of hydropower, navigation, or environment. Where the interests of upstream and downstream countries diverge sharply over specific issues, it is not unusual that agreement is reached in a wider framework involving cross-border trade or involving other issues that allow agreements in every party's interest.
- *International law and alternative dispute resolution*. Once international agreements have been established, conflicts can be addressed through formal (judiciary, international law) or alternative dispute resolution mechanisms (mediation, arbitration).

(World Water Council, 2000, p. 44.)

Mostert *et al.* (1999, p. 38) have also addressed this issue. In their review of river basin management, they conclude:

> A special type of RBM is the management of international river basins. International basins are usually larger than national basins and less homogenous. Natural and socio-economic conditions, culture and language often differ significantly between the different parts of the basin, and consequently upstream-downstream conflicts can occur easily. Most importantly, however, international basins are by definition located in different states. Consequently, international co-operation is needed in order to best manage the basin and prevent or solve upstream-downstream conflicts.

These authors also point out that very few obligations can be imposed on countries without their consent, with the "lowest common denominator" effect. "Consequently, many international agreements simply reflect the commonalities in the national policies of the states concerned or are very procedural and vague." (*Ibid*, p. 39.) These authors present a series of nine mechanisms that allow international agreements to move beyond the lowest common denominator and to produce more concrete impacts.

The Swedish Ministry of Foreign Affairs has conducted a study of several international basins. The study reveals the range and variation in institutional arrangements for managing trans-boundary water resources. All are closely linked to surrounding political environments, and are sensitive to changes in those environments. The importance of *political feasibility* is a central conclusion reached.

> In many of the basins analysed, the institutional arrangements have changed according to changing in political feasibility. Given the inter-linkages apparent, not only is the wider environment likely to impact on institutional arrangements for trans-boundary water management, but also the arrangements themselves can become a part of that wider environment — thus, for example, effective management institutions can themselves promote peace-building at a regional level. (Sweden, 2001, p. 3-4.)

At the INBO 1996 Workshop (Tulcea, Romania) the institutional arrangement required for river basin management (mainly international) was discussed,

> Informal cooperation can be established between basin organisations from two neighbouring countries; this may help to solve local crisis more efficiently, but this cannot support larger actions or mobilise important financial means. Setting up a formal framework ensures long-term commitments with requirements that are imposed on successive local decision-makers. The creation of a light structure (secretariat, logistics) is a simple and low-cost solution; setting up a more structured international organisation implies that the level of competence delegated by the states be defined beforehand. (Réseau International des Organismes de Bassin, 1996, p. 2; our translation.)

To the previous, we would add a *sine qua non* condition for success, the coherence between national and international programmes; it requires the harmonisation of programme objectives, which should be coherent between themselves, and then of interventions both at the sectoral and multi-sectoral levels.

> RBOs are essential players in the particular context of trans-boundary rivers. These organisations were created some twenty years ago in accordance with the principle of equitable division of a shared ressource, water, between riparian states of a single river basin. They give member states a political platform where the leaders of each state can set forth the direction it is taking in development and put this in the context of the whole river basin. This political function is an essential one, and the RBOs enable potentially conflicting situations to be discussed in the context of long-standing cooperation.
>
> However, RBOs are now undergoing change: the decline in member states contributions and the disengagement of donors have significantly reduced their resources. A review of these organisations roles is required and the preferred option is for them to develop a pared-down structure with an enhanced technical mandate.
>
> If this is to be achieved, RBOs will need to hire qualified staff and acquire the means of gathering, processing and, especially, synthesising management information. The value of the services provided by an RBO is a function of its perspective and of the specific scale of its deliberations; using the information provided by member states, it can deal with development problems at the level of the river basin and provide member states with development scenarios for the medium and long term. The difficulty is with the natural competition between member states and the RBOs for international funding, as each seeks to develop its own expertise: this is one area where coordination between donors is of paramount importance, to ensure optimal utilisation of ever-shrinking financial and human resources. (Burton, 1996, p. 21-22.)

PARTNERS

The main function of river basin organisations, whether created by formal or informal processes, is to coordinate actors within the basin in order to adopt more integrated management of water resources. But who are those targeted by this coordinating function? The term "stakeholders" has been largely used until now; it means those that have a stake in water resources, for legal reasons but also because of economic and social considerations. Parties invited to join the institution in this coordination process were those who, by right or by fact, could presume to have their say in the choices to be made over sharing and uses of water.

The notion of "partners" has recently been introduced in the water debate for two reasons: firstly, to avoid an approach based strictly on right, with its endless disputes; secondly, to allow for additions to the list of potential collaborators who can contribute to a more integrated management of water resources within the river basin. Using the term "partner" is quite significant; we will try to assemble those who can make a difference and are convinced that cooperation is the way to go. The question is not who has the right to be part of the debate, but who can make it progress towards beneficial solutions for the majority.

At local and national levels, the partners list may include, for instance, users associations, water services, teachers, Chambers of Commerce, industries, etc. What is important here is to bring together those affected by the issue in order to create a strong supportive grass-roots movement. We will return to this idea in Chapter 5 while dealing with public participation. We can include amongst the partners: funding agencies and international organisations from the water sector, within integrated river basin management frameworks, both for national and trans-boundary basins.

According to Mostert *et al.* (1999, p. 45-46),

> International donors and banks can support RBM significantly by means of the projects and programmes they finance. In the past, development assistance and lending operations focused mainly on constructing water supply infrastructure (dams, wells), without much attention being given to water quality and other environmental issues, to operation and maintenance, nor even to economic costs of the infrastructure. Increasingly, however, such issues do get attention. […] The possibilities of international banks and donors to improve RBM are limited. For example, it has happened that the World Bank has refused loans for projects for social or environmental reasons, but the projects were implemented with purely national means. Still, international donors and banks can make a difference. They should only finance projects that reflect the principle of sustainable development — however difficult it may be to specify this principle and make it operational. Moreover, their supportive programmes can promote capacity building, policy changes and institutional development.

Alaerts (1999) presents similar arguments in favour of an increased implication in integrated water resources management from international development banks.

> The World Bank, ADB and IDB now strongly emphasize their goal of reducing poverty by supporting equitable, efficient and sustainable economic development. […] Water is acknowledged to have a significant impact on the economic development potential of individuals, through agriculture, water supply and sanitation, public health, power generation, flood mitigation, etc. In addition, water sustains ecological systems which have economic value too, and in turn generate a healthy hydraulic system. (Alaerts, 1999, p. 142.)

And Alaerts (1999), adds:

> Banks always have recognized the productive role of water, but they treated it as an input to other sectors, as if it could be taken from an assumedly inexhaustible reservoir. Until the mid-1980s, banks treated the water “sub-sectors” (water supply, irrigation, navigation, etc.) separately. […] Three factors contributed to revision of this fragmented approach. Firstly, the population growth, especially in urban areas, and the growth in income per capita, readily caused water demand (including demand for removal of pollution) to outstrip supply. Secondly, the implicit assumption that countries would automatically take corrective action and shift from resources development to integrated management did not hold true. […] Finally, many investment projects failed to reach their development goals or to make an impact on the ground because of poor integrated planning and management. […] Banks incorporated the principles of the Dublin International Conference on Water and the Environment (1992) which specifically called for holistic approaches, better policies and administrative arrangements, and a more critical look at efficiency and effectiveness of investments. (*Ibid.*, p. 143.)

But what about large international organisations from the water sector? A comparative analysis of three such organisations was produced by Regallet and Jost (2000) from the ISW: the WWC, the WSSCC and the GWP. The ISW paper tends to clarify the confusion created by the proliferation of water-related organisations on the international scene during the 1990s. Even though ISW thinking is focused on drinking water, the issue of the complementarity or concurrence between large international water organisations is much wider and includes organisations such as the INBO and the IWRA.

All of these organisations were brought together in the Vision exercise, each one with its specific expertise. But how will they collaborate in the implementation of the Vision? The ISW even suggests “an ideal collaboration model for the three organisations, from the users' point of view” (Regallet and Jost, 2000, p. 2). We agree that this is the key to the enigma; visibility and power disputes must be avoided at all costs. This common sense recommendation, not to mention the wisdom of the ISW, is deeply rooted in their fieldwork, working with the three organisations since their creation. They have several complementary aspects in common and act together for a more sustainable use of water resources, though from a different perspective. This is the very definition of partnership.

THE LEGAL ASPECTS

We will not discuss in detail the legal aspects associated with the implementation of institutions or partnerships within the IWRM framework. Nevertheless, this key issue merits mention, as it has been at every seminar organised during the project; it is constantly brought forward in debates touching on improved coordination between institutions and users. This issue was dealt with at the INBO Workshop organised in Tulcea (Réseau International des Organismes de Bassin, 1996). The main conclusions are:

- The legal framework will have to plan steps and procedures based on dialogue and search of a consensus between interested parties, government services, local elected officials and users.
- The representation of all who need water for their activities, be it directly or indirectly, must be planned for and ensured in legislation. Public participation must be recognised in legal texts with clear guidelines for its development.
- The legal framework will also include resolution mechanisms for any conflicts that may emerge over time.
- Management mechanisms are not designed only for ordinary situations but also for emergencies and crises, notably in order to be able to react in case of accidents or shortages.
- Finally, the legal framework, as the master plan, must allow for changes over time in order to reflect the reality and the diversity of situations experienced in the field. (Our translation.)

The study conducted by the Swedish Ministry for Foreign Affairs is quite interesting; even though it deals mostly with international cases, most of its conclusions can be applied to national river basins.

> An important part of this process is agreement on conditions for participation (who should participate and at what level), for decision-making (transparency and who should be included), and on the principles by which benefits (or water shares) should be apportioned. Hence, establishing the principles and norms involved is an essential step towards the provision of the regional public good. […] The difficulties in reaching agreement are considerable, and the difficulties in monitoring and enforcement are even greater. […] The principles established by the convention are just and reasonable. They include an obligation not to cause significant harm, to give prior notification, and to cooperate on the basis of sovereign equality and mutual benefits. Beyond the agreement of these broad principles substantial further work needs to be done to make them operational. There are still many unresolved politically complicated issues in river basins where water use between riparians is unbalanced and contentious… (Sweden, 2001, p. 13.)

SUCCESS FACTORS

The success of a process aimed at the implementation of arrangements between stakeholders depends on certain characteristics clearly presented by Alaerts (1999, p. 154).

> A careful and impartial process is essential to rally stakeholders behind a common vision, to assist in "educating" the stakeholders about the options and their respective benefits and costs, and, importantly, to ensure that the consensus receives broad-based support. External parties whose expertise and impartiality is acknowledged by all stakeholders can play an important mediating role in this process. This holds especially true where the main stakeholders are all of the same hierarchical level and have no higher or supervising authority above them. This is typically the case with international waters.

The key characteristics of successful processes are:

- That the win-win vision must be visible, which implies that parties who stand to lose from change should be compensated.
- All stakeholders, including those that are often invisible in conventional sectoral water management (nature, fishermen, people depending on wetlands, etc.) must be heard and have the perception that their voice counts.
- "Sticks and carrots" can be applied to coax stakeholders into giving up privileges, and accepting new collective arrangements.
- "Trigger events" are often necessary to speed up the negotiation process. Typically, rational arguments for integrated management fail to deliver the conclusive impact. However, once a theoretical case is built and disseminated, and a predicted accident occurs, or a new opportunity for institutional rearrangements occurs, reluctant parties can be put under pressure to accept the new arrangement.

PUBLIC PARTICIPATION

"The essence of Vision 21 — the sector Vision on water for people — is to put people's initiative and capacity for self-reliance at the center for planning and action. Water and sanitation are basic human needs — and hygiene is a prerequisite. Recognising these issues can lead to systems that encourage genuine participation by empowered men and women, improving living conditions for all, particularly women and children." (World Water Council, 2000, p. 42.)

Following the principles adopted in Dublin (1992), the worldwide recognition of the importance of public participation is a notable progress. Similar texts are now found in legal documents. For instance, the European Community Framework Directive on Water, Article 14, says: "Member states shall encourage the active involvement of all interested parties in the implementation of this Directive, in particular in the production, review and updating of the river basin management plan." In fact, this principle had also been adopted at Rio (1992), in the broader context of environment management; environmental issues are better managed if concerned citizens are involved at the appropriate level. But, this level has never been defined; depending on the issues, it could be set at different levels, from local to international, including the basin level.

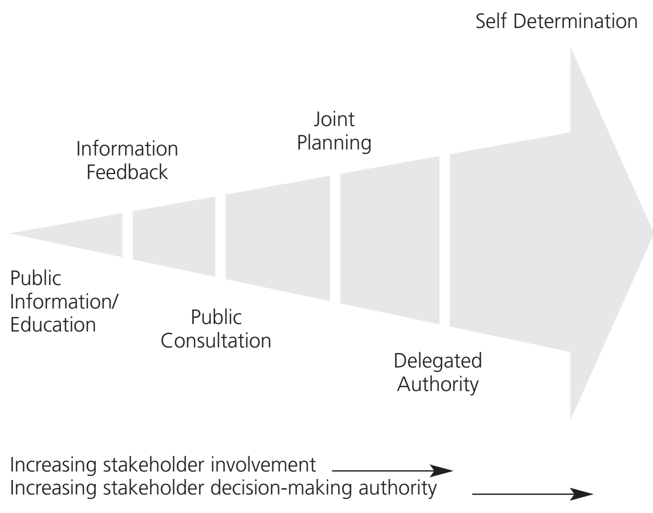
Several terms are used in the literature to identify the "concerned public"; the word "user" is often used to identify both individuals and groups; the broader notion of "civil society" is frequently used in the context of decentralisation. It may be quite confusing, so we will use the term "user" when the public is involved in information or consultation processes (section Users); we will use the term "civil society" only when referring to decentralisation operations where the population is invited to develop on its own a natural resource or a specific usage of water (section Civil Society).

DIFFERENT LEVELS OF PARTICIPATION

Before discussing public participation in more detail, we must realise that a continuous gradient exists between different levels, from information, at the lowest extremity, to self-determination at the top level. This is illustrated in Figure 6 (Donaldson, 1994, p. 4). A precise definition is provided for every one of these steps (Appendix 2, The Public Involvement Continuum). The author closes the list of definitions with a series of remarks that should be kept in mind before discussing the different forms of public participation.

FIGURE 6

The Continuum of Public Involvement



- All public involvement processes are not created equal.
- Many public consultation processes result in needless conflict and confrontation.
- Joint planning (multi-stakeholder) offers a non-confrontational alternative, but has special needs such as open membership, flexibility, and willingness to explore new ideas.
- Careful consideration should be given as to what level of public involvement is appropriate based on the nature and scope of the issue at hand. That is, in some instances it will be quite appropriate for the information-only process, while others might require a full multi-stakeholder process. (Donaldson, 1994, p. 9.)

USERS

Who are the users in these new participatory approaches? "A user is first a water user (industrialist, electricity generator, farmer, population). This notion also includes those who use water for recreation." (Réseau International des Organismes de Bassin, 1998, p. 7; our translation.) The definition is very broad and, in practical terms, will vary depending on the river system we deal with. There are several cases of public participation at local and national levels; but is it possible for the public to participate at the international level? Based on the few international case studies (Sweden, 2001, p. 11), "On balance, however, the role of civil society in trans-boundary waters management is limited. […] Some nascent indigenous NGOs looking in particular at issues surrounding the environment and dam-building are emerging."

The second question to be asked is why consult with users? "Active user participation is the best way to solve conflicts in use; dialogue is the first step to wisdom." (Réseau International des Organismes de Bassin, 1998, p. 7; our translation.) Mostert *et al.* have treated the same subject:

> Public participation (PP) plays an essential role in planning and policy-making. PP can be seen as a legal right of individuals and social groups, often resulting in procedural requirements for decision-making. PP can also be seen as a means for empowering individuals and groups and developing local communities. Finally, PP can be seen as a means of improving the quality and effectiveness of decision-making. (Mostert *et al.*, 1999, p. 47.)

These authors go on to discuss advantages and disadvantages for each definition. We will not discuss here the first type of public participation, the one based on legal grounds; the second type, the empowerment type, will be discussed in the section on Civil Society. But what is of real interest here is the third type, as a means to improve the decision-making process, as part of an integrated management framework.

> It makes clear that PP can also have benefits for the managers who make the decisions. The public can come up with the information that would otherwise not be available and with innovative solutions. Moreover, the public's involvement in the decision-making process can enhance the legitimacy of the process and the acceptance by the public of the resulting decisions. In this way costly and time-consuming litigation can be prevented. PP is easier said than done. If PP is to realise its potential, a number of issues will have to be addressed. (*Ibid.*, p. 48.)

The same authors discuss the need to involve the public but at the international level this time:

> For international rivers it could be argued that, in addition to public participation at the lower levels, public participation at the international level (the level of riparians states) is needed. If there are only possibilities for public participation at the national level, the interests of the stakeholders are to be balanced at this level. However, conflicting interests are often located in different basin countries, e.g. a drinking water company using surface water may be located in a downstream country, and an industrial plant discharging waste water may be located in an upstream country. Therefore, public participation at the international (basin) level may contribute to a more integrated management of a river basin. (*Ibid.*, p. 49.)

The diverse conditions for success in public participation have been discussed by several authors, clearly demonstrating the diversity of experience (Niagara Institute, 1989, p. 5; Mostert *et al.*, 1999, p. 48; Ontario, 1993, p. 30-32; Réseau International des Organismes de Bassin, 1998, p. 8-10). There are several common ideas and we could very well use, as a summary, an extract from a practical guide on public participation developed for Environment Canada (Donaldson, 1994, p. 59-60).

CENTRAL POINTS FOR PUBLIC PARTICIPATION

- "A well-founded need must be demonstrated to attract stakeholders to the process.
- Careful advance consideration should be given as to which type of public process is selected.
- Opinion leaders should be consulted for comment and advice on the project and the process.
- The physical environment of the first meeting should be comfortable, convenient and neutral.
- The proponent should make all stakeholders feel welcome with a common sense of purpose.
- The initial meeting should be empowering and constructive.
- The proponent should be flexible and open to new ideas.
- At all times the developmental stages of the group should be remembered.
- Resources must be available for the group to complete its tasks."

Numerous experiences of public participation have been conducted including information activities and more or less complex consultation processes. Common traits can be identified from this diversity, mainly in terms of "do and don't" (Appendix 4). But there is no unique model, quite the contrary; these processes have to be closely adapted to the cultural and political particularity of the territory. There are common findings though; the importance of engaging in a dialogue with the public in order to improve the planning and decision-making processes, but most importantly, to increase the probability of attaining the results of projects and programmes implemented in the community.

THE CIVIL SOCIETY

We will now discuss the other form of public participation, the one that aims at the empowerment of civil society. According to Mostert *et al.* (1999),

> Public participation as a means of community development is closely related to decentralisation and the development of common property management institutions (cf. Barraqué, 1999). The aim is to increase the capacity of local communities to become meaningfully involved in management and ultimately to manage as much as possible on their own. This corresponds to the notion of "direct democracy", in which individuals as citizens and members of a polity become personally and directly involved in government (as opposed to the traditional notion of parliamentary democracy, in which public participation is basically limited to elections). Means to promote community development include financial support for local groups and institutional changes such as decentralisation. (p. 47-48.)

> Decentralisation is not possible for tasks such as establishing the institutional structure and formulating policies that apply to a country as a whole. However, decentralised governments should be involved because of their superior information on local conditions and because of their (usually) closer contacts with the population. (p. 33.)

The INBO has also concluded that it is important to include civil society to achieve better water management

> The experience of several decades has shown that, in terms of water management, there is a necessity for an institutional association of civil society within decentralised water management processes, in order to achieve optimal and adapted satisfaction of needs, both diversified and increasing.

> Public institutions and agencies in charge of water management must decentralise their actions in order for a decision to be made in conjunction with the field. It must be based on a partnership with local authorities and users' representatives (households, irrigators, industrialists, fishermen, etc.).

> Several needs will not be satisfied by central authorities using traditional top-down approaches, but through individual or collective initiatives emerging directly from the field, they will not necessarily be spontaneous and will require as much competence and well adapted know-how.
>
> Decisions will have to be part of a democratic process, progressively creating an expression opportunity for these opposition forces, who, in order to be able to participate in a positive manner, and avoid getting bogged in theoretical and sterile debates, will need to have access to independent and serious expertise, and complete and transparent information. (Réseau International des Organismes de Bassin, 1998, p. 6; our translation.)

However, this vision of the future relies on means without which effective public participation will not reach full maturity: transparent and complete information, capacity development and, of course, financial means.

The latter aspect has been analysed in detail for water distribution services whose funding mechanisms are based on users' participation and solidarity. The ISW has developed a large expertise in schemes involving partnership between public institutions, the private sector and community-based organisations. A workshop organised in Montreal in 1999 defined the term "social privatisation": "This approach could lead to a number of water management and sanitation models for urban zones (areas surrounding capital cities and other small regional centres) impoverished and without public utilities." (Secrétariat International de l'Eau, 1999, Summary.) A number of typical characteristics derived from case studies are presented, along with a project conducted by the ISW in Central Asia (Régallet and Gungoren, 2000).

DRINKING WATER FOR THE POOREST

Why a billion and a half human beings have no access to drinking water? How could private or public operators provide a service that meets their needs while remaining affordable for the destitute? Several factors are required to ensure the success of these projects.

It appears, according to the three cases analyzed, that the existence of a community base is a must. The priority is to enable the community to take on the water and sanitation services; in other words, resolve the legal, political, social, economic and taxation issues which make the project overly precarious.

User representation must foster their full participation, from the highest levels of decision-making process down to the day-to-day operations. The administrative framework must never be allowed to cut itself off from the community nor should the management structure turn into a parallel operation.

The issue of determining a fair price while ensuring the economic viability of the business must be addressed. Infrastructures are non-recoverable costs, whereas the costs related to users can support operation, maintenance and reinvestment. However, the community must take on major responsibility in the active management of water supply and sanitation to achieve financial autonomy.

This type of approach also entails an important investment in the capacity building of the community, while providing an essential service. The dynamics of the partnership with the public and private sector shift, as the community competency levels rise.

Partnership means creating links with established, organized bodies and involves both rights and obligations. The relationship must be clearly detailed to identify potential conflict areas and develop solutions accordingly. Each party contributes something towards the shared objective, seeking common grounds through mutual support throughout the project.

(Secrétariat International de l'Eau, 1999, overview).

CONDITIONS FOR SUCCESS

THE INTERNATIONAL CONSENSUS

We will close Part One of the manual by reviewing the conditions which, once joined together, will make integrated river basin management a reality. Several papers were prepared for the Second World Water Forum (The Hague, 2000): Mostert (1999) summarised the results of the International River Basin Workshop as a series of some sixty recommendations and guidelines. Another document was prepared by The Netherlands (2000), presenting the same issue but with a broader perspective and including some political dimensions. Below is the central message regarding the importance of integrated river basin management and the conditions that may ensure its implementation.

> Water is an environmental resource and it is the basis for social and economic development. River basins are paramount source of freshwater. To preserve and maintain this precious resource for present and future generations there is a need for sustainable river basin management. *Political leadership and commitment* are crucial. In view of regional differences, a blueprint for river basin management cannot be given. However, the following elements are essential for achieving sustainable river basin management in all basins:
>
> **1. Basin-wide planning**
>
> Basin-wide planning should balance user needs for water resources, in the present and for the long term, and should incorporate spatial developments. Vital human and ecosystem needs have to be given special attention.
>
> **2. Participation in decision-making**
>
> Local empowerment and public and stakeholder participation in decision-making will strengthen river basin management.
>
> **3. Demand management**
>
> Demand management has to be part of sustainable water management.
>
> **4. Compliance**
>
> Compliance monitoring and assessment of commitments under river basin agreements or arrangements need to be developed.
>
> **5. Human and financial capacities**
>
> Long-term development of sufficient human and financial capacity is necessary. (The Netherlands, 2000, p. 7.)

We prepared, for the International River Basin Workshop (Burton, 1999a), a summary of our findings regarding river basin management; several of our conclusions have been incorporated in the workshop report cited above. Nevertheless, there are several dimensions of integrated river basin management that we would like to present here:

- *The River Ecosystem.* The system is very complex. Water, one of the system's many components, is limited both in terms of quantity and quality. The system is open and influenced by outside forces that must be taken into account: climate change, long-range transport of pollutants, international markets. This is a dynamic system; changes have and will occur over time and space. All components of the river system are interdependent; humans and their activities are part of the system, as are the river's natural functions, which must be maintained.
- *River Basin Management.* We do not, nor can we, manage the river system itself; we can only manage the human activities that take place within this natural system. The "magic pill" of technology has already done enough damage; we should take a more cautious approach. The contours of natural watersheds do not match the political boundaries. To manage means to allocate scarce resources among competing users, in an optimised fashion, both for now and for the future. Management is a dynamic process that requires continual updating; it must be flexible and account for uncertainties. Problems arise at different levels and the timing of the management response is crucial. Management is multisectoral in nature and implies strong partnerships among all parties concerned. Management requires the participation of users at the grassroots level. Management is based on multidisciplinary knowledge, not on science alone.

- *Information Management*. Information includes science-based data, as well as local knowledge and expertise. Information is hoarded by numerous institutions whose first reaction is to hold it back; information is power. Existing information is often sufficient to get started, but difficult to assemble and integrate; the first step may be to bring together experienced managers to assess what is available versus what new information is really needed. Information sharing is a must; new information is costly to acquire. Information sharing is also the first step to positive partnerships. Management needs should define the requirements of an information management system, not the other way around; technological dumping (GIS, expert systems, mathematical models) is useless for managers unless they can use the tools properly.
- *Institutional Arrangements and Partnership*. No single institution can be all things to all people — that is, to manage all human activities related to water resources within a basin. River basin planning cannot be a "stand-alone" process; harmonisation with other planning activities is critical. Several planning processes are already in place that will interfere (e.g. economic plans, sectoral and local plans, land-use planning, and special area planning [national parks]). The first step is to paint an overall picture of those involved in water-related issues (i.e. the respective mandates and responsibilities of organisations, their interest or reluctance to participate in any form of institutional arrangement). Develop the right arguments to get other institutions involved — this is a people issue rather than an administrative or legal one. Better to start with an existing institution than to build a new one. Agree first on a common vision and shared goals before defining specific mandates for and responsibilities of each partner. The whole process is based on mutual respect and trust, which need time to mature.
- *Legal Framework*. There already exists a wide range of laws and regulations that apply to water-related activities. First assemble and review existing legislation. Compare to similar contexts in other countries within a given basin or internationally. Recommend how existing legislation can be better adapted. Enforcement is a key to ensuring that the legal framework provides a dependable means to manage conflicts among users.
- *User Participation*. Individuals and organisations with a vested interest in the allocation of basin resources should have their say. Determine how people will be affected or will benefit from the projects; gather information from local sources and build a broad-based constituency within the population. Well-defined goals and clear implementation processes must be shared in a language people can understand. Those most affected by a given project should play the leading role in its planning and implementation. They should be involved as early as possible in the planning process; this is an investment in the future success of a project. Public consultation is a powerful tool; do not use it if you are not willing to take into account people's views and to modify plans accordingly. Public consultation is deeply rooted in the cultural context; there is no single best approach to public consultation. Who to consult depends on the issues involved and on the planning process underway. Explain your reasons for consulting, and the use to which the results of the consultation process will be put. To consult, first share a common information base, and be willing to listen and facilitate access to information.
- *Conflict Resolution*. There is a long list of problems to be resolved and a limited amount of resources (natural, human, technological, financial); difficult choices have to be made. The process of setting priorities is a challenging management task, but an essential one; it must be recognised early on and addressed systematically within the planning process. How to identify priorities? Ask a wide range of parties what they consider most important. A crude ranking method can be used at first. Draw up a list of issues and ask people to rank them. Then compile the results, assigning different weightings to reflect top and bottom ranks. This simple approach will produce interesting results inexpensively, and participants will recognise the overall selection of priorities as being valid. The priority list is only one step to resolving conflicts; a common understanding of the problems, with all parties identifying their particular part in the solution, is the next step. Managers have developed solutions to local issues that could be adapted and applied in other parts of a basin. Showing what has worked elsewhere is an effective way to resolve conflicts.
- *Action Plans*. By definition, action plans are multisectoral when applied to river basin management. Goals and objectives need to be clearly presented: they have to be measurable, realistic and easily understood. An action plan is made up of a list of projects related to one another in

a defined spatial pattern and following a chronological order. An action plan has to allow for changes over time and space; it has to be revisited periodically and allow for political, economic or environmental changes. It is easier to implement an action plan in phases, using demonstration projects along the way to show tangible results and to test solutions on a more manageable scale. Monitoring of actual results is essential; information must be delivered in a timely manner in order for management to evaluate progress. Monitoring should include certain effects on the river system, not only on the project components; otherwise, the project may well be detrimental to other uses or natural functions of the system and no one will notice. Sharing lessons learned from experience with all partners is part of the adaptive approach required for integrated river basin management.

THE HUMAN FACTOR

The "human factor" is a common element to all conditions required for successful river basin management, but it is not often enough recognised as such. We presented this issue at the 11th Stockholm Water Symposium (Burton, 2001a). We can discuss this topic under three complementary aspects: expertise, institutional arrangements and public participation.

The foundation of the decision-making process is the wide range of existing expertise and know-how within any given river basin. We have discovered through our work that expertise exists everywhere — locally, nationally and regionally, within government, in private firms and in community-based and non-governmental organisations. The problem is more often related to the use being made of this expertise: international donors seem to place more value on the results of an expert mission that spends a few days in the field, applying some international fits-all approach, than on recommendations issued by local, national or regional institutions that have lived with the problems and have often developed original and considered solutions.

The first issue is related to the recognition of local and national expertise. How to identify this pool of expertise and make better use of it at the basin level? How can we expect these national and regional river basin institutions to become self-sufficient if the experience of their managers is not fully recognised and they are not given the opportunity to develop and put their know-how to good use? How can we identify the organisations that have succeeded in involving communities in their planning process and developed tools for conflict resolution amongst users?

The second issue has to do with institutional arrangements. How to encourage institutions (public, private and community-based), that would otherwise have reason to butt heads, to collaborate with each other instead? Based on our own Canadian experience, one of the best starting points is the sharing of information. Another way to jump-start the process is to create ad hoc working groups, at the technical level. These simple approaches can be adapted to a broad range of political and institutional contexts — if, and only if, top-level decision-makers are willing to commit themselves to give them a try. In terms of institutional arrangements, people who make a difference are those who want collaboration to move ahead, before and often beyond formal agreements. Such "champions" are as essential at the political than at the administration level.

The third important issue is community involvement. How to go about mobilising local communities so that they can assume full partnership in water-related projects? Several interesting initiatives exist worldwide that need to be better publicised and adapted to local cultural contexts. This is a major theme developed by the International Secretariat for Water (ISW) with solid water and sanitation fieldwork. Here again, public participation is based on the will and engagement of individuals, often volunteers, who believe in the rightness of their action and are the real forces that will in time mobilise the whole population.

ACTIONS TO BE UNDERTAKEN

There is a lot to do in order to move from concept to reality with integrated river basin management being applied more widely in favour of sustainable development of water resources. However, we will focus on only two of the many aspects, those that we have dealt with during the past 10 years through the Large River Management Project: information sharing and recognition of expertise.

We believe that dialogue must be improved internationally to facilitate the sharing of expertise and know-how, particularly with regard to human factors associated with management. From case studies, it would be possible to identify interesting approaches, developed at the local or national level, which could be better known and advantageously adapted on the basin level and even on the international scene. These are the cases where multiple uses of water are satisfied, in a collective arrangement in which individuals are directly involved, while sustaining the functions of the natural host system.

On the other hand, these multipartner collaborations are not without difficulties; some of the constraints have been described in very applied terms by Mostert *et al.* (1999, p. 46-47):

> The issues involved in technology and knowledge transfer and research co-operation are as diverse as the types of technologies and knowledge. […] The solution to these issues is in theory simple. Knowledge and technology transfer should respond to the needs in the receiving country/basin. All available knowledge and technologies should be disseminated freely, using information technology and other appropriate means, in order to derive the greatest benefit from them and prevent duplication. Research and development should focus on the biggest, most significant gaps in knowledge. Some degree of — open — competition between providers is beneficial to the quality and cost-efficiency of the services provided, but the providers should co-operate when necessary. Moreover, they should co-operate with the clients and increase their clients' expertise rather than just sell their services, produce reports, and leave.
>
> This is the ideal, but in practice commercial/institutional/national/political interests can stand in the way. For instance, technology transfer is sometimes inspired more by the interests of the providers of specific technology than by the needs of the recipient. Given the reality of these interests, the main issue is how the ideal can be brought nearer; what types of programmes and projects would be most useful; and what each one's role should be. One possible form is twinning.
>
> Twinning is another word for a long-lasting co-operative relation between two river basin organisations, involving the exchange of information and experiences. Typical twinning activities are short visits including site visits and presentations, and long-term staff exchange. The aim is mutual learning with respect to operational, policy and institutional aspects of RBM. Twinning may also be a framework for development assistance and for specific projects.

CONCLUSION

Basin-wide management has been applied for several decades and on all continents; the fact that the success level may be limited should not condemn the whole approach, quite the contrary. Let us mention again that river basin management does not require the creation of an institution dedicated exclusively to this task; this is an approach which, through collaboration processes involving public institutions, private enterprises and public participation, will ensure that water resources are used in a sustainable manner, meeting the essential needs of all users while maintaining the functions of the natural ecosystem.

Based on cases with which we are familiar, we have identified some of the elements that contribute to the success of an integrated river basin management approach. Successful experiences derive from the combination of several of these factors:

- *Political Will*. At the highest possible level. Clear and tangible (legal framework, institutional arrangements, budgets). Sustained over time, beyond elected terms of politicians.
- *Knowledge*. Not science alone, but through the proper use of all available sources of information. Information has to be shared and easily accessible. Integration of information is key to sensible decision-making. Information technologies need to be adapted to managers' needs; these management tools need to be properly understood to be useful.
- *Sustainable Technologies*. Start small to validate the most appropriate technology. Learn from the mistakes of others: technology transfer is essential. Readiness to innovate, while technology dumping may do a lot of damage.
- *Institutional Arrangements*. Water is a responsibility shared by a wide range of institutions. Start with existing institutions, but redefine mandates. Informal arrangements are useful to start with; begin with working groups or task forces to bring people together. This is a people issue; be mindful of personal expectations.
- *Building on Existing Expertise*. There exists a wealth of expertise to build upon. This expertise should be put to better use. Capacity development is the key.
- *Community Involvement*. Takes time to put it in place; is a long-term investment. Once trust is established, it needs to be nurtured over time. A strong component of any natural resources management project.
- *Economic Prosperity*. Difficult to manage without financial support. More than just direct project funding; a whole range of government incentives create a favourable context in which initiatives flourish. Explore new sources of funding; local partnerships can provide a lot of support.
- *Right Timing*. All of the above do not have to occur simultaneously, but there exists a successful combination of these elements that requires some of them to be present in the right mix and at the right time.

Part Two of the manual is definitely training oriented. It will lead the reader and the trainer through the different steps of the proposed river basin management framework. The suggested formula is a two-week seminar that has already been applied six times in national and international river basins in Africa and Southeast Asia. We will present practical advice to participants; comments, instructions and tables to be completed, all of which will facilitate the application of the framework, step by step. The reader should keep in mind that this exercise can also be done autonomously. Moreover, specifically for trainers, detailed instructions for the organisation of a seminar are provided: a typical schedule (Appendix 5), blank tables (Appendix 6), a checklist to be sent to participants before the seminar (Appendix 7), a detailed approach for cumulative impact assessment (Appendix 8) and, finally, a simple method to identify priorities (Appendix 9).

Part Two of the manual presents a series of training instruments oriented towards the development of river basin management capacities. It results from an amalgamation of the first seminar (Segou, 1991) with results from the five other seminars organised in 1992 and 1993. We have also included, in the comments section, results from the Nile seminar and several other national and international workshops on river basin management.

SEMINAR ORGANISATION

GOALS AND GENERAL INSTRUCTIONS

The goal of this seminar is to offer selected managers the opportunity to become familiar with an integrated framework for river basin management developed in Canada and adapted to the management of African river ecosystems. This seminar is intended for managers responsible for or directly involved in the planning and management of programmes on uses and biological resources associated with river ecosystems.

National and regional programmes that have in common the uses of river water are much diversified, as are the players involved in their management. They come from sectors as different as hydraulics, fishing, health, agriculture, forestry, wastewater treatment, and transportation.

The seminar is designed to immerse managers in a multidisciplinary exercise that is as real as possible.

TO TAKE FULL ADVANTAGE OF THE SEMINAR

We recommend that participants:

- *Read carefully Part One of the manual;*
- *Familiarise themselves with the river basin management framework;*
- *Read the checklist to facilitate information gathering (Appendix 7);*
- *Analyse the documentation available in their own field of activity;*
- *Prepare the necessary data (tables, charts).*

During the seminar, *participants will be invited to:*

- *Present data specifically related to their field of activity;*
- *Define an analytical framework with their colleagues (territory under study);*
- *Participate in discussions in a multidisciplinary context;*
- *Draft a number of common documents resulting from the sharing of information (tables, matrices, charts).*

THE TRAINING MANUAL

- First is presented the river basin management framework: origin, main phases, minimum path, and pitfalls to be avoided.
- Each stage of the framework is presented in the same sequence:
  - A miniature diagram and a corresponding number identifying the stage reviewed;
  - A first box describes the targeted objective, the means to be used to attain it, and the results anticipated at the end of the stage;
  - A series of explanatory notes, such as definitions, concepts, goals and words of advice, completes the information. An application of this process in tabular form presents the data gathered at the Segou Seminar (October 1991), or in the synthesis of the five 1992-1993 seminars (Burton, 1995); in the last case, the indication "(1995)" will be added to the title of the table. Examples are provided to guide the discussion, not to limit it; it is in the reality of the basin that the actual contents for the seminar will be found;

    N.B.: The information in these tables is provided as an example only and must be considered as approximate.These tables have beem generated during the seminars using information provided by the participants themselves.
  - Blank tables to be completed by the participants with information they will provide during the seminar; these tables are in Appendix 6.
- Throughout the manual, we use the example of fishing on a stretch of the Niger River in the State of Niger to illustrate the river basin management framework. This guiding thread will facilitate the understanding of the logical path that takes us from one stage of the framework to another.
- Finally, we specify the anticipated results, data to be gathered and processed, tables to be drawn up, etc., in a box presented at the end of every stage.

SESSIONS ORGANISATION

Participants constitute a group of professionals from several sectors and different portions of the basin. They have been invited because of their expertise and every one has a contribution to make to the whole process. This is above all a training exercise, even though results derived from the seminar can be used as the starting point for a full-blown planning project. Detailed information is provided for trainers in Appendix 5.

The trainer will guide the work throughout the seminar; he must act with flexibility and adapt the schedule to the needs of the debate. Nevertheless, he is also responsible for the progress and coherence of the work and must ensure that all of the framework steps are respected. He makes sure that all participants actively participate, paying attention to the right to speak but also limiting the debate in view of the time constraints. The trainer provides comments on the results in order to stimulate group dynamics while always respecting people's opinions. A typical schedule and practical advice on the organisation of a seminar are presented in Appendix 5.

Work will be conducted in both plenary and working group sessions.

Plenary Sessions

The trainer introduces the work to be completed, provides technical information and proposes a schedule.

Working group representatives present their results.

Participants discuss results and share ideas under the trainer's supervision.

Working Group Sessions

Participants are split into working groups according to the following criteria:

- A maximum of 10-12 participants per group to facilitate the debate;
- A good distribution of expertise (sectors) between the groups;
- A balanced representation of the portions of the basin (countries or sub-basins).

The working language is an important issue; based on our experience, it is more important to group participants who can communicate easily than to maintain a representative cross-section (countries or sectors) at all costs. French and English working groups have been organised, the integration of results being conducted simultaneously in both languages at the plenary sessions.

A *chair* is identified for every working group session, on a rotating basis preferably, so that every participant can play that role at least once during the seminar. The chair conducts the debates, while respecting the allotted time and facilitating the active participation of everyone.

A *secretary* must be designated for each working group session, on a rotating basis also. The secretary collects the results and presents them at the plenary session.

Results

Participants are invited to contribute individually to the gathering of results with information they have brought with them. The secretary of each working group, using the blank tables, collates these results daily. They are presented and discussed at the plenary sessions in order to compare results from each group. A summary is prepared by the trainer, photocopied and distributed to participants daily so that participants will have a full documentation on an on-going basis at the end of each stage.

Throughout the seminar, two distinct facets of the reality will overlap. On the one hand, there is the basin reality with its problems, activities, and resources, as described using the information provided by the participants; based on this information a diagnosis will be prepared. On the other hand, there are the management needs: insufficient information, administrative structures limitations, financial constraints, all of which can be used to produce another type of diagnosis, on the capacities to manage human activities within the basin. The seminar will look mainly at the first aspect, at the basin itself; nevertheless, the second aspect, the management aspect, should not be neglected as this seminar is aimed at the development of river basin management capacities. So, at every stage, participants will treat the management capacity in order to identify needs and suggest solutions.

Finally, the notion of "master plan" will be present throughout the seminar; the information gathered can be used as the basis for a full-scale master plan, once the framework is fully mastered and, most of all, when managers are convinced of its potential for concrete applications. The next question will then be how to prepare such a master plan based on existing knowledge and expertise; the seminar can certainly be used as the first step of a planning process for the basin, sub-basin or national stretch of the river. The very fact of bringing together experienced people in a sharing of information and experience exercise is already a solid investment for future collaboration.

SEARCH FOR INFORMATION

The concept of information is used here in its broader sense, corresponding to the overall knowledge that makes it possible to bring the management process to a conclusion in an appropriate manner (see the chapter on Knowledge).

The entire river basin management framework is based on seeking, processing and using information. It also builds largely upon the expertise and know-how of a wide range of technicians, scientists, project managers, decision-makers, elected representatives or NGO managers. The human factor is essential in this process; the very foundation of the decision-making process lies with the people that make decisions, at the interface of multiple information sources to be interpreted objectively or not.

To start with, it is necessary to know how to make the best use of *available information*. One cannot wait until all the desired information is available before initiating a planning process.

- Information does not have to be quantitative; reliable qualitative evaluations are very useful. This may seem a blunt statement but one should not postpone the planning process and the preparation of a first diagnosis using incomplete information as an excuse. Information will always be incomplete; therefore, we should do as much as we can with what we already have and later gather information considered essential. This is a matter of attitude; while looking attentively at available information and relying on existing expertise, we should have a sufficient basis to initiate a first diagnosis.

- Information processing systems (data bases, modeling, geographical information systems, etc.) are often too complex with respect to the quantity and the quality of the data to be processed. These are tools whose usefulness must be assessed. They are not an end in themselves. One should not hesitate to initiate the planning process because they do not have computer facilities; managers' needs dictate the definition of the information management systems, not the other way around.
- When relatively little reliable information is available, discussion and information sharing are sound management practices. Information is costly to obtain, and the lack of relevant information leads to significant delays at every stage of the management process.
- Furthermore, the *reliability* of the information must be established throughout the process. To this end, one must consider whether the information is reliable, and to what extent it is to be trusted.

  There is no simple answer to this question. It may be looked at from two different viewpoints:

  – Information source. Certain sources (agencies, programmes, researchers) are recognised for their reliability;

  – Validity of the information. Beware of collections of data gathered at different periods or in different territories; and verify the methods used for gathering, analysing and processing the data. Access to metadata is important, even more so when information has already been integrated to produce cartographic documents.

  It is a question of attitude toward information. Without questioning everything systematically, it is appropriate to retain one's critical sense and not to hesitate to ask questions. Managers are particularly vulnerable if they depend on a very limited number of information sources.
- In addition to reliability, one must question the *usefulness* of the information. Information may be ranked according to whether it enables one to answer the questions asked, with respect to time and space, more or less satisfactorily:

  – With respect to *time*: How old is the information? How often is it collected? What is the timespan covered?

  – With respect to *space*: Has the territory under study been fully surveyed? How accurately (spacing between stations)?
- Finally, the objectives targeted by the search for information must be very clearly specified, with particular attention being paid to:

  – *The timespan:* the period concerned by the gathering of information.

  The length of the period depends on the speed of changes, needs of the study, and availability and reliability of older data. The period may be the past 20 years for uses and resources. But longer periods may be useful for natural phenomena and human activities. We will have to deal with information gaps in chronological series, whatever basin we will work on.

  – *The territory:* the area covered by information gathering.

  The territory may cover the entire basin, be limited to the main channel of the river with its flood plain, or even be restricted to one stretch of the river, without affecting the scope of the management process. It all depends on the process objectives. Within the seminar, we are restricted to the information provided by participants. We will have to evaluate if this incomplete information base is sufficient to produce an acceptable portrait of the territory under study. In real life as well, information is limited in terms of spatial coverage; extrapolating to the whole territory is a risky operation but it is still possible if conducted with a solid knowledge of this territory.

  In the manual, the term "basin" will be used to include both river and lake basins. In most cases, no distinction will be made between basin and sub-basins, unless required by the context.

  – *The scale:* the level of precision or detail limiting the gathering of information.

– *The level of integration.* At the outset, information is gathered by theme or discipline. Subsequently, we may be tempted to bring together the information from several disciplines in order to produce an integrated portrait. It is therefore necessary to select one of two approaches: one that integrates at the outset, the other that integrates results a posteriori. In the first scenario, common information management instruments can be put in place to facilitate the gathering of information in a standardised manner (maps, survey format, etc.), which in turn will facilitate the integration of information at a later stage. In the second scenario, with disciplinary research, more attention will have to be given to questions of scale and timespan, since information will have to be integrated once the information-gathering exercise is completed.

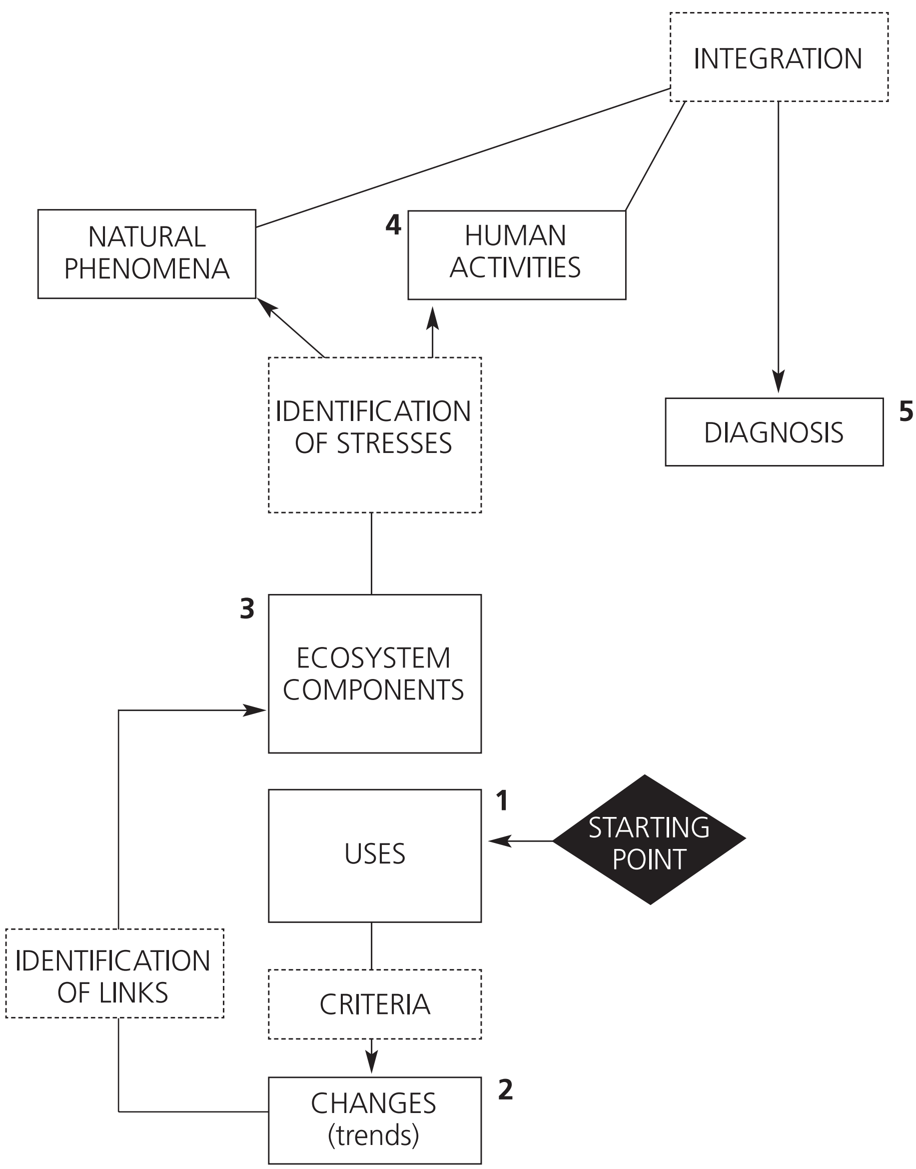
Let us keep in mind that the seminar is meant to be an exercise for the use of a river basin management framework. Besides, this is an excellent forum to evaluate the whole issue of available information at the basin level, in terms of information sources and their validity. Nevertheless, one should not hesitate to extrapolate, when necessary, from the limited volume of information provided by participants, in order to be able to move from one stage to the other without being stopped by the lack of information.

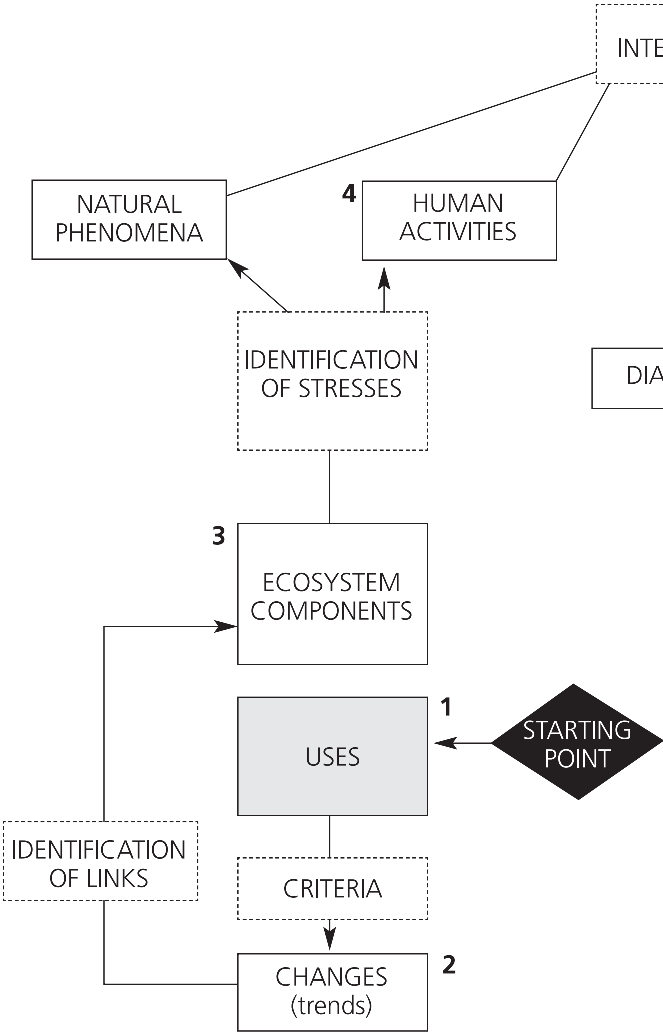
The Ouagadougou Seminar, September 13-24, 1993.

THE DOCUMENTATION PHASE

The first phase of the framework — Documentation — is meant to gather and evaluate the relevance of information which will be used to identify problems corresponding to the uses and biological resources from the river territory under study. This phase consists of several stages, from the definition of the current state of uses and biological resources to the establishment of a diagnosis (Stages 1 to 5; Figure T-1).

FIGURE T-1
The Documentation Phase





STAGE 1

USES AND BIOLOGICAL RESOURCES

OBJECTIVE

- To describe the current state of uses and biological resources.

MEANS

- Seeking, analysing and synthesising available information.

RESULTS

- A list of uses and biological resources of the territory under study.
- A synthesis establishing the current state of each use and biological resource.

THE DOCUMENTATION PHASE

STAGE 1: USES AND BIOLOGICAL RESOURCES

DEFINITIONS

The starting point for the management framework lies with uses and biological resources (see the section on Integrated River Basin Management). These are very broad notions.

What is a use?

A use means any use of water and other resources of the river by man. For example: drinking water, floodwater farming, irrigated farming, stock breeding, forestry, fishing, fish farming, hunting, transportation, tourism, conservation, and hydroelectric power.

What is a biological resource?

Biological resource means living species, whether or not they are used by man, and their habitats. Examples are fish, birds, mammals, rare species, wetlands, and gallery forest. They are closely linked to the basin and rely directly on the ecosystem components.

Why limit ourselves to biological resources, while other resources are also part of the basin?

- Water resources will be treated in Stage 3, as an ecosystem component;
- Mineral resources are not associated with the basin but to geological conditions; they will be discussed in Stage 4, as mining operation within human activities;
- Human and financial resources will be treated in Stages 6, 7 and 8;
- As for soils, they are discussed indirectly when looking at the surface occupied by agriculture and cattle ranching (human activities).

How to make a list of the uses and biological resources of the territory under study?

An inventory is conducted for all uses and biological resources present within the territory under study; we do not include, at this time, potential uses because they will be dealt with in Stage 6, being then considered as "issues". We cannot study everything at once and this inventory requires that choices be made at the outset. Tables 1A and 1B present lists produced at the five 1992-1993 seminars; these lists are provided to assist with the inventory but will have to be adapted to the particularities of the basin under study.

The list of uses is very important and will be referred to several times during the seminar; however, we have to limit ourselves to the significant uses as it is easy to get lost in detail. Uses will have to be grouped by larger categories. How do we know if a use should be considered in this exercise? By answering the following question:

If the river were not there, would this use be present in the basin?

We should note that biological resources form two large groups: habitats (major vegetal formations) and the most important species of the basin. Important species are identified using several criteria: used by man (hunting and fishing), cause damage to man (pests, disease carriers), rare or endangered, or even tourist attraction. In some cases, identification is at the family level while in others the species will be identified.

To describe the current state of a use or biological resource, units of measurement recognised and used by specialists in the field must be agreed upon. These units of measurement are important throughout the framework and not only at Stage 1. They allow for the evaluation of quantitative and qualitative aspects of uses and biological resources (Tables 1A and 1B). This a double issue; we must first use units of measurement that are recognised and used in the information base; but also, as the discussions involve a multidisciplinary group, we have to adopt a list of common measures understood by everyone. For instance, sedimentation on the riverbed is measured in tons by geologists and in cubic metres by dredging managers.

A list of uses and biological resources is one of the results targeted for Stage 1. The multidisciplinary group will therefore have to agree on a suitable classification, with clear definitions for each class of uses and biological resources. It will also be necessary to choose the units they intend to use. Definitions correspond to managers' needs and will be presented in Table 1C. We have to ensure that all participants use the same terms with the same meaning, as the group is made up of people with different training backgrounds; the definition can be either well used within a specific domain or simply adopted for the duration of the seminar, the main objective being to avoid confusion during the debates.

Looking at Table 1C should raise at least one question: why do we consider human health as a use of the river? Human health is a good evaluation of the capacity of the basin to support water uses by humans who live there; indeed, parts of the basin may be so infected by waterborne diseases that human populations will be almost excluded. On the other hand, human health is always a priority in any planning exercise; we have decided to include it at the very beginning, even though this may be seen as an unusual extension of the definition of a water use.

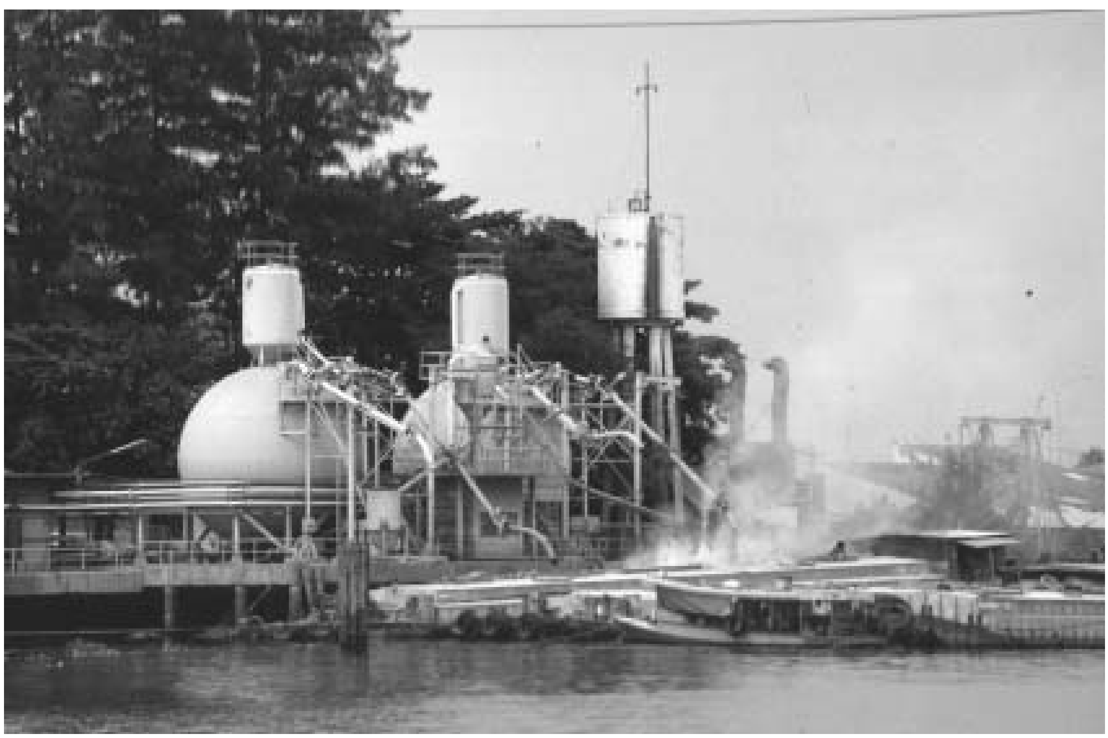


TABLE 1A
List of Uses (1995)

Use	Units of measurement	
	Quantity	Quality
1. WATER SUPPLY		
a) Domestic		
Treated	m^3	Standards (WHO, national)
Untreated	Demography	Acceptability by users
b) Industrial	m^3	Industrial standards
2. DISPOSAL (wastewater)		
a) Domestic (water)	Demography	Loadings
– solid waste	kg/person/d × population	Biodegradability/recyclability
b) Industrial (water)	m^3/d	Loadings
– solid waste	t/yr	
c) Agricultural	m^3/d	Loadings
d) Stock breeding	kg/UBT/d × No. UBT	Biological and chemical characteristics
e) Rainwater (urban)	m^3/d	Loadings
3. AGRICULTURE		
a) Floodwater farming	ha	kg/ha
b) Recessional		
– natural	ha	kg/ha
– artificial	ha	kg/ha
c) Irrigated farming		
– traditional	ha	kg/ha
– modern	ha; m^3 of water	kg/ha
– agro-industry	ha; m^3 of water	kg/ha
d) Rainfed	ha	kg/ha
4. STOCK BREEDING		
a) Watering	Number and type of livestock UBT × 1/UBT	Standards (animal health)
b) Pasture		
– natural	ha	Acceptability by breeder
– irrigated	ha; m^3 of water	kg/ha
c) Transit zones	ha	kg/ha; absence of conflicts
d) Transit corridors	km	No. of water points; absence of conflicts
e) Sanitary zoos	No. of sites No. of heads	No. of UBT treated Success of treatment

Use	Units of measurement	
	Quantity	**Quality**
5. FISHING		
a) Self-employed	No. of fishermen; t/yr	Composition of catches (species, size); % of pop. involved
b) Semi-industrial	No. of fishermen No. of vessels; t/yr	Type of catches (species, size); Investments; number of jobs created; % of market share
6. AQUACULTURE		
a) Fish farming		
– intensive	m^3 (cages)	t/m^3
– extensive	ha (basins)	t/ha
b) Water breeding (crocodiles, geese, ducks)	No. of sites No. of individuals	Productivity No. of individuals/yr
7. HUNTING		
a) Traditional	No. of permits/type No. of hunters	Authorized period (months) Sanitary condition of meat Success rate (No./hunter)
b) Recreational	No. of permits/type No. of hunters	Value of the trophy Financial gains made Origin of the hunters Success rate (No./hunter)
c) Poaching	No. of animals killed	Effect on populations
8. BEEKEEPING		
	No. of hives	kg (honey, wax)/hive
9. TRANSPORTATION		
a) Navigation		
– canoes	No. of vessels/type No. of passengers m^3 transported	No./km (density) Cost/passenger
– ships, passenger boats	No. of vessels/type No. of passengers t transported	Navigability (months/yr) tonnage per km/yr Cost/t Cost/passenger
b) Floating	m^3 No. of logs	km of floating Floating period (months)
10. FORESTRY		
a) Agro-forestry	ha	No. of plants/ha
b) Silviculture	ha; No. of plants	No. of plants/ha
c) Logging		
– firewood	Stere	Stere/ha, caloric value
– sawmill lumber	m^3	m^3/ha
– craft wood	m^3	m^3/ha
– pharmacopoeia	kg	
– exudation products	kg	
– seeds and fruit	kg	

Use	Units of measurement	
	Quantity	Quality
d) Gathering		
– firewood	Stere	Stere/ha, caloric value
– sawmill lumber	m^3	m^3/ha
– craft wood	m^3	m^3/ha
– pharmacopoeia	kg	
– exudation products	kg	
– seeds and fruit	kg	
11. TOURISM		
a) Hunting and fishing	No. of tourists Investments Revenues	Success (No./hunter or fisherman) Trophy
b) Sightseeing	No. of tourists Investments Revenues	Uniqueness of site Accessibility
c) Leisure	No. of tourists Investments Revenues No. of tourist welcoming points	Classification of infrastructures Safety
d) Health	No. of tourists Investments Revenues	Quality of the cure
12. RECREATION		
a) Swimming	No. of people No. of beaches, lakes	No. of visits Water quality
b) Water sports	No. of people Investments Revenues	No. of visits
c) Cruises	No. of people No. of boats Investments Revenues	No. of visits Availability (months)
d) Hunting and fishing	No. of people	Success (No./hunter or fisherman)
e) Cultural	No. of tourists Investments Revenues	Uniqueness and frequency of events Authenticity
13. CONSERVATION		
a) Protected areas	ha No. of sites	Biological diversity Uniqueness Rate of regeneration
b) Water	Length of section (km) m^3 underground waters	Degree of pollution Filling rate
c) Soil	ha	Rate of erosion Salinity or acidity rate

Use	Units of measurement	
	Quantity	**Quality**
14. ENERGY		
a) Hydroelectric power	MW, MWh	Reliability % of pop. serviced Cost/kW
b) Thermal power	MW, MWh	% of pop. serviced Cost/kW Reliability
c) Bio-gas	m^3 No. of units	Cost/kW
d) Renewable power	kW No. of units/type	Reliability Cost/kW
15. REMOVAL OF MATERIAL		
a) Construction–brickwork (sand, gravel, clay)	m^3/yr t/yr No. of bricks	Physical-chemical characteristics
b) Gold panning	kg/yr	
c) Arts and crafts (reed, straw, clay)	No. of artisans No. of articles/type	% of pop. involved
d) Other products (natron, algae)	t/yr	Quality of product Export (t and value)
16. HUMAN HEALTH		
a) Ingestion	No. of sick; prevalence	Mortality rate/Type of illness
b) Contact	No. of sick; prevalence	Mortality rate/Type of illness
c) Sites		
– natural	ha No. of individuals/species/m^2	Characteristics of favorable habitat
– artificial	ha No. of individuals/species/m^2	Characteristics of favorable habitat
d) Thermal waters	No. of sources m^3	No. of visits Chemical composition

TABLE 1B
List of Biological Resources (1995)

Biological Resource	Units of measurement	
	Quantity	Quality
HABITAT		
a) Algae	ha by species	t/ha
b) Macrophytes	ha by species	t/ha No. of species/ha
c) Islands, islets	ha; number	Physical characteristics (slope, banks, area/perimeter ratio)
d) Foodplains	ha	Duration of flooding
e) Gallery forests	ha	No. of plants/ha No. of species/ha t/ha
f) Forests	ha by type	No. of plants/ha No. of species/ha t/ha
g) Swamps	ha by type	No. of species/ha t/ha
h) Wetlands	ha by type	No. of species/ha t/ha
i) Mangrove swamps	ha	No. of plants/ha t/ha
j) Deserts	ha	No. of plants/ha t/ha
WILDLIFE		
a) Vertebrates – mammals – birds – reptiles – amphibians – fishes	No./species No. of species	Relative abundance Population structure No./ha or No./km^2
b) Invertebrates – mollusks – crustaceans – insects	No./species No. of species	No./m^2 No. of species/m^2
c) Microorganisms	No. of species	No./cm^3 No. of species/m^3

TABLE 1C
Glossary

Disposal:	All waste discharged into the river, of domestic or industrial origin.
Navigation:	Organised transportation, by water, of individuals and goods.
Harvesting:	Harvesting of resources on an industrial scale.
Gathering:	Harvesting of resources by individuals or families
Tourism:	Recreational activities carried out by non-residents of the actual site.
Recreation:	Recreational activities practised by residents of the actual site where they are practised.
Conservation:	Includes all areas where certain uses are prohibited by government order, with the objective of habitat and/or animal species conservation.
Health:	Not an ecosystem use or resource as such, but represents an evaluation of the overall quality of the environment for humans living there.

TABLE 2
Data Sheet — Current State of Uses and Biological Resource

River: **Niger**

Use: **Fishing**
or
Biological Resource: ______________________

Current State: In 1990, there were 3,000 professional fishermen on the entire stretch of the river in the State of Niger. Landings amounted to approximately 1,000-1,200 t.

Reference	Location	Medium	Timespan	Territory
Author Year Title, etc.	Wildlife, Fishing and Fish Farming Branch Ministry of Hydraulics and the Environment Niamey	Reports (printed material)	1990	Stretch of the Niger River in Niger

SEARCH FOR INFORMATION

What is involved here is not different from classic bibliographical research: consultation of indexes, files, establishment of reference lists, verification of relevant contents, etc. But it has certain specific aspects:

- It takes into account unpublished data gathered by governments or NGOs;
- It is interested in local and traditional knowledge;
- It is interested in domains that are not the subject of scientific research.

Throughout the search for information, special attention will be paid to the following aspects:

Location: Site where the document is to be found, in very real terms;

Medium: Physical medium on which the information is stored (microfiches, automated data banks, printed material, Internet, etc.);

Timespan: Period of time covered by the document;

Territory: Area corresponding to the information contained in the document.

From the information gathered, a data sheet must be prepared for each document. This complements the bibliographical reference. Note that a document may be printed material (report, book, magazine article, etc.), a map, an automated databank, a microfiche, a website, etc. A brief statement is drafted on the current state of the use or biological resource based on the information available in this document; this is the most important portion of the data sheet as it is the starting point for all discussions during the seminar. A qualitative statement is acceptable, if quantitative data are missing; the important thing is to clearly define the current state of all selected uses and biological resources, even if we have to rely on an appreciation by experienced participants who know the area well. The rest of the data sheet may be completed if the document is available at the seminar. An example is provided in Table 2.

Finally, the quality of the information gathered must be evaluated with respect to managers' needs. To this end, two questions must be asked:

Does this document present reliable information on which a decision can be based?

Is this document useful for the management exercise, and to what extent?

EXAMPLE OF APPLICATION: FISHERIES ON THE NIGER

Analysing and synthesising the available documentation may help describe the current state of the fisheries on that stretch of the Niger River that runs through the State of Niger.

The quantitative units of measurement used are the number of fishermen and landings. The qualitative measurements of this use are based upon the breakdown of catches, by species and size (see Table 1A).

In this way, we can draft a document that synthesises the overall information on the current state of the fisheries, in both socioeconomic (landings, fishermen) and ecological (species, size) terms. The spatial dimensions are also very important (where is fishing practiced, and in which type of habitat?), as are the temporal dimensions (at which time of year, and for how many days?).

Such a document includes tables of analysed data, interpreted maps and, generally, illustrations of the main fish species and fishing gear. They often contain a list of scientific and common names for species of fish presented in a glossary format.

The sources of data used are the subject of a data sheet (Table 2) and complement the list of references to be attached at the end of the document.

In some cases, it is possible to use a monograph dealing with fisheries; it can be completed with more recent information, as required.

Note in conclusion that the document we are discussing here, in the case of fisheries, is not necessarily intended for publication. Its main function is to gather the overall information on the current state of fishing and to present it simply and clearly. It is meant primarily for managers not specialising in fisheries management.

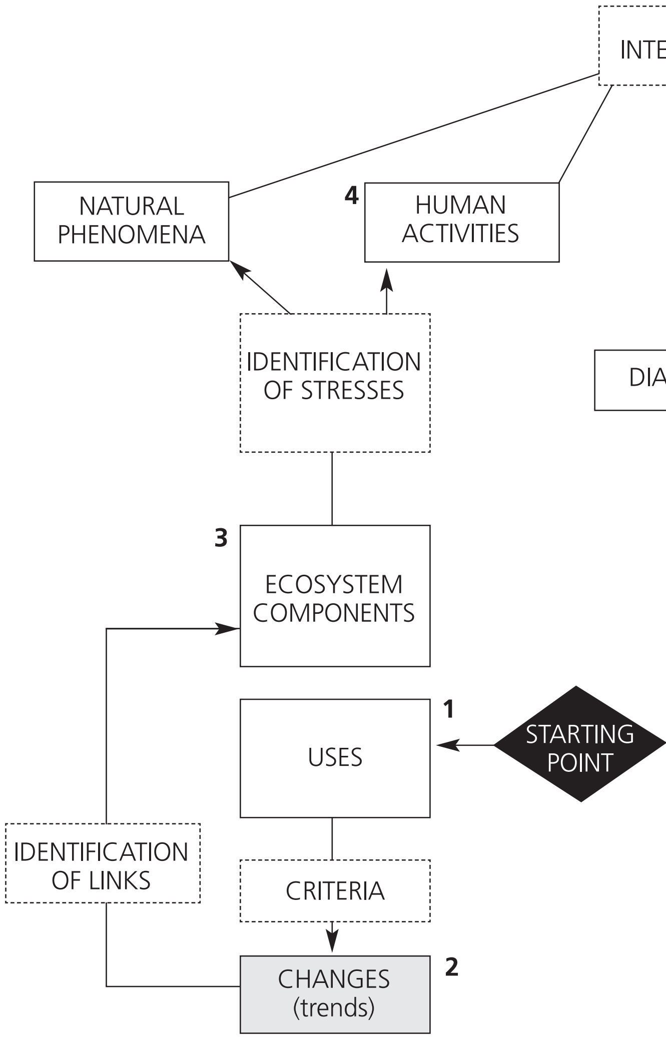
Finally, it is important to properly define the terms used, so that the reader can grasp quickly the scope of the document: what is meant by professional fishermen, how landings are calculated, etc.

RESULTS FROM STAGE 1:

- **List of uses and units of measurement used (Table 1A).**
- **List of biological resources of the river and units of measurement used (Table 1B).**
- **Glossary of definitions used (conventions) to draw up a list of uses and biological resources (Table 1C).**
- **Data sheet for documents used (Table 2), for each use and biological resource: printed material, data banks, charts, etc.**

  Blank copies of Tables 1A, 1B, 1C and 2 are provided in Appendix 6.

The Hanoi Seminar, February 12-24, 1993.



STAGE 2

Changes

OBJECTIVE

- To identify changes occurring in uses and biological resources in the timespan and territory under study.

MEANS

- Seeking, analysing and synthesising available information.
- Comparing data collected with quality criteria.

RESULTS

- A synthesis establishing the changes in time and space for each use and biological resource, with identification of observed trends.

STAGE 2: CHANGES

MEASURING CHANGES

The second stage looks at changes, because a complex system like a river basin is in perpetual evolution. Indeed, managing a river basin really means managing human activities in a continuously evolving context characterised, in most cases, by uncertainty. Why should we pay attention to changes? To better understand what has happened in the past to arrive at the current situation; and, to a certain extent, to be able to forecast future evolution of the system, all things being equal.

For each use and biological resource appearing on the list (Tables 1A and 1B) we attempt to establish which are the changes that have occurred in the timespan and territory defined for this study. From this analysis, we derive trends (upward, downward, etc.), which help calibrate the reference points to be followed for future evolution of these changes (monitoring). Thus, we can draw up a list of changes and trends.

The faster the changes, the shorter the data collection intervals (time step, and spacing of measuring stations). The slower and more gradual the changes, the larger the territory under study and the longer the period to be covered by the analysis. The information used is derived from many sources and is gathered at different scales or over different periods; caution is therefore required in combining data from disparate sources, so as to minimise the risk of errors in interpretation.

The most objective method for establishing changes and trends is that of quality and quantity criteria. These criteria are varied in type: standards, quality objectives, thresholds of tolerance, carrying capacity, etc. The threshold notion is particularly useful; it facilitates the definition of the current state of a use or biological resource, as with endangered species for instance. Several sets of criteria have been published by national and international organisations; caution must be exercised and only those pertinent to the specific situation in the basin should be used.

In some cases, no quantitative criteria exist. One must then make up one's own mind, based on the scope of the changes undergone through use or biological resources, and develop a classification system as objective as possible.

This is above all an exercise in judgment and common sense. One should not hesitate to express cautious opinions, making allowances for the limitations inherent to this type of exercise. The important thing here is to be able to count on "sound scientific judgment", based on both the available information and managers' experience.

For instance, let us summarise in a data sheet format (Table 3) the case of fisheries on the stretch of the Niger River running through the State of Niger. The statement is quantitative in this case, which will facilitate the interpretation of changes.

In Table 4A, the "present" column is filled with information already given in the data sheets completed at Stage 1 (Table 2); this is the most recent information and we have to assume that the situation has not changed since the last survey. Information for the "past" column comes from Table 3 completed above; here again, the definition of the past may be quite variable and it is imperative to clearly indicate the period we are referring to. One has to be careful with conclusions drawn from periods in time that are too short; trends cannot be defined with only two years data. In practical terms, these statements should be produced in pairs, for each use and biological resource: one statement for the current situation, one for the past, a trend being defined by comparison between the two statements.

TABLE 3
Data Sheet — Changes in Uses and Biological Resource

River: **Niger**

Use: **Fishing**

or

Biological Resource:

Changes: The number of professional fishermen held steady at about 10,000 from 1960 to 1976, falling to 1,900 between 1980 and 1989. Landings went from 4,000-5,000 t/yr in 1970 to 1,600 t/yr in 1980 and 900 t in 1985.

Reference	Criteria	Medium		Timespan	Territory
	Number of professional fishermen Landings (t/yr)	Wildlife, Fishing and Fish Farming Branch Ministry of Hydraulics and the Environment Niamey	Reports (printed material)	1960 to 1990	Stretch of the Niger River in Niger

We should complete an evaluation of change for all uses and biological resources. The discussions of these results bring forth two observations spontaneously: some elements will have to be deleted from the lists at this moment because information is not available; we will use this opportunity to identify information requirements and means to fill them if this should prove necessary in a future full-scale planning exercise.

Hypotheses will then be formulated spontaneously on the causes of these changes; we should note carefully these hypotheses for discussions later in the seminar. It will then be interesting to compare the opinions based on a first series of information on changes (spontaneous reactions, biases) with the results derived from a more structured analysis leading to a well-documented diagnosis.

TABLE 4A
Changes Observed in Uses (1995)

Uses	Trends	Past	Present
1. WATER SUPPLY			
a) **Domestic**			
Treated			
• Kagera (Rwanda)	↑	700,000 pers. (25%) — 1970	4,500,000 pers. (75%) — 1992
• Senegal (Mauritania)	↑	5% coverage — 1960	30% coverage — 1992
(Senegal)	↑	3.8×10^6 m³/yr — 1978	4×10^6 m³/yr — 1992
(Dakar)	↑	800,000 pers. — 1980	1,000,000 pers. — 1992
• Chad (Cameroon)	↑	600×10^6 m³ — 1987	840×10^6 m³ — 1992
Untreated			
• Kagera (River)	↑	83.6×10^6 m³/d — 1978	118.8×10^6 m³/d — 1992
(Tanzania)	↑	>45,000 pers. 29,800 m³/d — 1980	1,087,000 pers. 41,800 m³/d — 1992
• Niger (Guinea)	↑	13,416 m³/d — 1988	16,716 m³/d — 1992
• Mekong (Laos)	↑	1.2 m³/s — 1987	12.5 m³/s — 1992
b) **Industrial**			
• Niger (Guinea)	↓	45,650 m³/d — 1988	24,050 m³/d — 1992
• Mekong (Vietnam)	↑	104×10^6 m³/yr — 1980	450×10^6 m³/yr — 1990
2. DISPOSAL (wastewater)			
a) **Domestic**			
Senegal (River)	↑	1.2×10^6 pers. — 1970	2.0×10^6 pers. — 1982
b) **Industrial**			
Senegal (River)	↑	Non-existent — 1972	7 industrial units — 1992
c) **Agricultural**			
Senegal (River)	↑	160×10^6 m³ — 1984	400×10^6 m³ — 1992
3. AGRICULTURE			
a) **Recessional — natural**			
• Senegal (Middle Valley)	↓	150,000 ha — 1963	50-60,000 ha — 1992
(Podor)	↑	20,000 ha — 1987-1988	35,000 ha — 1991-1992
• Mekong (Delta)	↓	1,800,000 ha — 1976	1,600,000 ha — 1993
• Chad (Niger)	↓	55,000 ha — 1956	150 ha — 1991
(Nigeria)	↓	13,262 ha — 1987	8,262 ha — 1993
(Chad)	↑	1,500 ha 2,080 t of corn — 1990	3,880 ha 5,380 t of corn — 1991
b) **Recessional — artificial**			
• Senegal (Mauritania)		4,000 ha — 1960	
	↓	400 ha — 1975	
	↑	2,500 ha — 1987	2,500 ha — 1993
c) **Irrigation**			
• Mekong (Delta)	↑	200,000 ha — 1976	900,000 ha — 1993
(Laos)	↑	600,000 ha 2.19 t/ha — 1976-1987 4.5 m³/s — 1986	607,000 ha 2.34 t/ha — 1990 6.2 m³/s — 1992
(Cambodia)	↑	15,000 ha — 1979	122,000 ha — 1992
(Thailand)	↑	85,000 ha — 1989	100,000 ha — 1992
(Vietnam)	↑	200,000 ha — 1975 300 km of canal — 1980	900,000 ha — 1982 400 km — 1990

Uses		Trend	Past	Present
• Niger	(River)	↑	475,000 ha — 1980	500,000 ha — 1987
	(Burkina Faso)	↓	500 ha — 1984	418 ha — 1992
	(Benin)	↑	885 ha — 1979	1,360 ha — 1992
	(Niger)	↑	7,040 ha — 1990	8,050 ha — 1991
	(Mali)	↑	191,269 ha — 1989	231,071 ha — 1993
	(Nigeria)	↑	23,000 ha — 1977	26,100 ha — 1991
• Kagera	(Buyenzi)	↑	309.5 ha — 1987	1,443 ha — 1990
	(Bugesera)	↑	1,200 kg/ha — 1970	1,500 kg/ha — 1980
• Senegal	(River)	↑	63,790 ha — 1989	107,289 ha — 1992
	(Right bank — Kaedi)	↑	246 ha — 1973	1,665 ha — 1993
	(Upper bassin)	↑	7 ha — 1975	728 ha — 1993
• Chad	(Niger)	↓	9,897 ha — 1989	5,279 ha — 1990
	(Cameroon)	↑	9,389 ha — 1990-1991	10,880 ha — 1991-1992
	(Nigeria)	↑	3,000-14,000 ha 6,000 t/yr 3,000 families — 1976-1988	15,000 ha 30,000 t/yr 15,000 families — 1992
	(Chad)	↓	20,000 ha — 1979	8,000 ha — 1992
d) **Agro-industry**				
• Senegal		↑	7,000 ha (cane) — 1988	7,500 ha — 1992
e) **Rainfed farming**				
• Kagera	(Uganda)	↑	0 prior to 1960	256,000 ha — 1992
• Niger	(Benin)	↑	18,500 ha — 1980	20,000 ha — 1992
• Mekong	(Laos)	↑	600,000 ha — 1976-1987 2.19 t/ha	607,710 ha — 1990 2.34 t/ha
4. STOCK BREEDING				
a) **Watering**				
• Kagera	(Tanzania-Rubuare)	↑	0 ranch — 1971	14,000 heads 10 large ranches — 1989
• Niger	(Burkina Faso)	↑	625,000 UBT — 1980	1,200,000 UBT — 1991
• Senegal	(Mauritania)	↓	5×10^6 heads — 1960	2.5×10^6 heads — 1992
b) **Pasture — natural**				
• Chad	(Niger)	↑	1,124,187 t dry matter — 1991	2,096,000 t — 1992
• Senegal	(Basin)	↑	Major deficit — 1973	Beginning of rebuilding — 1992
5. FISHING				
• Senegal	(Manantali reservoir)	↑	150 fishermen — 1954	10,000 fishermen — 1990
	(Manantali — Kaye)	↓	12,000 t — 1954	
		↑	4,000 t — 1984	6,000 t — 1990
• Chad	(Lake)	↓	5,200 fishermen, 4,000 t — 1986-1987	3,700 fishermen, 2,000 t — 1990-1991
	(Niger)	↓	4,000 fishermen, 10,000 t — 1984	500 fishermen, 215 t — 1987
• Niger	(Benin)	↓	200 kg/fisherman/yr — 1970	100 kg/fisherman/yr — 1992
	(Burkina Faso)	↓	500 fishermen — 1988	300 fishermen — 1987
• Mekong	(Thailand — Lumpao)	↑	2,321 t — 1983	3,576 t — 1987
	(Cambodia)	↓	120,000 t/yr	84,000 t/yr
		↑	80,000 prof. fishermen	100,000 prof. fishermen
		↓	40,000 temp. fishermen	20,000 temp. fishermen
		↑	200,000 families — 1960	300,000 families — 1992
	(Delta)	↓	145,000 t — 1980	100,000 t — 1992
	(Nan N'Gum)	↓	818.8 t — 1985	204 t — 1990

Uses			Trend	Past	Present
6.	AQUACULTURE				
	• Mekong	(Cambodia)	↑	3,000 t — 1985	8,550 t — 1992
		(Laos)	↑	3 stations — 1975	8 stations — 1992
7.	TRANSPORTATION				
	Navigation				
	• Niger	(Basin)	↑	Navigability — 5 months — 1987	Navigability — 7 months — 1992
		(Nigeria)	↑	237 t upstream	8,575 t upstream
			↑	315,000 t downstream — 1980	1,102,846 t downstream — 1992
	• Mekong	(Delta)	↔	4×10^6 t/yr	4×10^6 t/yr
			↑	6,500 passengers/yr — 1987	6,900 passengers/yr — 1991
		(Laos)	↑	262,000 t/yr — 1976	1,066,000 t/yr — 1991
			↓	583,000 passengers/yr — 1990	121,000 passengers/yr — 1991
		(Thailand)	↓	3,000 passengers/yr — 1985	1,000 passengers/yr — 1991
	• Senegal	(Bafoulabe — Loutou)	↑	25 canoes, 3 barges — 1958	115 canoes
				45 canoes, 6 barges — 1982	18 barges — 1991
8.	FORESTRY				
	a) Silviculture				
	• Chad	(Nigeria)	↓	1,000 ha	400 ha
				1×10^6 plants — 1990	0.48×10^6 plants — 1992
	Agroforestry				
	• Kagera	(Burundi)	↑	46,000 ha plantation — 1980	91,814 ha plantation — 1991
	b) Logging				
	– Firewood				
	• Niger	(Burkina Faso)	↑	3.25×10^6 steres — 1980	$4{,}556 \times 10^6$ steres — 1992
	• Senegal	(Mauritania)	↓	2.5×10^6 quintals — 1960	0.5×10^6 quintals — 1992
	– Sawmill lumber				
	• Chad	(Chad)	↓	Abusive logging pre-1960	Decrease in logging — 1980-1993
	• Mekong	(Laos)	↓	310,000 m^3 — 1990	300,000 m^3 — 1991
	• Kagera	(Burundi)	↑	1,182,029 TEP — 1984	1,604,793 TEP — 1989
	– Exudation products				
	• Chad	(Chad)	↓	Arabic gum: 900 t until 1966	Decrease in exploitation — 1992
9.	TOURISM				
	• Kagera	(Rwanda)			
	• Parc Akagera		↑	4,771 visitors — 1975	Marked decrease — 1992
			↓	14,540 visitors — 1989	
	• Parc des Volcans		↑	830 visitors — 1975	
			↓	5,282 visitors — 1988	Marked decrease — 1992

Uses		Trend	Past	Present
10. CONSERVATION				
a) **Preserves**				
• Mekong	(Cambodia)	↓	11 sites, 3,500 ha — 1970	8 sites, 3,000 ha — 1992
	(Vietnam)	↑	15 sites — 1970	20 sites — 1992
	(Thailand)	↔	200 sites — 1970	200 sites — 1992
b) **National parks**				
	(Cambodia)	↓	2 sites — 1970	0 site — 1992
	(Vietnam)	↑	1 site — 1980	3 sites — 1992
	(Thailand)	↑	2 sites — 1985	5 sites — 1991
• Niger	(Benin)	↓	3,490 km^2 — 1986	<3,000 km^2 — 1992
• Senegal	(Mauritania) (Rosso)	↓	High concentration; a variety of species	Decreased concentration; disappearance of species — 1992
11. ENERGY				
a) **Hydroelectric power**				
• Niger	(River)	↑	1,500 MW — 1980	2,100 MW — 1987
• Kagera	(Burundi)	↑	1,250 kW — 1982	4,000 kW — 1992
	(Rwanda)	↑	69.4 GWh, 4 stations — 1981	107.8 GWh, 6 stations — 1990
• Senegal		↑	400 kW — 1932-1988	
			1,030 kW — 1988-1991	1,180 kW — 1993
• Mekong	(Laos)	↑	210 MW	216 MW
		↑	708 GWh — 1990	827 GWh — 1991
			1 station — 1971	4 stations — 1993
	(Thailand)	↔	100 MW	100 MW
		↑	1 station — 1972	5 stations — 1992
	(Cambodia)	↑	0 station — 1972	1.3 MW, 1 station — 1992
	(Vietnam)	↑	30 kWh/yr, 4 MW — 1990	95 kWh/yr, 12 MW — 1993
b) **Thermal**				
• Mekong	(Laos)	↑	17 MW — 1989	19.2 MW — 1991
	(Vietnam)	↔	33 MW — 1975	33 MW — 1993
c) **Biogas**				
• Niger	(Burundi)	↑	630 m^3/d — 1987	1,600 m^3/d — 1991
12. REMOVAL OF MATERIAL				
Chad				
• Clay	(Chad)	↓	Industrial brickwork — 1979	Brickyard closed 1979-1993
• Natron	(Chad)	↓	Intensive exploitation — 1976	Decrease or stop in extraction — 1993
Niger				
• Gold	(Burkina Faso)	↑	0 site — 1980	11 sites, one industrial — 1993
panning	(Guinea)	↑	Traditional — 1982	Industrial on 800 m stretch — 1993
• Sand	(Mali, Bamako)	↑	Traditional — 1960	Semi-industrial, several thousand m^3/yr — 1993
13. HUMAN HEALTH				
• Kagera Malaria	(Gitega)	↓	5.2% prevalence — 1990	85.6% prevalence — 1991
• Senegal Intestinal bilharzia	(Richard Toll)	↓	0% — 1986	
			30% — 1990	
			47% — 1991	57% — 1992

EXAMPLE OF APPLICATION: FISHERIES ON THE NIGER

From the analysis and synthesis of available information we wish to identify the changes that have occurred in fisheries during the period and within the territory under study.

To do so, we will use the same measurement units we used to characterise the current state of fisheries at Stage 1 (Table 1A).

The objective now is to identify changes quantitatively (number of fishermen, landings) and qualitatively (species, fish size) that have occurred within different fishing areas over the years (Table 4).

From this information, we must produce a document describing the importance of changes. We must determine if these changes were sudden or progressive (temporal aspect) and specifiy the locations where they were observed (spatial aspect). An integrated analysis is then completed to identify when and where changes were observed.

This document includes tables with analysed data sets; using graphs showing landings versus time, and maps illustrating the location of fishing activities over time, we have to establish trends in fisheries.

We have to pay special attention to these trends; were there sudden changes, and if so, when did they occur? The localisation of fishing activities and their changes must also be considered.

Information sources will be described in Table 3 and referred to in the reference list at the end of the document.

The document produced at the second stage of the framework is intended for decision-makers. It must clearly emphasise a limited number of phenomena related to fisheries, phenomena that we will try to explain for two reasons:

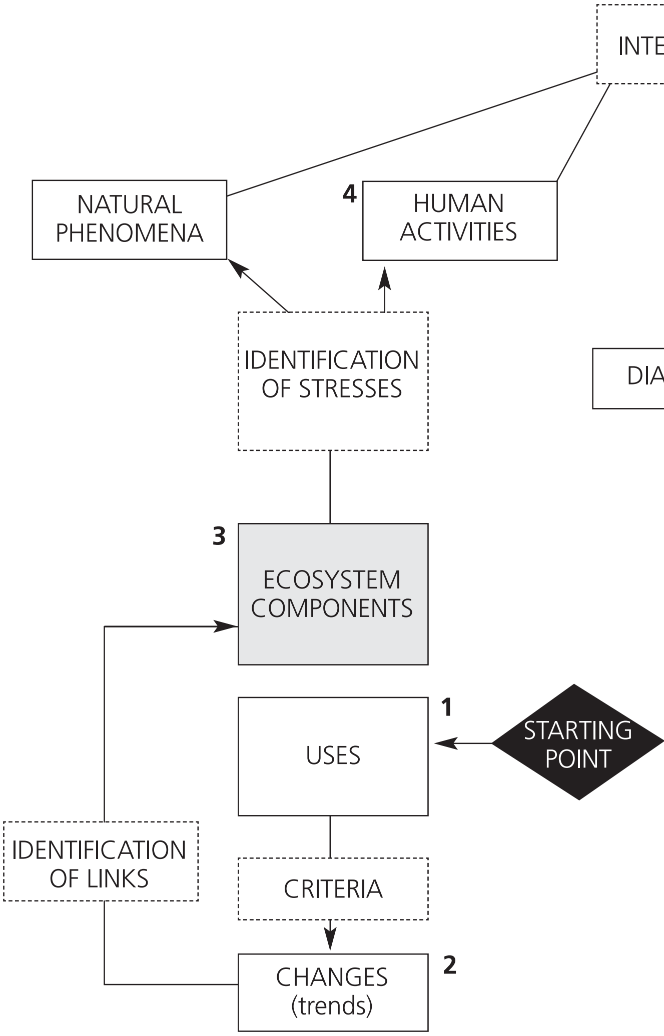
- To better understand what happened during the period and within the territory under study;
- To anticipate changes that could occur in the future.

Looking for explanations to these phenomena we will have to formulate hypotheses that we will verify later in the next stages of the river basin management framework (identification of links and causes).

RESULTS FROM STAGE 2:

- **Data sheets on documents used (Table 3) for each use and biological resource: printed material, data bases, maps, etc.**
- **List of changes and trends observed in uses and biological resources (Tables 4A and 4B).**
  Blank copies of Tables 3, 4A and 4B are provided in Appendix 6.

The N'Djamena Seminar,
April 19-30, 1993.



STAGE 3

Ecosystem Components

OBJECTIVES

- To describe the current state of ecosystem components.
- To evaluate modifications in ecosystem components.
- To establish links between modifications in ecosystem components and changes observed in uses and biological resources.

MEANS

- Seeking, analysing and synthesising available information.
- Comparing data collected with quality and quantity criteria.
- Using matrices.

RESULTS

- A synthesis establishing the current state and modifications for each ecosystem component, in time and space.
- A document establishing the links between modifications in ecosystem components and changes observed in uses and biological resources.

STAGE 3: ECOSYSTEM COMPONENTS

DEFINITIONS

Throughout the first two stages of the river basin management framework, we described the current state and changes in uses and biological resources. With Stage 3, we look for the causes of these changes. As this is a natural ecosystem in which man is living, changes may be explained either as a result of human activities or as an effect of natural phenomena. But before we get too deeply involved in the search for causes, we will stop to consider for a moment the river ecosystem components; we want to know if modifications at the ecosystem level correspond, in time and space, to changes observed in uses and biological resources. We will first go through this level of integration as several changes within uses or biological resources may be linked to the same modification of an ecosystem component.

The notion of ecosystem implies the existence of well-defined functions and processes. Man is part of this system (see the section on Ecosystem Approach). What is of interest to us here are the links between the main ecosystem components, and the uses and biological resources that are part of the ecosystem. The central notion is of a system, characterised by internal processes and, to some extent, durability and resilience. In the proposed framework, the river ecosystem is reduced to three of its main components:

- *Water*: in quantitative terms (levels, flows, etc.) and qualitative terms (physical, chemical, bacteriological, etc.);
- *Sediments*: solids deposited on the river bed in quantitative terms (volume, tonnage, etc.) and qualitative terms (contamination, particle-size distribution, etc.);
- *Habitats*: by major type, corresponding to the main biological communities, in quantitative terms (surface area, density, etc.) and qualitative terms (productivity, variety, etc.).

This simplification allows us to turn our attention to the essential, without attempting to explain everything. At this stage, we have to proceed in two successive steps. We will first establish the current state and modifications of the ecosystem components. Then we will proceed with the identification of links that may exist between these modifications and the changes observed at Stage 2 for uses and biological resources.

MODIFICATIONS TO ECOSYSTEM COMPONENTS

Here again, the use of objective criteria is a basic tool for describing the current state and evaluating modifications to ecosystem components in both space and time.

A number of criteria have been defined internationally. Using them allows for the comparison of levels observed in the region under study with situations documented elsewhere. But one must be fully familiar with the particular context in which these criteria were developed and applied.

When data are limited and preclude the use of quantitative criteria, we must define categories that are as objective as possible.

Finally, in many cases, we can only rely on a limited number of parameters, used as “indicators”. Certain reference levels are thus established, for instance:

– *For water*: pH, conductivity;

– *For sediments*: percentage of organic matter;

– *For bacteriological contamination*: fecal coliform count per 100 ml;

– *For toxic contamination*: concentration of heavy metals or well-known pesticides.

For each ecosystem component, we attempt to describe the current state (Table 5), to evaluate modifications that have occurred in time and space (Table 6), and to derive trends (Table 7). In order to do so, information must first be sought and two data sheets completed for each ecosystem component, the first establishing the current state, and the second identifying modifications. Again, we will attempt to formulate as many quantitative statements as possible.

One sheet is completed per document. A brief statement is drafted on modifications that have occurred in the ecosystem component. The reference is clearly indicated in the case of quality criteria; these may come from various sources and have their own significance. The results of the five 1992-1993 seminars are presented in Tables 7A and 7B; as with Table 4, we can identify at a glance the main modifications that the ecosystem has been through, with reference to spatial (where?) and temporal (when?) aspects.

In the "present" column are results taken from fact sheets (Table 5) while the "past" column is completed with results from Table 6. As with Table 4, we will identify trends using the same symbols and the same comments applied to the spatial and temporal scales.

IDENTIFYING LINKS

We now attempt to identify links between modifications in ecosystem components and changes in uses and biological resources. For this purpose, we can use a first tool, an interrelationship matrix (Tables 8A and 8B):

- Rows show ecosystem components (Table 7);
- Columns present uses and biological resources (Tables 1A and 1B);
- By convention, the following question is always asked in the same order:

  *If component X is changed, can this have a **direct** effect on use Y?*

If the answer is "yes", an interrelationship is indicated (•); if the answer is "no", the absence of a link is indicated (–). Depending on available information, the link can be real and well documented, or potential and to be demonstrated; we will have to take this into account when we analyse the results. The reverse question, the effect of uses on ecosystem components, will be treated at the next stage (Stage 4) where some uses will be considered as human activities.

Each question requires an answer and the overall results allow for a rapid appraisal of the relationships that exist between these two sets. Reading down a column of the matrix illustrates the links between one ecosystem component and several uses and biological resources; looking along a horizontal line allows us to measure the sensitivity of a use or biological resource to modifications in ecosystem components.

The matrix method imposes judgments, and remains an initial analysis tool that allows for pre-sorting among a broad range of possible interrelationships. This is indeed a primary tool but so easy to use. Subsequently, the analysis continues on each interrelationship.

It is necessary to match the space and time dimensions of the changes, on the one hand, and, on the other hand, to verify the scientific validity of the causal links identified.

It is important to remember that in the absence of scientific proof, the manager must nonetheless reach an opinion. Caution is therefore necessary, but we can always consider an interrelationship to be possible (potential links) until additional data enable us to refine our judgment.

The Geographical Information System is quite often used to facilitate spatial analysis by superimposing digitised and geo-referenced information. This may also be done manually, with several layers of transparencies in varied colours while the superimposed areas are calculated with a planimeter.

At the end of Stage 2, hypotheses were formulated to explain changes among uses and biological resources; we may now verify the ones that were linked to ecosystem components. The end of Stage 3 is also favourable for the formulation of hypotheses, attempting to explain the modifications in ecosystem components; which of man or nature, or even both at the same time, is responsible for these modifications? Here again one should pay special attention to spatial (are links established for the same territory?) and temporal (do the links coincide to the same periods?) dimensions.

A discussion on available information should allow for the identification of the means that will have to be put in place to improve the quality of information. Take note of the conclusions as they are also part of the management diagnosis for the territory under study.

TABLE 5
Data Sheet — Current State of Ecosystem Components

RIVER: **Niger**

ECOSYSTEM COMPONENT: **Water (quantity)**

CURRENT STATE: Flow in Upper Basin is 973 m^3/sec (1980).
Flow at Tiguiberi is 970 m^3/sec (1980).
Flow at Niamey is 1,600 m^3/sec (1985-1986).

Reference	Location	Medium	Timespan	Territory
	Hydraulics Division Secretariat of State for Energy Guinea	Reports (printed material)	1983	Upper Basin
	ORSTOM Hydraulics Division Ministry of Mines, Hydraulics and Energy Niger	Automated data banks Reports (printed material)	1983 1985-1986	Upper Basin Niamey

TABLE 6
Data Sheet — Modifications in Ecosystem Components

RIVER: **Niger**

ECOSYSTEM COMPONENT : **Water (quantity)**

MODIFICATIONS: Flow in Upper Basin was 99 m^3/sec (1956).
Flow at Tiguiberi was 1,513 m^3/sec (1951).
Flow at Niamey went from 2,000 m^3/sec in 1963-1964 to 1,600 m^3/sec in 1973-1974 and 1,250 m^3/sec in 1984-1985.

Reference	Criteria	Location	Medium	Timespan	Territory
	Flow (m^3/sec)	Hydraulics Division Secretariat of State for Energy Guinea	Reports (printed material)	1956	Upper Basin
		ORSTOM	Automated data banks	1951	Tiguiberi
		Hydraulics Division Ministry of Mines, Hydraulics and Energy Niger	Reports (printed material)	1963 to 1986	Niamey

TABLE 7A

Trends Observed in Ecosystem Components (1995) (Water Quantity)

Components	Trends	Past	Present
NIGER			
Upper basin	↓	51,947 × 10^6 m^3	31,981 × 10^6 m^3
Middle basin	↓	33,645 × 10^6 m^3	21,294 × 10^6 m^3
Lower basin	↓	204,021 × 10^6 m^3	147,152 × 10^6 m^3
		1960-1961 — 1969-1970	1970-1971 — 1991-1992
CHAD			
Lake	↓	60 × 10^9 m^3 — 1975	38 × 10^9 m^3 — 1988
	↓	25,000 km^2 — 1960	
	↓	10,000 km^2 — 1975	
	↑	2,000 km^2 — 1984	10,000 km^2 — 1988
SENEGAL			
Bakel	↑	210 m^3/s — 1984-1985	375 m^3/s — 1992-1993
Diama	↑	0.30-1.20 m — 1989-1990	1.50-1.75 m — 1992-1993
Manantali (reservoir)		160.0 m — 1987	
	↑	198.0 m — 1990	
	↑	207.5 m — 1991	
	↓	203.5 m — 1992	198.5 m — 1993
KAGERA			
Kigali	↓	360 m^3/s — 1963	
		265 m^3/s — 1973	112 m^3/sec — 1988
Rusumo	↓	772 × 10^7 m^3 — 1962-1983	577 ×10^7 m^3 — 1984
MEKONG			
Laos (Vientiane)	↓	4,614 m^3/s — 1913-1981	± 3,000 m^3/s — 1992
Thailand (Mun)	↑	12,008 × 10^6 m^3 — 1965	19,451 × 10^6 m^3 — 1979
Cambodia (Stung Freng)	↑	11,400 m^3/s — 1968	14,800 m^3/s — 1991
Vietnam (Pakse)	↓	3.64 m — 1982	3.26 m — 1989

TABLE 7B
Trends Observed in Ecosystem Components (1995) (Water Quality)

Components	Trends	Past	Present
CHAD			
Gashua	↑	80 ppm — 8/73	876 ppm — 8/84
– S.S.		100 ppm — 9/73	227 ppm — 9/84
		40 ppm — 11/73	104 ppm — 11/84
SENEGAL			
Lower valley			
– S.S.	↑	50 mg/l — 1983	60 mg/l — 1992
Lac de Guiers	↑	250 mg/l — 1958	
– chlorides		280 mg/l — 1960	300 mg/l — 1992
KAGERA			
Rusumo			
– conductivity	↓	89.7 µs/cm	83.6 µs/cm
– pH	↑	7.07 — 6/1978	7.5 — 10/1978
Ruvuba			
– conductivity		43.8 µs/cm	44.4 µs/cm
– pH	↓	7.5 — 6/1978	6.65 — 10/1978
MEKONG			
Nam N'Gum (Laos)			
– pH	↔	7.51 — 1987	7.51 — 1989
Mun R. (Thailand)			
– transparency	↓	29.5 cm	26.25 cm
– pH	↑	6.5	7.27
– DO	↓	8.5 ppm	6.0 ppm
– DBO	↑	0.9 ppm	2.15 ppm
– conductivity	↓	182.5 µmhos — 1981	177.5 µmhos — 1992
Cantho (Vietnam)	↑	0.3 kg/m^3 — 1960	0.5 kg/m^3 — 1992
– S.S.			

TABLE 7C
Trends Observed in Ecosystem Components (1995) (Sediments)

Components	Trends	Past	Present
NIGER			
In Niger	↑	4 t/ha/yr — 1969	25 t/ha/yr — 1982
SENEGAL			
Lower valley	↑	1.1 × 10^6 t — 1983-1984	1.5 × 10^6 t — 1992
MEKONG			
Nam N'Gum	↓	282,956 t — 1987	
	↑	206,447 t — 1988	
		251,886 t — 1989	369,780 t — 1990
Nam Num	↓	4.04 × 10^6 t — 1962	3.9 × 10^6 t — 1978

TABLE 7D
Trends Observed in Ecosystem Components (1995) (Habitats)

Components	Trends	Past	Present
a) Macrophytes			
• Senegal			
– Fresh water lettuce	↑	Negligible — 1984	Considerable development 1992
– Water lillies, reeds	↓	Entire basin — 1960	
	↑	Strong reduction — 1972	
		Improvement — 1986-1987	Accelerated growth — 1992
• Niger			
– Water hyacinths	↑	Several patches — 1988	Invades cutoffs (Niamby-Gaya) — 1991
• Chad			
– Macrophytes	↑	Absence of vegetation — 1972-1973	Occupies a large part of the southern section of the lake — 1992
b) Islands and Islets			
• Senegal			
– Delta	↓	Increase in area 1972	Decrease in area 1992
• Chad	↑	30 islands	80 islands
c) Floodplains			
• Senegal			
– Mauritania	↓	150,000 ha — 1950	10,000 ha — 1992
– Senegal (Bakel — St-Louis)	↑	262,000 ha — 1986	
		394,295 ha — 1988	429,154 ha — 1992
• Niger			
– Mali	↓	32,000 km² — 1930	28,000 km² — 1990
– Burkina Faso	↑	41 km² — 1966	97 km² — 1992
• Chad			
– Cameroun	↓	60,000 km² — 1973	30,000 km² — 1988
– Nigeria	↓	2,000 km² — 1964-1971	
		2,000-1,000 km² — 1972-1982	900 km² — 1987
d) Gallery Forests			
• Senegal	↓	Several clumps — 1950	Upper basin only — 1982
• Kagera (including the Burundi savannah)		104,000 ha — 1942	
	↓	56,784 ha — 1991	41,600 ha — 1992
e) Forests			
• Senegal			
– Mauritania	↓	13 protected forests — 1950	Generalised deterioration — 1992
– Mali	↓	Baoule loop Park; dense forest — 1972	Marked deterioration — 1992
• Niger			
– Burkina reach	↓	65 saplings/ha — 1980	<65 slaplings/ha — 1992
f) Mangrove Swamps			
• Mekong	↓	250,000 ha — 1960	100,000 ha — 1992
• Senegal			
– Mauritanian delta	↓	Dense, diversified and in good condition — 1985	Marked deterioration — 1992

EXAMPLE OF APPLICATION: FISHERIES ON THE NIGER

From the interrelationship matrix (Table 8A), we can see that fishing may be affected by the overall modification of river ecosystem components.

Seeking, analysing and synthesising the available information leads us first to describe the current state of each ecosystem component, using quality and quantity criteria. For instance, we can establish certain links between the current state of the ecosystem and the current situation of fisheries. This year, did river flow and the size of the flood plain enable fish to spawn?

Then, we must determine the modifications that have affected the ecosystem components, in time and space.

An attempt must be made to explain “matches” between an ecosystem modification and a change already observed in the fisheries. We attempt to verify the hypotheses put forward in the previous stage. Is there a period during which modifications in water level (sudden or gradual) match changes in catches?

Are the areas flooded at a given moment still flooded, and can this explain movements of fish populations or their disappearance from certain stretches of the river?

Comparison of trends observed in the fisheries and certain ecosystem-related phenomena therefore culminates in the formulation of hypotheses on certain links that are more obvious than others and, often, better documented.

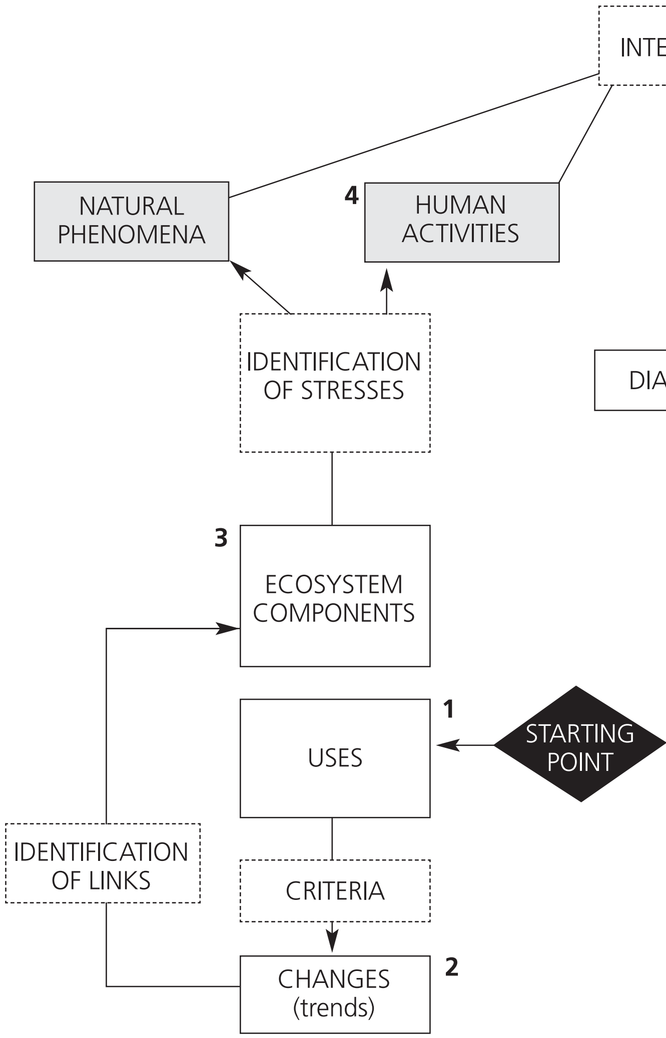
Therefore, we must try to explain as well as possible each interrelationship illustrated in the matrix. In the absence of direct known links, we refer to potential links that are to be further documented.

RESULTS FROM STAGE 3

- **Data sheets of documents used, for each ecosystem component, dealing with the current state (Table 5) and modifications (Table 6): printed material, data banks, maps, etc.**
- **A list of river ecosystem components, with modifications and trends (Table 7).**
- **An interrelationship matrix (Tables 8A and 8B) and identification of links between modifications of ecosystem components and changes in uses and biological resources.**
  Blank copies of Tables 5, 6, 7, 8A and 8B are provided in Appendix 6.

TABLE 8
Matrix of Interrelationships between Ecosystem Components and Certain Uses of the Niger and Senegal Rivers

Use	Water		Sediment		Habitat				
	Quantity	Quality	Quantity	Quality	Macrophytes	Islands — Islets	Flood Plain	Gallery Forests	Mangrove Swamp
Drinking water	•	•	•	•	–	–	•	–	–
Disposal (industrial wastewater)	•	–	–	–	–	–	•	–	–
Floodwater farming									
– natural	•	•	•	•	–	•	•	–	–
– irrigated	•	•	•	•	–	•	•	–	–
Irrigated farming	•	•	•	–	•	•	•	–	–
Stock breeding	•	•	–	–	•	•	•	–	–
Forestry									
– lumbering	–	–	–	–	–	–	–	•	–
– agroforestry	•	•	•	•	–	•	•	•	–
– silviculture	•	•	•	•	–	•	•	•	•
– gathering	–	–	–	–	•	•	•	•	•
Fishing	•	•	•	•	•	•	•	•	•
Fish farming	•	•	•	•	•	–	•	–	•
Transportation									
– navigation	•	–	•	–	•	•	•	–	•
– floating	•	–	•	–	•	•	•	–	•
Traditional beekeeping	–	–	–	–	–	•	•	•	–
Removal of material									
– quarries	•	–	•	•	•	•	–	–	–
– brickworks	•	–	•	•	•	–	•	•	–
Health	•	•	–	•	•	•	•	•	•



STAGE 4

Human Activities and Natural Phenomena

OBJECTIVES

- To describe the current state of human activities and natural phenomena.
- To define the evolution of human activities and natural phenomena.
- To establish links between the evolution of human activities and natural phenomena and the modifications to ecosystem components.

MEANS

- Seeking, analysing and synthesising available information.
- Comparing data collected with criteria or indexes.
- Using matrices.

RESULTS

- A synthesis establishing the current state and the evolution of each human activity and natural phenomenon in the timespan and the territory under study.
- A document establishing links between the evolution of human activities and natural phenomena, on the one hand, and the modifications to ecosystem components, on the other hand.

STAGE 4: HUMAN ACTIVITIES AND NATURAL PHENOMENA

After analysing changes in uses and biological resources, we established a few links between these changes and modifications in ecosystem components. Following the two exercises, hypotheses were formulated regarding the causes of these changes, mainly with the use of matrices. What we still have to do is to find causes for the modifications in ecosystem components; are they linked to human activities or are they an effect of nature?

This fourth stage is in two parts. First, the current state and the evolution of human activities and natural phenomena must be defined. Then causal links must be established between the evolution of these two series of causes and the modifications observed in ecosystem components.

DEFINING CURRENT STATE AND EVOLUTION

Human activities

At this point, a list should be drawn up of those human activities entailing modifications to ecosystem components (water, sediments and natural habitats). We must now include those water uses that may have such effects and consider them as human activities. The list of uses (Table 1A) is the starting point; we will then add activities not associated with water uses. Table 11 provides a list of human activities derived from the five 1992-1993 seminars. Socioeconomic data account here for a large proportion of the information necessary for the analysis of effects; production systems, traditional land use models and population movements can be compared (same timespan, same territory) with modifications in ecosystem components.

Natural phenomena

The specific context of the framework should not be forgotten: the establishment of links between the evolution of certain natural phenomena and the modifications to ecosystem components, in the context of a planning exercise at the basin level.

The natural phenomena which are of interest to us here are therefore those affecting hydrological regimes (precipitation, deforestation due to erosion or epidemics, etc.) and large-scale habitat changes (desertification, for instance). We are looking for natural phenomena that would have undergone important changes over the years, with readily identifiable trends.

Some natural phenomena have short cycles, with important inter-annual variations (temperature, humidity); others can be quite variable (wind) while showing well-known seasonal patterns (monsoon). This is not what we are looking for, either because variations are at random or because there are no well established trends. Even if certain continental or global phenomena are having or may eventually have effects on river basins, these are often very difficult to measure and occur at spatial or temporal scales that go beyond the planning objectives (geological phenomenon). This does not mean that we will leave them unaccounted for entirely; we will include them in long-term adaptation scenarios (climate change) or contingency plans designed to face violent natural events (floods, earthquakes). The importance of the impacts of violent natural events cannot be evaluated on the same basis as human activities. Let us note however that wars are human activities whose effects are quite similar to violent natural phenomena. A number of natural disasters may also have major effects; but one of their features is their unpredictability and they will not be dealt with in the course of the seminar.

For each human activity and each natural phenomenon, the information must first be sought and two data sheets completed; the approach is similar to that followed in Stages 2 and 3. The first data sheet establishes the current state, and the second identifies the evolution in time and space (Tables 9 and 10).

One sheet is completed per document. A brief statement is drafted on the evolution that has occurred in the human activity or natural phenomenon. The reference is clearly indicated in the case of the criteria used; these may come from various sources and have special significance.

We will then regroup the information to fill Tables 11 and 12; the results presented here are from the five 1992-1993 seminars. Consulting these two tables will facilitate the preparation of lists of human activities and natural phenomena for the seminar. The information in the “present” column is extracted from Table 9, while the “past” column is built from Table 10. As in previous exercises, arrows indicating trends and statements are clear in terms of territory (where?) and timespan (when?). We will again make a diagnosis on the state of available information on human activities and natural phenomena, with recommendations on essential information needs.

ESTABLISHING CAUSAL LINKS

We now attempt to establish the causes for the modifications to ecosystem components by establishing the links that may exist with the evolution of human activities and natural phenomena.

To this end, we can use a matrix tool, with the same approach already applied in Table 8. The rows present human activities and natural phenomena, while the columns show ecosystem components (Tables 13 and 14). The following question is asked (Table 13):

*If human activity X changes, can this have a **direct** effect on ecosystem component Y?*

If the answer is "yes", an interrelationship is indicated (•); if the answer is "no", the absence of a link is indicated (–).

Then, for the second matrix (Table 14), we ask ourselves the following question:

*If natural phenomenon X changes, can this have a **direct** effect on ecosystem component Y?*

If the answer is "yes", an interrelationship is indicated (•); if the answer is "no", the absence of a link is indicated (–).

As mentioned earlier, the matrix method imposes judgements, and remains an initial analysis tool that allows for pre-sorting among a broad range of possible interrelationships. Depending on the nature of the data available, the interrelationship may be real and well-documented, or potential and to be demonstrated. Subsequently, the analysis continues on each interrelationship; it is necessary first to match the spatial and temporal dimensions of the evolution of human activities and natural phenomena with the modifications to ecosystem components; then the scientific validity of the causal links thus identified must be verified.

Note that we are not looking for scientific proof but rather for a focus for action to be undertaken. In the absence of precise scientific data, we are nonetheless interested in potential interrelationships, since they provide managers with valuable hypotheses.

A Geographical Information System is quite often used to facilitate spatial analysis by superimposing digitised and geo-referenced information. This may be done manually, with several layers of transparencies in varied colours, while the superimposed areas are calculated with a planimeter.

TABLE 9
Data Sheet — Current State of Human Activities and Natural Phenomena

RIVER: **Niger**

HUMAN ACTIVITY: ______________________

or

NATURAL PHENOMENON: **Rainfall**

CURRENT STATE: Tillabery: c. 400 mm (1991)

Reference	Location	Medium	Timespan	Territory
	AGHRYMET	Reports (printed material)	Yearly	Tillabery region

TABLE 10
Data Sheet — Evolution in Human Activities and Natural Phenomena

RIVER: **Niger**

HUMAN ACTIVITY: ______________________

or

NATURAL PHENOMENON: **Rainfall**

EVOLUTION: At Tillabery, precipitation fell from 533 mm (1948-1967) to 354 mm (1968-1987).

Reference	Criteria	Location	Medium	Timespan	Territory
	Precipitation (mm)	AGRHYMET	Reports (printed material)	1948 to 1987	Tillabery region

TABLE 11
Evolution in Human Activities (1995)

Human Activities		Trends	Past	Present
1. BUSH FIRES				
• Chad	(Niger)	↓	320,000 ha — 1977	300,000 ha — 1980-1990
• Niger	(Burkina Faso)	↑	Decrease in area (policies) — 1985-1986	Increase (change in political regime) — 1987-1992
• Mekong	(Cambodia)	↓	50% of territory — 1970	27% of territory — 1985
• Senegal	(Basin)	↓	Increase until 1989	Decrease since 1990
2. GROUND TRANSPORTATION				
• Niger	(Burkina Faso)	↑	550 km of impassable roads 1983	975 km of road, of which 425 km paved — 1992
• Senegal	(Basin)	↑	Very limited network — 1975	Relatively large development — 1992
3. CONTROL STRUCTURES				
• Chad	(Chad)	↓	Construction of 55 km on the Logone — 1955	Degradation of dike — 1993
	(Nigeria — Kyobe)	↑	1 dam, 22×10^6 m^3 — 1970	20 dams, $3{,}658 \times 10^6$ m^3 — 1993
• Senegal	(Basin)	↑	National works — 1981	OMVS, Diama, Manantali works, 76 km dike on the right bank — 1993
4. URBANISATION				
• Niger	(Niger)	↑	7% growth rate 1970	10% growth rate 1980
	(Mali — Bamako)	↑	419,239 inhabitants — 1976	710,000 inhabitants — 1989
5. MINES				
Gold		↓	875,000 m^3 ore — 1988	nil — 1992
• Niger	(Guinea — Signiri)			
6. WAR				
• Mekong	(Cambodia)	↓	70% of territory — 1970-1975	30% of territory — 1979-1992

TABLE 12
Evolution in Natural Phenomena (1995)

Natural Phenomena		Trends	Past	Present
1. RAINFALL				
• Kagera	(Basin, upstream from Rusumo)	↑	1,121 mm — 1931-1950	1,209 mm — 1951-1971
• Chad	(Niger, Nguigni)	↓	480 mm — 1962	
			290 mm — 1988	216.2 mm — 1992
	(Niger, Gome)	↓	650 mm — 1952	390 mm — 1988
	(Chad, N'Djamena)	↓	441.1 mm — 1982	228.5 mm — 1984
	(Cameroon, Kaele)	↑	768.9 mm — 1980	783 mm — 1990
	(RCA, Bosangoa)	↑	1,309.9 mm — 1980	1,297.6 mm — 1990
		↓	1,550.7 mm — 1988	
• Senegal	(Senegal, Bakel)	↓	469 mm –1986	
		↑	433 mm — 1984	
		↓	663 mm — 1988	386 mm — 1991
• Niger	(Upper basin, Bamako)	↓	981 mm — 1960-1970	876 mm — 1971-1990
	(Mid-basin, Mopti)	↓	<500 mm — 1902-1972	<400 mm — 1973-1990
	(Lower basin, Tillabery)	↓	533mm — 1948-1967	354 mm 1968-1987
• Mekong	(Cambodia, Pnom Penh)	↓	1,368 mm — 1958	1,274.3 mm — 1963
	(Thailand, Mun)	↓	1,588 mm — 1951	1,489 mm — 1980
	(Vietnam, Cantho)	↑	1,115 mm — 1965	1,635 mm — 1992
2. EVAPORATION				
• Chad	(Kamodougou/Yobe)	↑	0 from reservoirs before 1970	300 × 10^6 m^3 from reservoirs — 1993
• Senegal	(Senegal, Bakel)	↑	2,616 mm — 1986	
		↓	2,687 mm — 1987	
		↑	2,549 mm — 1988	2,666 mm — 1989
• Niger	(Upper basin, Bamako)	↓	<1,800 mm — 1960-1970	>1,800 mm — 1971-1990
	(Middle basin, Niamey)	↑	<2,100 mm — 1951-1970	>2,100 mm — 1971-1990
• Mekong	(Cambodia, Pnom Penh)	↑	1,460 mm — 1929-1940	2,153.5 mm 1963-1970
	(Thailand, Mun)	↑	2,150 mm — 1951-1972	2,225 mm — 1980
	(Vietnam, Cantho)	↓	1,450 mm — 1965	1,250 mm — 1992
3. EVAPOTRANSPIRATION				
• Senegal	(Senegal, Bakel)	↑	2,351 mm — 1986	
		↓	2,394 mm — 1987	
		↑	2,289 mm — 1988	2,409 mm — 1989
4. SEDIMENTATION				
• Senegal	(River)	↑	1.1 × 10^6 t/yr — 1983-1984	1.5 × 10^6 t/yr — 1992
• Mekong	(Laos, Nam N'Gum)	↓	0.28 × 10^6 t/yr — 1987	
		↑	0.21 × 10^6 t/yr — 1988	
		↑	0.25 × 10^6 t/yr — 1989	0.37 10^6 t/yr — 1990
	(Cambodia, Pnom Penh)	↑	103.3 × 10^6 t/yr — 1939	140 × 10^6 t/yr — 1961
	(Thailand, Mum River)	↓	4.04 × 10^6 t/yr — 1962	2.3 × 10^6 t/yr — 1970
5. FLOODING				
• Kagera	(Cameroon)	↓	6,000 km^2 — 1977	4,000 km^2 — 1988
6. DESERTIFICATION				
• Chad	(Komadougou/Yobe)	↓	30,000 km^2 — 1978	29,500 km^2 — 1989
• Niger	(Timbuktu)	↑	Floodplain 100 km wide — 1984	30% reduction after 1984

Natural Phenomena	Trends	Past	Present
7. WIND EROSION • Senegal (Basin)	↑	25,000 ha/km/yr — 1975	35,000 ha/km/yr — 1991
8. LOCUST INFESTATION • Chad (Komadougou Yobe)	↑	Previously: June-July/ October-November	Now: June-November

EXAMPLE OF APPLICATION: FISHERIES ON THE NIGER

In the previous stage, we established links between modifications to the ecosystem (quantity of water for instance) and fisheries, using a matrix (Table 8) and cartographic analysis.

We now use the second series of matrices to identify which human activities or natural phenomena may have generated these modifications to ecosystem components affecting fisheries at the same time.

Numerous human activities may affect the quantity of water in the river and the flood plain (Table 13), whereas these same ecosystem components may be influenced by natural phenomena as a whole (Table 14).

Let us begin with the possible causal links between the current state (human activities and natural phenomena) and fisheries.

For instance, at what level were the dams operated? Were releases carried out during the year? Have new irrigated perimeters been developed, blocking access or modifying spawning grounds? As to rainfall, for instance, what level did the precipitation reach this year?

Then we evaluate temporal and spatial “matches” between the evolution of certain human activities or natural phenomena, whose causal links appear to have been possibly established for the current year, with previously observed trends, both in the ecosystem (lower water levels) and in the fishery itself.

Thus, rainfall has changed over long periods, with a marked downward trend. Many control structures were built, and areas developed for irrigated farming have increased.

The temporal analysis thus attempts to match the moments when certain phenomena occurred, whereas cartographic analysis matches surface areas undergoing changes. Following this analysis, we can develop certain hypotheses as to the causes of ecosystem modifications and, indirectly, changes in the fisheries. In some cases, the links are clear and direct: the drying of habitats, changes in river flow. In other cases, we are left with potential causes, for lack of adequate scientific knowledge.

RESULTS FROM STAGE 4

- **A data sheet of documents used, for each human activity and natural phenomenon, covering current state (Table 9) and evolution (Table 10): printed material, data banks, maps, etc.**
- **A list of human activities, evolution and trends observed (Table 11).**
- **A list of natural phenomena, evolution and trends observed (Table 12).**
- **Interrelationship matrices (Tables 13 and 14) and evaluation of causal links between the evolution of human activities and natural phenomena, on the one hand, and the modifications to ecosystem components, on the other hand.**

Blank copies of Tables 9 to 14 are presented in Appendix 6

TABLE 13

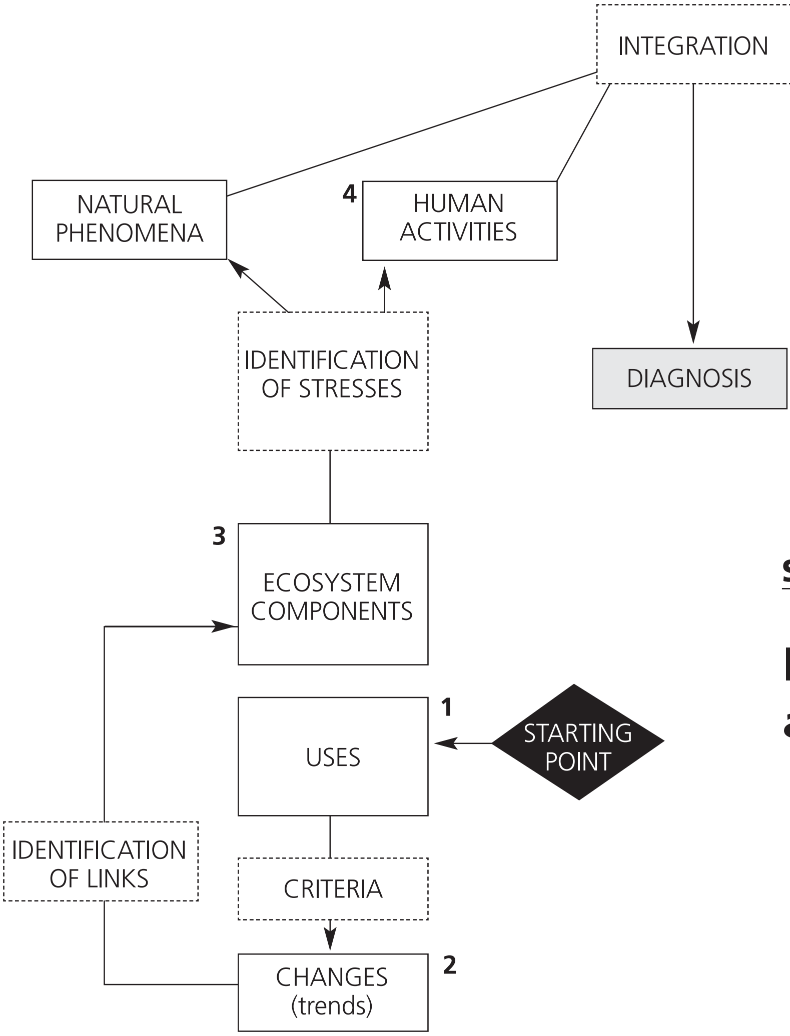
Matrix of Interrelationships Between Human Activities and Ecosystem Components (Niger and Senegal Rivers)

	Water Withdrawn (Drinking, Domestic and Industrial)	Disposal (Domestic and Industrial)	Natural Floodwater Farming	Irrigated Floodwater Farming	Irrigated Farming	Stock Breeding	Forestry — Logging	Agroforestry	Silviculture	Gathering	Bush Fires	Fishing	Fish Farming	Transportation — Navigation	Floating	Dredging	Control Structures	Combustion	Traditional Beekeeping	Urbanisation	Industrialisation	Quarries	Brickworks
Water:																							
Quantity	•	•	–	•	•	•	•	•	•	–	•	–	•	•	–	–	•	–	–	•	•	–	•
Quality	•	•	•	•	•	•	•	•	•	–	•	•	•	•	•	•	•	•	–	•	•	•	•
Sediment:																							
Quantity	–	•	•	•	•	•	•	•	•	–	•	–	–	•	•	•	•	–	–	•	•	•	•
Quality	–	•	•	•	•	•	•	•	•	–	•	–	–	•	•	•	•	–	–	•	•	•	•
Habitats:																							
Macrophytes	•	•	•	•	–	–	–	–	–	–	–	–	–	•	•	•	•	•	–	•	•	•	–
Islands and Islets	•	•	•	•	–	•	–	–	–	–	•	–	–	•	•	•	•	•	–	•	•	•	•
Floodplain	•	•	•	•	•	•	•	•	•	–	•	–	•	•	•	–	•	•	–	•	•	–	•
Gallery Forest	•	•	•	•	–	–	•	•	•	•	•	–	–	•	•	–	•	•	•	•	•	–	–
Mangrove Swamp	•	•	•	•	–	–	•	–	–	•	–	–	–	•	–	–	–	•	–	•	•	–	–

TABLE 14

Matrix of Interrelationships Between Natural Phenomena and Ecosystem Components (Niger and Senegal Rivers)

	Rainfall	Evaporation	Evapotranspiration	Erosion-sedimentation
Water:				
Quantity	•	•	•	•
Quality	•	•	•	•
Sediment:				
Quantity	•	–	–	•
Quality	•	–	–	•
Habitats:				
Macrophytes	•	•	•	•
Islands and Islets	•	•	•	•
Floodplain	•	•	•	•
Gallery Forest	•	•	•	•
Mangrove Swamp	•	•	•	•



STAGE 5

Integration and Diagnosis

OBJECTIVE

- To identify losses and gains in uses and biological resources, whether real or potential.

MEANS

- Evaluating cumulative effects.

RESULTS

- A summary table identifying real or potential losses or gains for each use and biological resource (diagnosis).

STAGE 5: INTEGRATION AND DIAGNOSIS

IDENTIFICATION OF GAINS AND LOSSES

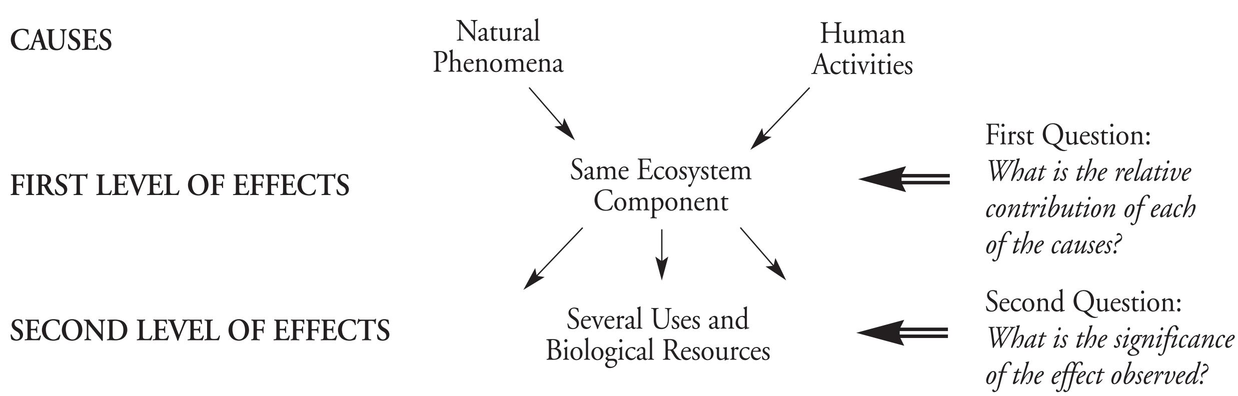
We have come a long way since the beginning of the management framework; through information gathering, we characterised the river basin in terms of uses and biological resources, plus the ecosystem components, trying to establish links between observed changes and the evolution of natural phenomena or human activities. The documentation phase concludes with the synthesis of results obtained through the analysis of available information and the development of an integrated diagnosis that will be used as a guide to make up the list of issues specific to the territory under study.

The logical sequence of our synthesis process is as follows: it recapitulates, in reverse, the chain of events we have already documented through matrix analysis (Tables 8, 13 and 14). We start from the cause to arrive at the effect. Natural phenomena and human activities may affect the same ecosystem component, and this is the first level of effect. In turn, this effect impacts on several uses and biological resources in a second chain of effects. This is what Figure T-2 illustrates.

We answer the *first question* by evaluating, for instance, discharged loads or affected surface areas; causes may then be ranked in a decreasing order of importance. What we try to identify, in a first step, is the relative importance of each cause of modification to ecosystem components. For instance, we can evaluate the rate of deforestation. Man contributes to it by logging, farming and urban development, construction of transport infrastructures; but nature also has some influence, through rainfall cycles or climatic phenomena like El Niño.

It is important to be able to establish the relative contribution of man and nature, be it in broad terms only. Indeed, in the planning and action stages, solutions to problems identified in the diagnosis will not be the same if the cause is of natural or human origin. Moreover, this question is often part of deep-rooted opinions; only a credible analysis may succeed in bringing parties to agree on the same vision of reality, an essential condition for the success of any planning and intervention process. A concrete example: in which proportion are the low water levels in a lake associated with evaporation rather than to the increased use of water for irrigation from an upstream tributary?

FIGURE T-2
Causual Links



The answer to the *second question* (Figure T-2) may be formulated in broad terms (global assessment); this is what we will do during the seminar. Nevertheless, more sophisticated approaches exist that allow for the estimation of cumulative effects on the environment, analyses that take into account the direction, scope, intensity, degree and duration of the effect. The final result may be a synthesis matrix presenting the overall results in a schematic format. The cumulative effect matrix presented in Appendix 8 was developed by Hydro-Quebec (1985) and adapted to the St. Lawrence River (Burton, 1991a); it illustrates this kind of instrument.

During this seminar, answers to both questions will be derived from discussions in plenary sessions; we will have to depend on "the weight of evidence" if we cannot produce a well-documented analysis before we establish the diagnosis.

DIAGNOSIS

An integrated analysis of effects leads us to determine, for each use or biological resource, whether there is a gain or a loss, what the current state is, and what the causes of the gain or loss are. We are referring here to factual gains or losses; the notion of problem will be derived from an analysis conducted at the next stage and requires a definition of values. Nevertheless, as a "diagnosis" is traditionally associated with a list of "problems", the Documentation phase will close on a list of what could be considered as problems to be solved at the Planning and Action phases that come next in the management framework.

So all elements from the diagnosis are not necessarily problems; we will also find gains associated to increased uses or biological resources. Nevertheless, even with gains, we may still consider that there is a problem if needs are not met. Therefore, it is essential to confront the factual evaluation of gains and losses with population expectations or objectives defined by political levels, which will be taken care of during the second phase of the management framework.

But let us go back to the diagnosis. First, the spatial (extent) and temporal (timespan) dimensions of the gains (Table 15A) and losses (Table 15B) must be clearly defined. For some uses (Table 4A) or biological resources (Table 4B) there were gains (positive effects), while in other cases losses will have been observed (negative effects). We have to be particularly careful with spatial and temporal dimensions of these statements; indeed, a problem is often linked to the magnitude of the changes in uses or biological resources, looking at the spatial (whole basin versus small sub-basin) or temporal (short term versus over several years) dimensions.

The last result of the Documentation phase, but not the least, is the preparation of a table to present in as complete as possible a diagnosis of the state of the basin: Table 16. For every use and biological resource, we indicate a brief description of the current state, a statement on gains or losses, a reference to the criteria used, a brief description of the causes of gains or losses, and a statement on the reliability of the diagnosis. This table allows for a rapid evaluation of all uses and biological resources, in order to identify what can be selected as problems and their causes, and is the basis for the planning phase that comes next. Table 16 presented here is a vast synthesis of results from the 1992-1993 seminars; it clearly illustrates the variety of gains and losses experienced in five large river and lake basins.

But in order to establish the diagnosis, we have to agree on a few conventions that are part of the results presented in Table 16, so that the reader can understand the meaning of our conclusions. Two definition sets are proposed below in order to provide answers to the following questions:

Has there been a gain or a loss?

What is the reliability of the diagnosis?

For the column "criteria used", we should use well-established thresholds accepted as reference points, as often as possible; if they are missing, we will at least indicate the measurement unit used. The information for the "cause" column is derived from the matrix analysis and discussions in plenary sessions. Finally, regarding the last column on the reliability of the diagnosis, we have to pay special attention to the difference between "known" and "likely" as defined

TABLE 15A

Spatial and Temporal Dimensions of Gains and Losses in Uses and Biological Resources (Senegal River)

	Spatial Dimensions	Temporal Dimensions
LOSS		
Floodwater Farming	Right bank	
	150,000 ha	1956
	20,000 ha	1990
Fishing	St. Louis Kaedi	
	10,000 fishermen	1960
	virtually stopped completely	1990
Transportation	Left bank	
	tonnage and number of passengers	
	substantial	1960
	insignificant	1991
GAIN		
Irrigated Farming	Right bank	
	200 ha	1963
	25,000 ha	1990
Forestry	Right bank	
logging for	2,273,775 quintals	1988
fuel	2,339,106 quintals	1991

earlier; information exists in both cases, but a link has only been established with the gain or loss in the case noted as "known".

This is the concluding exercise of the Documentation phase, which in practical terms occupies half of the duration of the seminar. This fifth stage is crucial to the planning process; it provides a list of gains and losses, established on the basis of available information and best judgement of experienced people, which will be used during the Planning and Action phases. We insist on the necessity to document, throughout this phase, what is known but also what should imperatively be documented in order to proceed eventually to a full-scale basin management exercise.

TABLE 15B

Spatial and Temporal Dimensions of Gains and Losses in Uses and Biological Resources (Niger River)

	Spatial Dimensions		Temporal Dimensions
GAIN			
Drinking Water	Segou		
	c. 13,000 people		1982
	(19% of population)		
	c. 40,000 people		1991
	(45% of population)		
Irrigated Farming	In Niger		
	3,000 ha		1974-1975
	7,593 ha		1991
Fishing	In Niger		
	No. of fishermen	10,000	1960-1976
		1,900	1989
		3,000	1990
	landings (t):	4,000-5,000	1970
		900	1985
		1,000-1,200	1990
Fish Farming	In Niger		
	a few ponds c. 5 t/year		1970-1980
	110 t/year (cages)		1990
	40 t/year (ponds)		
Transportation	Bamako-Gao		
	2 passenger vessels		1965
	6 passenger vessels		1991
Forestry:	Upper basin		
sawmill lumber	3,000 m^3		1975-1987
	25,000 m^3		1988-1991
HEALTH			
Guinea Worm Disease	Substantial drop (region)		From 1980 to 1991
Onchocerciasis	Mafou: population exodus		1975
(river blindness)	Eradication and repopulation		1991
LOSS			
Disposal of Industrial Water	Bamako		
	from 1 to 15 units		1960-1990
	10 units		1991
Hunting	In Niger		
	several types		1960-1972
	closed down		Since 1972
Health	Bamako		
molluscs	394/ha		1989
(intermediate hosts)	increased to 524/ha		1991

TABLE 16
Gain, Loss and Reliability of Diagnosis

LOSS OR GAIN?

Yes	The applicable criterion is exceeded; losses or gains have already been observed.
Maybe	The loss or gain has not been measured in the territory under study, but documents reported on elsewhere on the river present similar situations.
No	The applicable criterion is met; no loss or gain was observed.
Unknown	No information available

RELIABILITY OF DIAGNOSIS

Known	Data on the cause of the problem exist and enable us to establish a link between this cause and the loss or gain observed.
Likely	Data on the cause of the problem exist, but do not enable us to establish a link with the loss or gain observed. Studies are in progress on this subject.
Possible	There are few data on the cause of the problem, and these data do not enable us to establish a link with the loss or gain observed.

TABLE 16A
Diagnosis on the State of Uses (1995)

Use		Current State	Loss or Gain	Criteria Used	Causes	Reliability
1. WATER SUPPLY						
a) Domestic (treated)						
• Kagera	(Rwanda)	4.5 × 10^6 persons	Gain — Yes	No. of persons served	Improvement in distribution of water and financial resources.	Known
• Niger	(Mali)	6.8 × 10^6 m^3/yr in Bamako	Gain — Yes	m^3/yr	Increase in population and investments.	Known
• Senegal	(Senegal)	22% of the water supply in Dakar (1 × 10^6 persons) comes from Lac de Guiers	Gain — Yes	No. of persons served	Increase in demand, improvement in distribution network, availability of resource.	Known
		4.9 × 10^6 m^3/yr, right bank	Gain — Yes	m^3/yr	Increase in population and investments.	Known
		30% of coverage, right bank	Gain — Yes	Rate of coverage	Availability of the resource.	Known
• Mekong	(Laos)	20 × 10^6 m^3/yr in Vientiane	Gain — Yes	m^3/yr	National policy to improve the quality of life.	Known
b) Domestic (untreated)						
• Kagera	(Tanzania)	43,320 m^3/d 1,858,000 persons	Gain — Yes	m^3/d No. of persons	Increase in population.	Known
• Chad	(Kano)	40,000 m^3/d	Gain — Yes	m^3/d	Increase in population and urbanisation.	Known
• Niger	(Guinea)	16,716 m^3/d	Gain — Yes		Increase in population and investments.	Known
• Mekong	(Vietnam)	1 × 10^6 m^3/yr	Loss — Yes	m^3/yr	Reduction caused by deforestation.	Known
c) Industrial Water						
• Kagera	(Rwanda)	All industries are served	Gain — Yes	No. of industries served	Increase in industrialisation.	Known
• Niger	(Guinea)	8.8 × 10^6 m^3/yr	Loss — Yes	m^3/yr	Shutdown of mining industries.	Known
• Mekong	(Vietnam)	450 × 10^6 m^3/yr (Delta)	Gain — Yes	m^3/yr	Development of industrialisation. Economic growth.	Known
2. DISPOSAL						
• Kagera	(Tanzania)	19 cities serviced by network	Gain — Yes	No. of cities served	Urban development.	Known
3. AGRICULTURE						
a) Recessional — Natural						
• Chad	(Niger)	150 ha	Loss — Yes	ha	Rainfall loss; Control structures.	Known
	(Cameroon)	8,262 ha (Chari-Logone)	Loss — Yes	ha	Decrease in floodplain.	Known
	(Nigeria)	450 ha (Komadougou/Yobe)	Loss — Yes	ha	Reduction in runoff.	Known
• Senegal	(Mauritania)	400 ha (R'Kiz Lake)	Loss — Yes	ha	Drop in flooding.	Known
• Mekong	(Vietnam)	1.6 × 10^6 ha (Delta)	Loss — Yes	ha	Replacement by irrigation farming.	Known

b) Recessional — Improved						
• Senegal	(Mauritania)	2,500 ha (R'Kiz Lake)	Gain — Yes	ha	Planning and availability of water resource.	Known
c) Irrigation						
• Kagera	(Burundi)	1,443 ha	Gain — Yes	ha	Intensive farming.	Known
	(Uganda)	1,800 ha	Gain — Yes	ha	Absence of floods.	Known
• Chad	(Cameroon)	10,880 ha, 54,506 t/yr	Gain — Yes	ha — t/yr	Water control.	Known
	(Nigeria)	80,000 ha, 8 t/ha (Burno-Yobe)	Gain — Yes	ha — t/yr	Development of irrigation, improvement in cultivation practices.	Known
• Niger	(Basin)	500,000 ha	Gain — Yes	ha	Policy of self-sufficiency and of nutritional safety.	Known
					Increase in investments.	Known
	(Burkina Faso)	418 ha	Loss — Yes	ha	Abandoned for political reasons.	Known
• Senegal	(Basin)	107,239 ha	Gain — Yes	ha	Planning.	Known
					Availability of water.	Known
					Private initiatives.	Probable
					State policy.	Known
• Mekong	(Cambodia)	122,000 ha	Loss — Yes	ha	Use of fertilisers.	Known
					Investments.	
	(Vietnam)	900,000 ha (delta)	Loss — Yes	ha	Construction of drainage canals, salinity control, new varieties and fertilisers.	
	(Laos)	16,000 ha	Gain — Yes	ha	Salinity and drainage control.	Known
	(Thailand)	100,000 ha	Gain — Yes	ha	Salinity and drainage control.	Known
d) Rainfed						
•Kagera	(Rwanda -Burundi)	80% of areas sowed	Gain — Yes	% of areas sowed	Demographic increase and developmental efforts.	Known
	(Tanzania-Uganda)	256,000 ha	Gain — Yes	ha	Demographic increase and developmental efforts.	Known
• Niger	(Benin)	20,000 ha	Gain — Yes	ha	Demographic increase and reconversion of fishermen.	Known
					Decrease in pasture areas.	

4. STOCK BREEDING

a) Watering						
• Kagera	(Uganda)	14,000 heads (cattle)	Gain — Yes	No. of heads	Migration of breeders.	Known
		10 ranches	Gain — Yes	No. of ranches	Development policies and efforts.	Known
					Rainfall (habitat).	Known
•Chad	(Basin)	5.6×10^6 heads	Gain — Yes	No. of heads	Good vaccination coverage.	
		9.0×10^6 sheep			Pasture planning.	
		88,000 camels				
• Niger	(Burkina Faso)	1.2×10^6 UBT	Gain — Yes	UBT	Improvement in conditions (watering holes), animal health.	Known
					Farming-breeding association.	
• Senegal	(Mauritania)	2.5×10^6 heads (cattle)	Gain — Yes	No. of heads	Availability of water: hydro-agricultural planning and better rainfall.	Known
					Associated measures.	Probable
b) Pasturage						
• Chad	(Niger)	2.096×10^6 dry matter	Gain — Yes	t dry matter	Good rainfall.	Known
c) Transit zones						
• Niger	(Niger)	Decreased areas	Loss — Yes		Extension of rainfed farming; severe climate conditions.	Possible

d) Sanitary zoos						
• Kagera	(Basin)	600 units	Gain — Yes	No. of units	Policies to improve animal health.	Known
5. FISHING						
• Kagera	(Basin)		Gain — Maybe	t	New dietary habits.	Probable
• Chad	(Cameroon)	3,700 fishermen, 2,000 t	Loss — Yes	No. of fishermen, t	Insecurity of fishermen. Decrease in resources (prohibited nets).	
	(Niger)	500 fishermen, 215 t	Loss — Yes	No. of fishermen, t	Deficient rainfall. Decrease in resources (prohibited nets).	
• Niger	(Benin)	Less than 100 kg/yr/fisherman	Loss — Yes	kg/yr/fisherman	Decrease in resource and habitat (drought).	Known
	(Burkina Faso)	300 fishermen	Loss — Yes	No. of fishermen	Redirection of interests (irrigation agriculture).	Known
• Senegal	(Mali)	10,000 fishermen upstream from Manantali	Gain — Yes	No. of fishermen	Creation of the reservoir.	Known
	(Senegal)	6,000 t/yr	Gain — Yes	t/yr	Operation of dams (Diama, Manantali).	Known
• Mekong	(Cambodia)	300,000 fishermen, 84,000 t/yr	Gain — Yes	No. of fishermen, t/yr	New equipment. High flood levels. Fishing prohibited during spawning season.	Known
	(Laos)	204 t (Nam N'Gum) 40 fishing villages	Loss — Yes	t/No. of fishermen	Overfishing, use of dynamite, environmental changes.	Known
	(Vietnam)	100,000 t	Loss — Yes	t	Overfishing, loss of floodplains and mangroves.	Known
	(Thailand)	3,576 t/yr	Gain — Yes	t/yr	Improvement in the efficiency of fishing methods.	Known
6. AQUACULTURE						
a) Fish farming						
• Kagera	(Rwanda-Burundi)	50% of the territory	Gain — Yes	% of the territory	Search for increase in revenues, and diet quality.	Known
• Mekong	(Cambodia)	8,550 t/yr	Gain — Yes	t/yr	Government policies. Improvement in technology (cages).	Known
	(Vietnam)	3,000 cages — 9,000 t/yr	Gain — Yes	No. of cages, t/yr	Government policies. Improvement in technology (cages).	Known
b) Water breeding						
• Kagera	(Basin)	Embryonic	Gain — Yes	No. of species	Search for improvement in diet.	Probable
7. HUNTING						
• Kagera	(Basin)	Limited number of permits, or restrictions	Loss — Yes	No. of permits	Conservation policies. Decrease in hunting ranges. Animal migration.	Known
• Niger	(Burkina Faso)	87 permits	Gain — Yes	No. of permits	Resource availability and tourism.	Known
• Mekong	(Basin)		Loss — Yes	No. of hunters	Enforcement of regulations.	Possible
8. BEEKEEPING						
• Kagera	(Basin)	Praticed across the territory	Gain — Yes	No. of hives	Search for increased revenues, and diet quality.	Probable

9. TRANSPORTATION

a) Navigation						
• Kagera	(Basin)	Practiced on lakes and rivers	Gain — Yes	No. of units	Increase in trade.	Probable
• Niger	(Mali)	Small-scale navigation; 15,000 units	Gain — Yes	No. of units	Development of trade related to regulation by the Selingue dam.	Known
		Semi-heavy navigation; 20,000 t/yr	Loss — Yes	t transported/yr	Drought (draught). Competition with ground transportation, dilapidation of boats.	Known
	(Nigeria)	Heavy navigation: 8,575 t upstream and 1,102,896 t downstream	Gain — Yes	t	Industrial development (steel mills, etc.).	Known
• Senegal	(Valley)	From Bafoulabe to Coutou, 115 canoes, 18 barges	Gain — Yes	No. of units	Insufficient draught. Impracticability of roads.	Known
• Mekong	(Thailand)	10,000 passengers/yr	Loss — Yes	No. of passengers/yr	Competition from other modes of transportation.	Known
	(Vietnam)	1 million passengers	Gain — Yes	No. of passengers	Economic growth. Increase in the number of boats and in the length of canals. Government policies on navigation development.	Known
	(Laos)	121,000 passengers 1,066,000 t	Gain — Yes	No. of passengers t	Substantial savings for large quantities of goods transported.	Known
b) Floating						
• Kagera	(Basin)	Embryonic	Gain — Yes	t	Diversification of modes of transportation.	Probable

10. FORESTRY

a) Agroforestry						
• Kagera	(Rwanda-Burundi)	10% of forestry operations	Gain — Yes	% of operations	Parcelling of land. Environmental protection laws.	Known
	(Uganda)	2,000 ha	Gain — Yes	ha	Developmental efforts.	Known
b) Silviculture						
• Chad	(Nigeria)	400 ha of plantations 480,000 seedings produced	Loss — Yes	ha No. of plants	Drop in economic activity (financing).	Known
c) Logging						
• Niger	(Burkina Faso)	Firewood $4{,}536 \times 10^6$ steres/yr	Gain — Yes	Steres/yr	Increase in population and pursuit of profits. Difficult access to alternative sources.	Known
• Senegal	(Mauritania)	500,000 quintals of coal produced	Loss — Yes	Quintals	Scarcity of wood resources. Population awareness.	Probable
• Mekong	(Laos)	300,000 m^3 of timber	Loss — Yes	m^3	Deforestation for farming.	Known
	(Thailand)	26.8 % of territory	Loss — Maybe	% of surface area	Deforestation for farming and human settlement.	Known

11. TOURISM

a) Hunting and fishing						
• Kagera	(Burundi)	Hunting prohibited	Loss — Yes	No. of permits	Wildlife protection.	Known
b) Sightseeing						
• Kagera	(Rwanda)	14,540 visitors	Gain — Yes	No. of visitors	Advertising, developmental efforts, increase in financial resources for tourism.	Known

Use		Current State	Loss or Gain	Criteria Used	Causes	Reliability
12. CONSERVATION						
a) Protected areas						
• Niger	(Benin)	Less than 3,000 km^2 of protected forests and parks	Loss — Yes	km^2	Development of farming and breeding. Insufficient application of laws, and downgrading.	Known
• Senegal	(Mauritania)	Gani-Rosso forest, sparse and greatly diminished density	Loss — Yes	Density	Drought; overextension of resources.	Probable
• Mekong	(Cambodia)	No national parks	Loss — Yes	No. of parks	War.	Known
		8 fishing reservations and 9 million t	Loss — Yes	No. of sites and t	Sedimentation of the Great Lake due to deforestation for rice cultivation.	Known
	(Vietnam)	3 national parks	Gain — Yes	No. of sites	Biodiversity conservation policies and tourism.	Probable
		20 fishing reservations	Gain — Yes	No. of sites	Search for sustainable production in the fisheries.	Known
	(Thailand)	5 national parks	Gain — Yes	No. of sites	Tourism development.	Possible
		200 fishing reservations	Gain — Yes	No. of sites	Environmental protection policies.	Known
13. ENERGY						
a) Hydro-electric power						
• Niger	(Basin)	2,100 MW	Gain — Yes	MW	Increased demand followed by increased investment.	Known
• Senegal	(Basin)	1,180 kW	Gain — Yes	kW	Renovation and construction of power stations.	Known
• Mekong	(Laos)	216 MW — 4 stations	Gain — Yes	MW and no. of stations	Economic and industrial development and rural development demands.	Known
	(Cambodia)	1.3 MW	Gain — Yes	MW	Increase in the no. of power stations.	Known
	(Vietnam)	12 MW	Gain — Yes	MW	Increase in investments.	Known
	(Thailand)	5 stations	Gain — Yes	No. of stations	Increase in investments.	Known
b) Thermal						
• Mekong	(Laos)	19.2 MW	Gain — Yes	MW	Rural development demands.	Known
14. REMOVAL OF MATERIAL						
• Mekong	(Laos)	300,000 m^3/yr	Gain — Yes	m^3/yr	Increase in the demand for construction.	Known
15. HUMAN HEALTH						
• Kagera	(Basin)	Increase in disease prevalence rate	Loss — Yes	Prevalence	More hosts as a result of an increase in sites.	Known
• Niger	(Basin)	Increase in bilharzia	Loss — Yes	Prevalence	Development of macrophytes. Multiplication of reservoirs.	Known
• Mekong	(Thailand)	Mortality rate: 5.2%	Gain — Yes	Mortality rate	Increase in primary health care centres.	Known

TABLE 16B
Diagnosis of the State of Biological Resources (1995)

Biological Resource		Current State	Loss or Gain	Criteria Used	Causes	Reliability
1. HABITATS						
a) Macrophytes						
• Kagera	(Basin)	Increasingly rare	Loss — Yes	No. of sites	Management of marshes and waters.	Known
• Mekong	(Thailand)		Gain — Maybe	ha	Environmental changes.	Possible
b) Islands and islets						
• Chad		Rise in number	Gain — Yes	No.	Decreased water levels in Lake Chad.	Known
c) Floodplains						
• Kagera	(Basin)	Food-producing cultures in the floodplain	Loss — Yes	ha	Draining of marshes and hydraulic development.	Known
• Chad	(Nigeria)	Less than 900 km^2	Loss — Yes	km^2	Upstream control structures.	Known
	(Cameroon)	4,000 km^2 (Yaeres)	Loss — Yes	km^2	Drought.	Known
• Niger	(Burkina Faso)	97 km^2	Gain — Yes	km^2	Control structures on tributaries.	Known
	(Mali)	28,000 km^2, interior delta	Loss — Yes	km^2	Drought and sandbar formation.	Known
• Senegal	(Senegal)	429,154 ha (Bakel-St. Louis)	Gain — Yes	ha	Better rainfall and damming.	Known
• Mekong	(Vietnam)	1.6×10^6 ha	Loss — Yes	ha	Flood control structures.	Known
d) Gallery forests						
• Kagera	(Basin)	Partly inhabited and cultivated	Loss — Yes	ha	Demographic explosion.	Known
e) Savannahs						
• Kagera	(Basin)	Partly inhabited and cultivated	Loss — Yes	ha	Demographic explosion.	Known
f) Mangrove swamps						
• Mekong	(Vietnam)	10,000 ha	Loss — Yes	ha	Dam construction, war, and uncontrolled deforestation.	Known
g) Deserts						
• Chad	(Nigeria)	29,500 km^2	Loss — Yes	km^2	Increased plantations.	Known
2. WILDLIFE						
a) Mammals						
• Kagera	(Basin)	Increasingly rare	Loss — Yes	No. of species No. of animals	Destruction of habitat.	Known
• Chad	(Basin)	300,000 Kouri cattle	Loss — Yes	Heads of cattle	Disease, drought and crossbreeding.	Known
• Niger	(Benin)	More than 50 elephants (Kandl-Mal)	Gain — Yes	No.	Migration.	Probable
• Senegal	(Basin)	No longer any large mammals (middle and upper valley)	Loss — Yes	No.	Degradation of habitat. Poaching.	Probable
• Mekong	(Basin)	Very few left	Loss — Yes	No.	Deforestation. Overuse.	Possible
b) Birds						
• Mekong	(Vietnam)	2,000 cranes in the delta	Gain — Yes	No.	Creation of a reserved migration zone.	Known
c) Reptiles						
• Niger	(Mali)	Crocodile nearing extinction in the Dogon plain.	Loss — Yes	No.	Poaching. Drought.	Known
d) Fishes						
• Mekong	(Thailand)	Increase in "Giant Catfish"	Gain — Yes	No.	Improved technology.	Probable

EXAMPLE OF APPLICATION: FISHERIES ON THE NIGER

We therefore complete the Documentation phase with a table summarising problems (Table 16).

For fisheries, we have provided the information appearing in this table based on the results of the previous stages.

- What is the current state of this use?
  3,000 fishermen (Tables 2 and 4);
  1,000-1,200 t/y.
- Was there a gain or a loss?
  There was an increase, (Tables 3 and 4) following a long series of decreases.
- Criteria used:
  Number of fishermen (Table 1);
  Landings (t/y).
- Cause of the problem:
  The increase in use (Tables 8, 9, 10, 13 and 14) was not explained, although the previous losses may be attributed to…
- Diagnosis:
  Likely; some documents report changes (recent gain), but this cannot be clearly explained.

To complement the summary table, we must use quality criteria in addition to the quantity criteria already mentioned in this example.

Moreover, cartographic documents must be supplied that clearly locate the changes. This recent increase in landings is perhaps restricted to certain areas, while losses are still observed elsewhere. For instance, it may involve certain species of fish or an effect associated with a local increase in fishing activity, for demographic or other reasons.

Finally, we must be able to determine the relative importance of the different causes: What most affected the fisheries, natural phenomena (rainfall) or human activities (control structures)? This perspective is essential, since it guides the rest of the management process in the search for solutions.

RESULTS FROM STAGE 5

- **A list of gains and losses in uses and biological resources, with an evaluation of the spatial and temporal dimensions (Table 15).**
- **A diagnosis table (Table 16).**

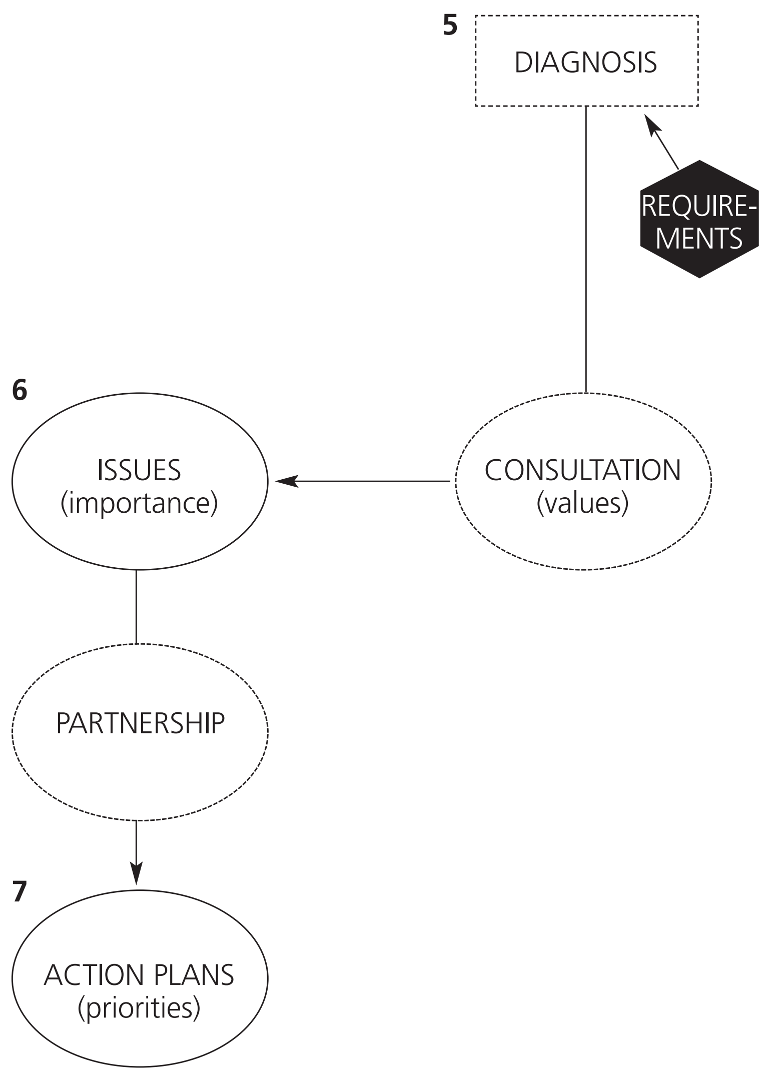
Blank copies of Tables 15A and 15B, 16A and 16B are presented in Appendix 6.

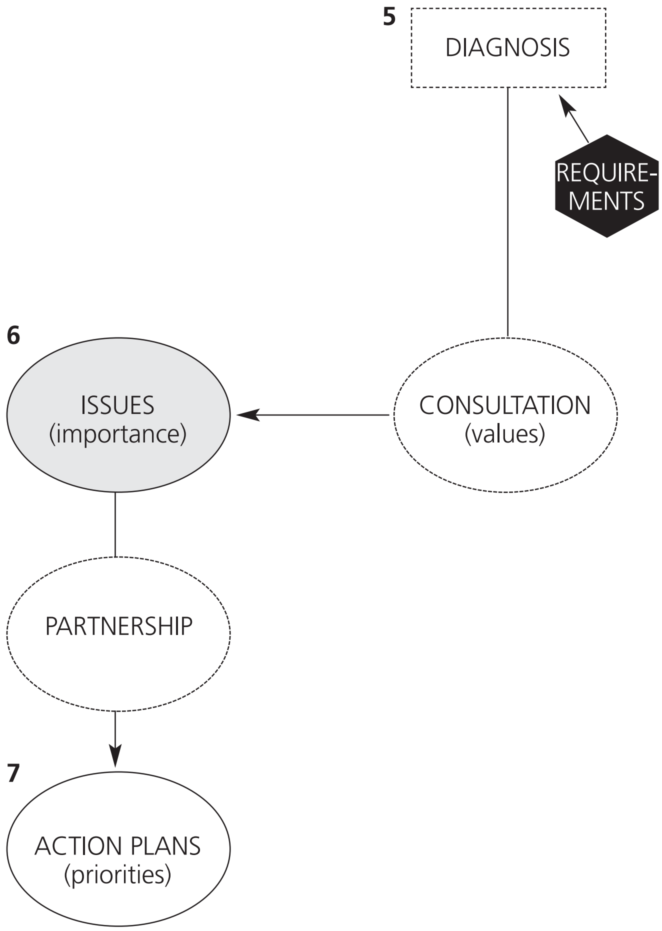
The Kigali Seminar,
October 26 to November 6, 1992.

THE PLANNING PHASE

The second phase of the river basin management framework — Planning — attempts to identify, through public consultation and partners' dialogue, actions to be undertaken in order to solve problems recognised as priorities. There are two stages (Figure T-3); issues identification and action plan. The management framework now moves out of government circles and opens up to the society at large (Stages 6 and 7).

FIGURE T-3
The Planning Phase





STAGE 6

Issues

OBJECTIVE

- To identify and rank issues in order of importance.

MEANS

- Submitting the previously developed diagnosis for consultation with riparian communities.

RESULTS

- A list of issues ranked in order of importance.
- A list of conflicts, with possible solutions.

THE PLANNING PHASE

STAGE 6: ISSUES

The long list of gains and losses, which is the outcome of an analysis of information conducted by a limited number of specialists and managers during the Documentation phase, will help us undertake the Planning phase of the management framework.

The Issues stage begins with a consultation exercise: in order to move from the long list of gains and losses presented in the diagnosis to the short list of issues required for planning purposes, we will have to consult with interested parties.

HOW TO CONSULT?

We must now submit the list of gains and losses to a broad range of interested public groups to get a clear definition of values specific to the riparian communities with respect to the uses and biological resources of the basin. Appendix 4 presents useful information on this vast question of public consultation that we have also discussed in detail in the chapter on Public participation. During the seminar, we must remain in contact with the basin reality: what is really being done in terms of consultation and who are the parties that are or should be consulted?

At this stage, the consultation should reach a great variety of public groups, the objective being to verify the values of a broad cross-section of society. To whom should we address this question? A list of the various interested public groups (users, for instance) is required from the start. In addition to identifying each group, we must specify why we would consult them and the means we should use to do so. Tables 17A, 17B and 17C present results from the 1992-1993 seminars. We distinguish the publics to be consulted by categories (individuals, groups, institutions, etc.), within which we identify target audiences (users, population, administration). We then have to answer two very real questions from the experience derived in the basin until now:

Why consult with this public group in particular?

How can we better achieve consultation?

Selecting the public groups to be consulted is very important. We must reach the groups of interested individuals who will subsequently ensure, through their active participation, that local projects will be implemented.

The means to be used will vary depending on the public groups targeted, in line with local habits and traditions, since there is no universal consultation model.

We must submit the entire list of gains and losses to consultation. Thus, fishermen are not consulted only on fishing and fishery resources, because their opinions on the other uses and resources of the basin are also very important.

In some cases, we may use intermediaries (facilitators) to reach specific public groups. Consultation may also be limited to designated representatives rather than to interested parties as a whole. Whichever means is used, the manager's intention must be clearly perceived by the person consulted and, in return, his or her response must be accurately conveyed to the manager.

The question to be asked is as follows:

Among the uses and biological resources of the basin, a number have undergone decreases, whereas others have shown increases. Which uses or biological resources are most important in your eyes, and what are the issues around which we should focus actions?

Discussion on the public groups to be consulted was of a more theoretical nature during the 1992-1993 seminars, even though participants recognised the importance of public consultation. The place occupied by public consultation in planning processes has a lot to do with society and culture. The goals of consultation, whatever form it takes, are numerous: to make sure that interested parties are involved early in the planning process; to facilitate access to popular knowledge to get round information deficiencies; to adjust planning to the real needs of beneficiaries and to ensure that they will participate in the implementation phase of the action plan.

Several questions were raised, in fruitful debates, on the multiple facets of public consultation:

In reality, how important is consultation to the planning process?

Can one really plan without consulting the interested parties at any given time?

Have consultation approaches proven to be successful and could they be adapted to different socio-political contexts?

HOW TO IDENTIFY ISSUES?

At the end of the consultation period, we have a series of opinions that must be reconciled. Unless the consultation has already brought together participants from all the sectors involved and a consensus has been reached, we will have to rank the choices of the various public groups (fishermen, farmers, stock breeders, etc.) in order of importance and identify issues.

The concept of issues is not easy to define. There are no objective criteria for ranking issues without using a great deal of caution and judgement. Issues also change with societies, in time and space. One approach is to identify issues that have already been the subject of political decisions or societal choices. A first listing of the major official policies, nationally or regionally, will reveal certain issues that have been clearly defined and will have to be taken into account in any new planning exercise concerning the management of biological resources and uses of the water within the basin. Table 18 presents examples of political statements taken from the seminar on the Niger River (1993). We do not have to complete an exhaustive inventory but rather to identify the policies that really concern the actual and future development of the basin. This exercise clearly sets the political context in which certain choices will have to (or can) be made.

The analysis of policy statements and important societal choices reveals an interesting mix of very broad orientations and quantifiable objectives. This brief survey has raised several questions:

Are the policy statements compatible from one basin state to another?

Are there any policies to which all basin states have formally adhered?

How can specific global policies be reconciled with objectives focused on the development of certain sectors or portions of the basin?

However, consulted people have their own scale of values and can rightfully identify what they consider to be issues. In order to build a first list of issues, as perceived by riparian communities, we can use a very simple approach; we ask every consulted person to classify uses and biological resources on three levels of importance: high, medium and low. As an example, we present the results obtained at the Segou Seminar (Table 19). Each participant ranked uses and biological resources according to the three levels of importance. Twelve participants carried out the exercise. The uses and biological resources were then presented in descending order of the number of "high" votes. Several other models can give similar results; in the case of the St. Lawrence River, we used the "nominal group method" for public consultations organised within the ZIP programme (Appendix 9).

TABLE 17A
List of Public Groups to be Consulted (1995) (Individuals)

Public Groups	Reasons for Consulting	Means Used for Consulting
A) USERS		
• Fishermen • Breeders • Farmers • Industrialists • Artisans • Transporters • Loggers • Miners • Consumers • Merchants/Tradesmen	• Know the territory and the problems. • Should be involved in process from the outset. • Are the beneficiaries of the projects. • Know the traditional practices.	• Surveys. • A variety of methods agreed to by the authorities before their use.
B) POPULATION GROUPS		
• Women • Youth • Elderly • Political, religious and traditional authorities • "Griots"	• Diversity of opinions. • Evaluation of project acceptability. • Broader view points. • Are the opinion leaders. • Represent memory and tradition. • Are representative of public opinion.	• Individual contact.
C) ADMINISTRATIONS		
• Technicians • Managers • Researchers • Administrative authorities • Teachers • Rural leaders	• Have experience in carrying out projects. • Can contribute to the success of actions. • Know what is happening elsewhere and can bring new insight. • Act as the interface between the administration and the population.	• Meetings, seminars, surveys, interviews, individual contact.

We may then apply various weighting methods to take into account the overall ranking obtained for each issue and not only that of the "high" importance ranking. By convention, we give a different weight to the "high" rank (10), "medium" rank (5) and "low" rank (1). This approach puts more weight on issues of high and medium levels, leaving low level issues far behind. We can select different weights from the ones selected here, but these have the advantage of facilitating the calculation of results. The results obtained in Segou are presented in Table 20. We may also push the analysis one step further by grouping results; for instance, in Table 20, we may identify three groups: 0-40, 41-80 and, 81-120. In doing so, we pool issues that have more or less the same importance level; we can then concentrate on the first group, where difficult choices will have to be made. The exercise will have helped sort out a shorter list of issues from a very long list of potential candidates.

It should be noted that the consultation exercise, organised during the seminars dealing with values and priorities, is quite legitimate; any group of experienced people can identify a list of what is important to them and what should be considered to be intervention subjects. However, results may vary between groups, depending on their interests and, of course, on the territory they live in.

TABLE 17B

List of Public Groups to be Consulted (1995) (Local groups)

	Public Groups	Reasons for Consulting	Means Used for Consulting
A)	USERS • Associations, co-ops • Breeders • Farmers • Artisans • Fishermen • Transporters • Industrialists • Consumers • Merchants/Tradesmen	• To obtain a synthesis of members' opinions. • Represent a large number of users. • Act as lobby groups. • Promote the interests of their membership.	• Direct contact, surveys, seminars, if several associations represent the same users. • Meetings, conferences.
B)	POPULATION GROUPS • Associations — youth — women — ecologists — workers • NGOs, GIE • Political parties • Traditional and religious authorities • Village associations	• Already take part in public debates. • Present a more global vision of society. • Are influential lobby groups.	• Individual contact. • Surveys. • Meetings, conferences, seminars.
C)	ADMINISTRATIONS • Specialized services • R & D organisations • Educational and training institutions	• Know the problems and solutions already tried elsewhere. • Have the quantitative tools necessary for evaluating the problems. • Can provide a scientific point a view of the problems. • Already have reliable data. • Can give strategic direction. • Are involved in the drafting of development plans.	• Direct contact. • Meetings, conferences, seminars.

We have pooled together results from the five 1992-1993 seminars in Tables 20A and 20B (uses). It is interesting to compare issues between different river basins and to keep in mind the overall synthesis presented in Table 20B. What is surprising is that the most important uses are quite similar from one basin to another: human health, water supply, energy, agriculture, conservation, fisheries are the dominant uses for river and lake basins. Basin peculiarities are found at the lower level of importance. A few questions were raised during the discussions:

Who really defines priorities in matters related to basin development, both at the national and regional levels?

Are these priorities periodically reviewed in light of emerging needs?

Which simple methods can be used to properly define priorities?

TABLE 17C
List of Public Groups to be Consulted (1995)
(National and international organisations)

	Public Groups	Reasons for Consulting	Means Used for Consulting
A)	USERS		
	• Chambers of Commerce — Craftsmen — Farmers • Corporations • Economic operators • Unions	• Can situate local problems within the national context. • Participate in the selection of development policy choices.	• Direct contact; formal or informal.
B)	POPULATION GROUPS		
	• National associations — youth — women — workers • National and international NGOs • Political parties	• Further broaden the debate on questions of national and international concern.	• Direct contact; formal or informal.
C)	ADMINISTRATIONS		
	• Technical services — departments — government ministries • Development partners	• Establish policies of development. • Ensure the harmonisation of activities. • Situate problems within the context of national and international cooperation policies.	• Direct contact by use of official channels.

The analysis of issues based on the ranking of uses and biological resources by level of importance brings to light the existence of conflicts; there are conflicts because certain uses and biological resources are at the same level of importance, on the one hand, but also because resources in the basin are fundamentally limited. We have to identify these conflicts and find solutions; conflicts may be real or potential, so are the proposed solutions. As examples, Table 21 presents conflicts and solutions identified at the Segou Seminar; the more concrete the examples, the easier the subsequent discussion. Table 21A presents the results from the 1992-1993 seminars; in it, we find a list of experiences that is quite interesting. This exercise is revealing, first of the large variety of conflicts, real and potential, but also of the managers' know-how. Several solutions are already at work and these experiences are a resource that should be shared within the basin, but also with other basins experiencing the same problems. Participants' discussions raised several interesting questions:

What are the most pressing needs in terms of conflict resolution?

Where are the centres of expertise located and who are the most experienced professionals in the various fields?

Are there any proven approaches to conflict resolution which could be adapted to various situations?

TABLE 18

Policies and Societal Choices (Niger River)

Themes	Description
1. DRINKING WATER SUPPLY	**BURKINA FASO** • Rural hydraulics: 100% supply rate based on 20 l/d/pers. • Urban hydraulics: 100% supply rate based on 100 l/d/pers. **CAMEROON** • Establishment of a Water Act. • 60% to 80% coverage of rural populations' water needs. **GUINEA** • Rural villages: creation of 12,200 water points to ensure 100% coverage. • Urban cities: 100% supply coverage. **NBA** • Creation of 1,500 water points between now and 2025, and increasing of rural supply levels to at least 30 l/d/pers.
2. AGRICULTURE AND STOCK BREEDING Self-sufficiency in food production and improved revenues by the year 2000	**BENIN** • Creation of irrigated areas (15,000 ha). • Intensified rainfed farming as a result of credit facilities. • Stock breeder integration into systems of production (3.5% increase in cattle and 5% increase in sheep). **BURKINA FASO** • Intensified rainfed farming (production 2×10^6 t/yr). • Advancement in hydro-agricultural development (5,000 ha/yr). **MALI** • Advancement in hydro-agriculture on 125,616 ha (year 2000). **NIGERIA** • Subsidisation policies for new farmers and improved access to agricultural credit. **NBA** • Planning of 200,000 ha by 2025. • Assistance to Nigeria's fish farming programmes.
3. TRANSPORTATION	**BENIN** • Asphalting of nearly 300 km of road in the basin area. **GUINEA** • Asphalting of intercity routes (500 km). **MALI** • Asphalting of the Niono-Timbuktu road (700 km). • Repairs over 10 km of the Kabara navigation canal. **NBA** • Improvement in navigability to open up the Sahel regions and develop trade. • Building of navigation canals. • Extending navigation period on a 3,000 km stretch (Guinea-Nigeria). **ALG** • Asphalting interstate roads: — Ouedbilla-Mopti: 300 km, — Tillaberry-Gao: 300 km, — Dori-Tera: 200 km.

4. CONSERVATION AND ENVIRONMENTAL PROTECTION	**BURKINA FASO** • Soil conservation (60,000 ha). • Development of 200,000 ha of protected forests across the territory. **NIGER** • Water and soil conservation on 500,000 ha (1992-1996). **NIGERIA** • Adoption of environmental protection laws. • Vast reforestation programme. **NBA** • Halt desertification in the basin and fight erosion in the interior delta. • Reforestation: around major dams and water sources, gallery forests and uncultivated land. • Reforestation for firewood production.
5. HYDROELECTRIC POWER	**CAMEROON** • Electricity in rural villages with populations greater than 350 inhabitants. **NBA** • Development of electrical power for industrial, mining, agricultural and domestic uses. • Goal of 500 MW through the construction of dams and power stations. **ALG** • 355 MW installation by 2020 to cover 100% of member-country needs and to export to other areas.
6. HEALTH	**BURKINA FASO** • PEV: 100% coverage rate. **CAMEROON** • Eradication of major endemic (pandemic) diseases. **GUINEA** • PEV: 100% by the year 2000. • Application of the Bamako initiative. • Construction of health centres, availability of generic pharmaceutical and first aid products at minimal cost. **NBA** • Before 2025, decontamination of areas infested with major endemic diseases (onchocerciasis, trypanosomiasis, Guinea worms and digestive tract parasites). **ALG** • Development of sanitation infrastructures to improve health conditions for all by the year 2000.
7. EDUCATION	**IVORY COAST** • Increase primary education rate from 80% to 100%. **GUINEA** • Increase primary education rate from 20% to 35%. • Improve and extend educational infrastructures. **NIGERIA** • Ensure primary education to 100% of the population.
8. URBANISATION	**BURKINA FASO** • Development of 10 mid-sized villages to alleviate congestion in Ouagadougou and Bobo Dioulasso. **GUINEA** • Development of the 6 major cities. **NIGERIA** • Promotion by financial institutions: housing and infrastructure.
9. INDUSTRIAL DEVELOPMENT	**NIGERIA** • Privatisation of government-owned corporations. **ALG** • Building of several phosphate plants in the three member-states (Burkina Faso, Mali and Niger).

EXAMPLE OF APPLICATION: FISHERIES ON THE NIGER

Consultation

Consultation of fishermen may be carried out at the individual and local association level in order to understand clearly the importance of the local issues.

A more comprehensive image may then be developed from national fishermen associations, but also from those involved in processing and marketing fishery products.

Issues

For the fishermen themselves, fishing is a major issue. This is all the more true since this activity is frequently practised exclusively, representing the main if not the only source of income for families.

For the participants at the Segou Seminar in October 1991, fishing ranked seventh in importance among all the issues associated with the river (Table 19); it is therefore an issue of medium importance.

Nonetheless, fishing contributes to meeting one of the main national challenges: food self-sufficiency (Table 18).

Finally, there are a number of conflicts between fishing and stock breeding (Table 21); the solutions are to be found, among other things, in multipurpose or integrated land use.

RESULTS FROM STAGE 6:

- **A list of public groups to be consulted and means to be used (Table 17).**
- **A list of official policies and goals that have already identified local, national and regional issues (Table 18).**
- **A list of issues ranked in three orders of importance: high, medium, low (Tables 19A and 19B, 20A and 20B).**
- **Identification of certain conflicts, with definition of the spatial and temporal aspects and possible solutions (Table 21).**

Blank copies of Tables 17 to 21 are presented in Appendix 6

TABLE 19
Classification of Issues in Three Categories of Importance

	Importance		
	Low	Medium	High
USES			
Health	0	0	12
Hydroelectric power	0	0	12
Agroforestry	0	1	10
Drinking water	0	2	10
Forestry (fuel)	0	3	9
Conservation	1	2	9
Floodwater farming (irrigated)	0	3	7
Fishing	2	2	7
Stock breeding	1	4	6
Recreation	1	5	6
Floodwater farming (natural)	1	4	5
Tourism	3	4	5
Removal of material	4	5	3
Sawmill lumber	7	2	3
Gathering	3	7	2
Wastewater disposal	8	2	2
Fish farming	6	6	0
Hunting	9	3	0
Transportation (navigation)	6	6	0
BIOLOGICAL RESOURCES			
Species:			
Fish	0	0	12
Granivorous birds	2	2	8
Birds	0	6	6
Molluscs and crustaceans	3	2	6
Mammals	1	6	5
Reptiles	2	6	4
Habitats:			
Floodplain	0	1	11
Gallery forest	0	2	9
Macrophytes	1	6	5
Mangrove swamp	3	2	5
Islands and islets	1	7	4

based on the number of votes (n)
abstention = 0

TABLE 20

Weighted Classification of Issues in Three Categories of Importance

	Importance			
	Low (n × 1)	Medium (n × 5)	High (n × 10)	Total (points)
USES				
Health	0	0	120	120
Hydroelectric power	0	0	120	120
Drinking water	0	10	100	110
Agroforestry	0	5	100	105
Forestry (fuel)	0	15	90	105
Conservation	1	10	90	101
Recreation	1	25	60	86
Irrigated farming	0	15	70	85
Fishing	2	10	70	82
Stock breeding	1	20	60	81
Tourism	3	20	50	73
Natural farming	1	20	50	71
Removal of material	4	25	30	59
Gathering	3	35	20	58
Logging (sawmill lumber)	7	10	30	47
Disposal (industrial wastewater)	8	10	20	38
Transportation (navigation)	6	30	0	36
Fish farming	6	30	0	36
Hunting	9	15	0	24
BIOLOGICAL RESOURCES				
Species:				
Fish	0	0	120	120
Granivorous birds	2	10	80	92
Birds	0	30	60	90
Mammals	1	30	50	81
Molluscs and crustaceans	3	10	60	73
Reptiles	2	30	40	72
Habitats:				
Floodplain	0	5	110	115
Gallery forest	0	10	90	100
Macrophytes	1	30	50	81
Mangrove swamp	3	20	50	63
Islands and islets	1	35	40	76

based on the number of votes (n)
abstention= 0

TABLE 20A
Classification of Issues by Order of Importance (1995)

Uses	Kagera		Chad		Niger		Senegal		Mekong		Total	
	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%
1. Water supply			(1)	98			(1)	100			(2)	89,7
– Domestic	(3)	93			(3)	95			(3)	91		
– Industrial	(10)	63			(12)	49			(13)	60		
2. Disposal (wastewater)			(9)	36	(15)	46	(10)	42			(11)	44,8
– Domestic									(18)	40		
– Industrial									(8)	73		
– Agricultural									(15)	53		
3. Agriculture											(4)	73,6
– Floodwater					(13)	48						
– Recessional			(4)	76	(7)	65	(9)	48	(14)	57		
– Irrigation	(13)	52	(2)	90	(2)	98	(4)	79	(1)	98		
– Rainfed	(2)	95			(6)	71						
4. Stock breeding			(3)	88	(4)	90	(7)	65			(8)	55,3
– Watering	(11)	57							(15)	53		
– Pasture	(7)	80							(21)	31		
5. Fishing	(13)	52	(4)	76	(5)	83			(7)	74	(6)	71,3
6. Aquaculture			(11)	28	(8)	61	(15)	19	(5)	83	(12)	43,6
– Water breeding									(16)	50		
7. Hunting			(12)	25	(19)	20	(14)	24	(23)	12	(15)	20,3
8. Navigation			(7)	51	(10)	57	(6)	73	(10)	68	(7)	58,4
– Floating									(20)	37		
9. Forestry											(9)	46,8
– Agroforestry	(9)	70			(9)	59	(8)	50	(11)	64		
– Silviculture	(8)	78	(5)	64	(10)	57			(15)	53		
– Logging	(10)	63	(14)	16	(17)	36	(12)	27	(19)	39		
– Gathering			(10)	30	(13)	48	(16)	16	(22)	28		
10. Tourism			(8)	45	(14)	47	(11)	32	(12)	61	(10)	46,3
11. Recreation			(13)	23	(18)	29	(17)	12	(17)	43	(14)	26,8
12. Conservation	(12)	53	(6)	63	(3)	95	(5)	78	(6)	76	(5)	73,0
13. Energy											(3)	80,6
– Hydroelectric	(6)	84			(4)	90	(3)	89	(4)	85		
– Thermal									(9)	72		
– Bioenergy					(11)	52						
14. Removal of material	(13)	52	(9)	36	(16)	44	(13)	25			(13)	39,3
15. Health			(1)	98	(1)	100	(2)	94	(2)	96	(1)	96,4
– Ingestion	(4)	88										
– Contact	(5)	85										
– Sites	(1)	100										

TABLE 20B
Overall Classification of Issues by Order of Importance (1995)

Uses	Overall Results (%)	Ranking
1. Water supply	89,7	2
2. Disposal	44,8	11
3. Agriculture	73,6	4
4. Stock breeding	55,3	8
5. Fishing	71,3	6
6. Aquaculture	43,6	12
7. Hunting	20,3	15
8. Navigation	58,4	7
9. Forestry	46,8	9
10. Tourism	46,3	10
11. Recreation	26,8	14
12. Conservation	73,0	5
13. Energy	80,6	3
14. Removal of material	39,3	13
15. Health	96,4	1

TABLE 21
Conflicts and Possible Solutions

Between…	… and	Solutions
1. IRRIGATED FARMING →	stock breeding	Set aside 20% of surface areas for forage crops. Use agricultural waste to feed livestock. Set aside access to the river.
Niger: 23,000 ha of floodplain, 7,000 ha with irrigated crops →	fishing	Complete withdrawal of depressions from agriculture and stock breeding.
2. CONSERVATION →	irrigated farming	Soil is unsuitable for farming: soil is salty, whatever small farmers think.
Mauritania: Park in lower delta (17,000 ha) →	stock breeding	4,000 ha will be set aside for stock breeding.
→	fishing	Fishing will be authorised.
Mauritania: Conservation of gallery forests down from 42 to 12 →	farming (mainly firewood)	No solution: occurs with the agreement of local authorities.
Niger: Wildlife reserve more than 100,000 ha →	stock breeding and multiple uses	Areas have been reclassified to allow multiple uses.
3. HEALTH →	irrigated farming	Techniques for setting up control structures based on the ecological requirements of disease vectors.
4. LARGE MULTIFUNCTIONAL DAMS eg.: Manantali (OMVS) – hydroelectricity – irrigation – navigation	power ↕ irrigation ↕ navigation	Management of the structure focuses on irrigation for the moment. Conflicts among the three objectives may be anticipated.

TABLE 21A
Conflicts and Possible Solutions (1995)

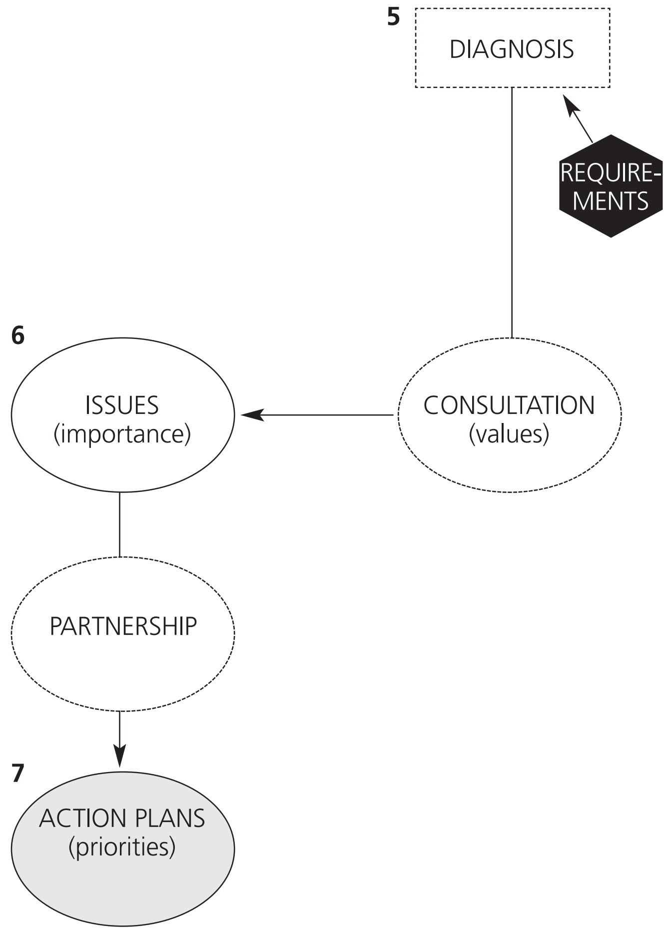
Between…	… and	Solution
1. **Water supply**	Irrigation	**Kagera:** Transferring water from a tributary to increase reservoirs and releases downstream. **Senegal:** Application of hydraulic masterplan.
	Conservation	**Niger:** Promoting national priorities. Developing other potential sites.
	Hydroelectric power	**Niger:** Promoting national priorities and international laws.
	Urbanisation	**Niger:** Controlling urbanisation by creating other poles of attraction.
	Stock breeding	**Senegal:** Increasing water points, especially in areas where surface waters are limited.
2. **Disposal (wastewaters)**		
• Domestic waters	Conservation	**Kagera:** Treatment of wastewaters.
• Industrial waters	Water supply	**Niger:** Enforcing laws governing the quality of discharged waters.
	Agriculture and health	**Mekong:** Treatment of wastewaters.
• Agricultural waters	Water supply	**Senegal:** Decanting of drainage waters in sugar-producing areas. Improving drainage in the delta.
3. **Recessional farming**	Stock breeding	**Chad:** Create mandatory corridors and zones with sufficient pastures.
	Hydroelectric power	**Senegal:** Long-term suppression of artificial floods to support recessional farming during years of low flows.
4. **Irrigation**	Water supply	**Chad:** Reserving a sufficient quantity of water for this purpose. **Niger:** Promoting national priorities and enforcing laws currently in effect.
	Recessional farming	**Chad:** Allocating more irrigated land to farmers. Using drainage waters for land used for traditional farming. **Senegal:** Long-term suppression of recessional farming. **Mekong:** Reserving land where flooding is high and leaching of acidic soil is difficult for recessional farming (floating rice).
	Stock breeding	**Chad:** Reserving 15% of areas for cultivating fodder and for watering. Transferring a portion of the water to Yaeres (floodplains). Using drainage waters to irrigate the floodplain, and creating transit zones. **Niger:** Agriculture and land reform. Reserving transit zones and controlling the movements of herds. Promoting intensive stock breeding. Creating a framework for dialogue. **Senegal:** Integrated stock breeding/agricultural management. Administrative measures and fencing off of areas. Construction of small dams with watering holes. Agreement among concerned parties.
	Fishing	**Chad:** Giving fishing a priority up to a maximum usage of 25% of the waters. Building reservoirs. Using drainage waters. **Niger:** Reserving fishing zones. Integrating fish farming within the irrigated areas. Promoting national priorities in creating a framework for dialogue. **Senegal:** Dialogue and planning. **Mekong:** Making choices. Relocating fishing villages. Introducing new fish farming technologies.

Between…	… and	Solution
	Forestry	**Senegal:** Better integration with agroforestry.
	Hydroelectric power	**Niger:** Promoting national priorities and international laws. Creating a framework for dialogue. Defining exploitation guidelines. **Senegal:** Orderly management and water management plan.
	Navigation	**Niger:** See above. **Senegal:** See above.
	Conservation	**Chad:** Reducing the magnitude of irrigation projects. **Niger:** Action plans for environmental protection. Drafting, updating and enforcing laws. **Senegal:** Agroforestry development. Integrated management and dialogue. **Mekong:** Setting aside land for cranes.
	Health	**Kagera:** Increasing drainage and upkeep of canals. **Niger:** Taking complementary measures (health centres, water treatment). Controlling use of chemical and biological products. Mechanical control by variations in water levels. Sanitary health education. Periodic impact assessments. **Senegal:** Public education. Public health measures. **Mekong:** Quality control of stagnant waters.
	Soil	**Kagera:** Drainage of salty soils. Fertilisation and research (decrease in fertility).
5. **Agro-industry**	Water supply	**Kagera:** Coffee industry: pre-treatment before disposal of wastewaters. **Senegal:** Sugar industry: treatment of wastewaters.
6. **Agriculture (rainfed)**	Stock breeding	**Chad:** Application of laws. Improving agriculture by using organic manure. Moving cultivation and sufficient distribution of watering points to pasture zones. Maintaining demography through family planning. Building up hay stocks. **Niger:** Rational division of areas. Intensive stock breeding. Creating corridors.
	Conservation	**Kagera:** Soil conservation measures. **Niger:** Agricultural settling. Respecting a minimum number of trees per hectares: 20 to 40 trees, depending on the zone. Intensive farming. Promotion and increase in agroforestry. Construction of anti-erosion sites. **Chad:** Adopting agroforestry techniques outside protected forests. **Mekong:** Decrease in slash-and-burn cultivation. Irrigation development (rice). Increase yield by widespread introduction of extension method. Land use planning. Approaches based on farmer participation.
7. **Stock breeding**	Conservation	**Chad:** Controlling grazing. Establishing pasture reserves. **Kagera:** Controlling animal populations to limit land erosion. Encouraging the use of cowsheds and the cultivation of hay.
	Fishing	**Chad:** Agreement between fishermen and stock breeders concerning the time allotted for watering (Yaeres).

Between…	… and	Solution
8. Fishing	Conservation Fish farming	**Kagera:** Curtailing illegal fishing by developing fish farming and enforcing laws. **Mekong:** Effects on reproductive stocks. Zoning, education of fishermen and strict enforcement of laws governing the fisheries.
9. Fish farming	Conservation Health	**Kagera:** No solution for the introduction of new species in the wild. **Mekong:** Shrimp farming. Reclassifying mangrove swamp areas to create appropriate area for shrimp farming. Estimating the effect of saline intrusion in canals and paddyfields. Defining criteria for wastes. **Kagera:** Supervising exploitation (water and fish quality).
10. Hunting	Conservation	**Kagera:** Controlling hunting to prevent animal migration to neighbouring states. **Mekong:** Restricting hunting. Prohibiting hunting of rare species. Strict enforcement of existing laws.
11. Forestry **Agroforestry** Firewood	Grazing and Rainfed farming Conservation	**Kagera:** Identifying lands to be used for reforestation. **Chad:** Assisting communities in the establishment of their own plantations by providing new farmers with plants, water, financing, etc. Providing alternate energy sources.
12. Tourism	Water supply Agriculture Conservation	**Senegal:** Protecting water sources from erosion by reforestation. **Chad:** Renovating parks and reserves to prevent elephant migration. **Mekong:** Defining protected areas and enforcing regulations to preserve historical sites, sanctuaries and animal species.
13. Conservation	Water supply Agriculture Stock breeding Fishing	**Chad:** Working to improve flow in the river bed. **Senegal:** Controlling macrophytes in drinking water supplies (Lac de Guiers). **Kagera:** Improving production on cultivated lands. **Chad:** Planning the reduction of irrigated areas (Sambissa, Nigeria). **Kagera:** Relocating ranches outside the reserves. **Chad:** Periodic releases, and concerted and integrated management. **Chad:** Periodic releases, and concerted and integrated management.
14. Energy (Hydroelectric power)	Water supply Rainfed agriculture Irrigation Fishing Navigation Conservation Health	**Niger:** Ensuring a minimal flow downstream. **Kagera:** Intensified farming. Developing fisheries and small industries. **Niger:** Rational use of water according to need. **Niger:** Building fish scales. **Mekong:** Building fish scales. **Kagera:** Locks. **Niger:** Maintaining draught by maintaining a minimal flow downstream. **Chad:** Integrated management of reservoir based on downstream habitats. **Mekong:** In certain cases, stopping the project altogether or increasing funding. Decreasing operating head of dam to preserve wildlife, forests and historical sites. **Kagera:** Eradication (bilharzia). **Niger:** Sanitary monitoring. **Senegal:** Introduction of a master health plan (WHO). **Mekong:** Control of hosts and education of the population.

Between…	… and	Solution
15. Urbanisation	Agriculture	**Niger:** Enforcement of land laws.
	Conservation	**Niger:** Decentralisation and regionalisation within the context of a master development plan for the territory. Creation of green areas, and reforestation.
	Health	**Niger:** Installation and regular upkeep of sanitation infrastructures. Collection, removal and treatment of solid wastes.
16. Industrialisation	Agriculture	**Niger:** Application of laws (expropriation of land, quality of wastewaters).
	Conservation	**Niger:** Rehabilitation of quarries based on the impact assessment, and specifications. Promoting national priorities and laws. **Mekong:** Enforcing the application of environmental laws. Directing public interest towards environmental protection.

The Saint-Louis Seminar, November 8-19, 1993.



STAGE 7

Action Plan

OBJECTIVE

- To establish an action plan on the basis of the issues identified and the partners concerned.

MEANS

- A dialogue between partners with a view to establishing a realistic, solid framework that will be used to focus overall projects in a logical implementation sequence.

RESULTS

- An action plan.

STAGE 7: ACTION PLAN

At the end of the consultation process, a list of issues ranked in order of importance is established. The goals of the planning process are to identify priorities and to attract partners whose actions will be pooled around one or more action plans corresponding to selected priorities.

PARTNERSHIP

While consultation benefits from being broad-based in order to reach a wide variety of interested public groups, partnership will benefit from first bringing together all the players directly involved, the partners. We are getting increasingly close to action and we must involve, in the planning process, those who have the power and responsibility to intervene, as well as the interest. We discussed this question in the chapter on Partnership.

This concept of partnership is a broad one and may include the government (at every level), funding agencies, implementing agencies, etc. The partners are those whose presence guarantees the success of the action plan. The only real selection criterion is the answer to the following question:

In the absence of this player, will the action plan meet its objectives?

Partners may already have been identified in official structures or involved in a more informal fashion. It would be a good idea to present the list of potential partners in a schematic format to clearly indicate the responsibilities of everyone and the links that exist between them. This exercise is like drawing the political, social and administrative scenery in which the action plan will have to fit.

PRIORITIES

The list of issues developed through consultation (Stage 6) is one of many starting points for planning. Priority setting also refers to policies already promulgated along with other action plans put in place by states or administrations.

In our case, the priority setting exercise begins with dialogue, and the clientele is the list of partners. Whatever the dialogue approach used to achieve a list of priorities, we should include a final conciliation step. Political decision-makers are under pressure, from several directions at the same time, and, the choices they have to make do not always follow the logic of science. The priority list, finalised after all of the dialogue efforts have taken place, will have to rally both political decision-makers and local communities if we are to ensure the success of planned interventions.

ACTION PLAN

Action plans are varied in scope, but they all share one feature: they consist of a series of actions (projects) in a logical implementation sequence. Within the management framework we have followed, the scope of the action plan depends on the problems we have chosen to solve. The term "action plan" is often synonymous to "programme" as it groups several projects and activities; however, programmes are most often sectoral while the action plans we are referring to in this manual are multisectoral by definition.

Action plan objectives should be clear, measurable, realistic and easy to communicate.

Producing action plans calls for answers to several questions:

Which problems are they intended to solve?

What are the objectives to be achieved?

Which partners may be interested in working together?

How do we intend to proceed (in technical terms)?

Where do the necessary resources come from?

Each problem to be solved must be identified and objectives clearly defined, in order to be able to measure the subsequent success of the action plan in time and space.

An action plan must also specify the scientific and technical aspects of the actions to be undertaken, as well as an evaluation of the reliability of these methods (success rates).

The funding plan is essential to identify sources of funding, their timing, control mechanisms, and re-evaluation instruments to be used during the implementation of the action plan.

The action plan must be realistic and well adapted to the specific features of the environment, both human and ecological. The cumulative effects of properly conducted local action are often more significant and longer-lasting than those of projects that are too vast and ill-adapted.

Table 22 presents some examples of action plans already in place in the basins of the Niger and Senegal rivers (descriptive sheets). Preferably, existing action plans should be chosen, indicating the official title, the territory and the period (beginning and end). By definition, an action plan should include several activities. Objectives, partners, funding sources and conditions for success should be clearly specified. Table 22A presents results from the 1992-1993 seminars, under two aspects only: partners and conditions for success.

Some discussion points have emerged from the previous five seminars:

What are the needs in terms of planning tools (multisectoral plans, master plans)?

How can we prepare a multisectoral plan that takes into account current realities and developmental priorities reflecting the needs of interested parties?

Where can the necessary financial resources be found that allow environmental impact assessment to be included at this stage?

What can be done to attract the interested parties without whom the success of the action plan might be jeopardised?

How can the action plan be revised to meet new realities?

TABLE 22
Action Plans

ACTION PLAN TITLE: **Regional Integrated Development Plan for the Upper Basin of the Niger 1991-2006 — Niger River (Guinea)**

Objectives	Partners	Funding	Conditions for Success
Short term: To improve the environment of people living along the river. Medium term: To restore the environment and ecosystem of the river. Long term: To regulate the river flow.	Decentralised communities NGOs Small and medium-sized firms Corporations Government services Development projects	EDF	Approach involving participation of public. Contractual approach (service contracts) with certain partners.

ACTION PLAN TITLE: **Lower Delta (Right Bank) Development Plan 1989 — Senegal River (Mauritania)**

Objectives	Partners	Funding	Conditions for Success
Grain production. Environmental protection and tourism. Development of stock breeding.	Ministry of Rural Development Ministry of Hydraulics Ministry of Crafts and Tourism Stock breeders federation	EDF CCCT IUCN	Regulation of river flow. Development of 6 replenishing structures, 2 of which are not funded.

ACTION PLAN TITLE: **Wildlife Development Plan 1990 Niger Valley (Niger)**

Objectives	Partners	Funding	Conditions for Success
Habitat rehabilitation. Regeneration of rare or endangered species. Conservation of diversity. Rational development of wildlife potential: hunting, fishing, tourism. Public involvement in and accountability for management.	MHE IUCN WWF	IUCN State of Niger	Political will. Funding. Information, education and consciousness-raising of public. Training of senior managers.

TABLE 22A
Action Plans (1995)

1. PARTNERS
   a) **Institutional, governmental**
   Member states, regional organisations, government departments, municipal services, water companies, electricity companies, local authorities, research and training institutions.
   b) **Non-governmental organisations** (NGOs)
   Associations of users, farmers, fishermen, stock breeders, artisans.
   Chambers of Commerce, social and socioprofessional groups.
   c) **Private and financing companies**
   Economic and industrial leaders, small and medium-size businesses and industries.
   Contracting firms, commerce companies, cooperatives, funding agencies, financial institutions.
   d) **Population**
   Consumers, beneficiaries.

2. CONDITIONS FOR SUCCESS
   a) **Political**
   Political will, willingness to cooperate among nations, regional stability, political stability, involvement of local authorities, harmonisation of development policies, integration of project in national plans, peace.
   b) **Human**
   Involvement of beneficiaries, active participation of the population, public consultation with respect to studies and realisation (management) of the project, awareness of the managers involved, decrease in demographic growth, public awareness, appopriate distribution of populations on available lands, improved social infrastructures, increased responsibility of beneficiary populations.
   c) **Financial**
   Availability of funding, regular payment of funds, facility of loan reimbursement, participation of economic leaders, involvement of funding agencies, better conditions in loan repayment terms.
   d) **Environmental**
   Improvement of the habitat, respect for the environment, availability of water resources, protection and rational management of pasture areas, sufficient rain, no major climatic changes.
   e) **Management-related**
   Rural management approach, independence of management with respect to administration, respect for the terms of the study contract, completion of sound diagnostic studies and solid feasibility studies, good construction design, periodic project monitoring and evaluation, technical involvement, involvement of technical services.
   f) **Training-related**
   Manager training, national administrative capacity, availability of skilled labour, re-education of farmers, technical involvement, training trainers qualified in the application of new technologies.
   g) **Technical**
   Mastery over irrigation waters, sanitary coverage of livestock, hydraulic development plan, construction of drainage canals, use of fertilizers, use of modern agricultural techniques and introduction of productive species.
   h) **Economic**
   Agricultural credit, an acceptable fee structure, trade circulation of products, credit for stock breeders, farmers, stock breeders and fishermen organisations, industrial development, flexibility in credit grants (working capital), strengthening of private initiatives, structural development, cereal and aquatic product processing plants, no shortage of construction materials.
   i) **Legal**
   Service contracts with certain partners, respect of regulations and management of shared waters, reclassification of coastal regions, allocation of land to farmers, classification/zoning of forested lands, review of forestry legislation.

EXAMPLE OF APPLICATION: FISHERIES ON THE NIGER

Partnership

The partners to be brought together around an action plan targeting, among other things, the resolution of problems associated with fisheries are those with responsibilities in the following fields:

• Management of fishery resource	Ministry of Fisheries
• Protection of vulnerable habitats	Nature Protection Branch
• Water quantity management	Ministry of Hydraulics Control Structure Management Agency (dams, dikes)
• Land use management	Ministry of Land Use Ministry of Lands and Forests Local government
• Water quality management	Ministry of Industry Municipalities and towns Private enterprises (manufacturing, stock breeding, agriculture)

Action plan

An action plan on fisheries can be designed on two levels:

- Within a broad multisectoral plan where fishing is one of many objectives (health, agriculture, tourism, etc.);
- In a specific fisheries-oriented action plan.

  If we choose the second level (sectoral plan), we have, for instance, to:

Define the territory:	One stretch of the river in the region of…
Specify problems:	Decreased catch of a species, previously in great abundance and much sought after
Define objectives:	To increase landings by X tonnes in Y years
Choose partners:	From among ministries, agencies, local government, fishermen associations, etc.
Establish funding:	National sources and international funding agencies
Define the conditions for success:	Knowledge of the biology of the species, partners' participation, funding, and no rainfall shortage

RESULTS FROM STAGE 7

From existing action plans, prepare:

- **A list of partners, with a diagram showing everyone's responsibilities (organisation chart);**
- **Technical aspects to be considered: methods and their limitations;**
- **One descriptive sheet per action plan bringing together the main features (Table 22):**
  - **objectives targeted, clear statements vis-a-vis the spatial and temporal aspects,**
  - **partners,**
  - **funding sources,**
  - **essential conditions for the success of this action plan.**

In choosing one or more issues of "high" importance identified in the previous stage, design the features of a multisectoral plan.

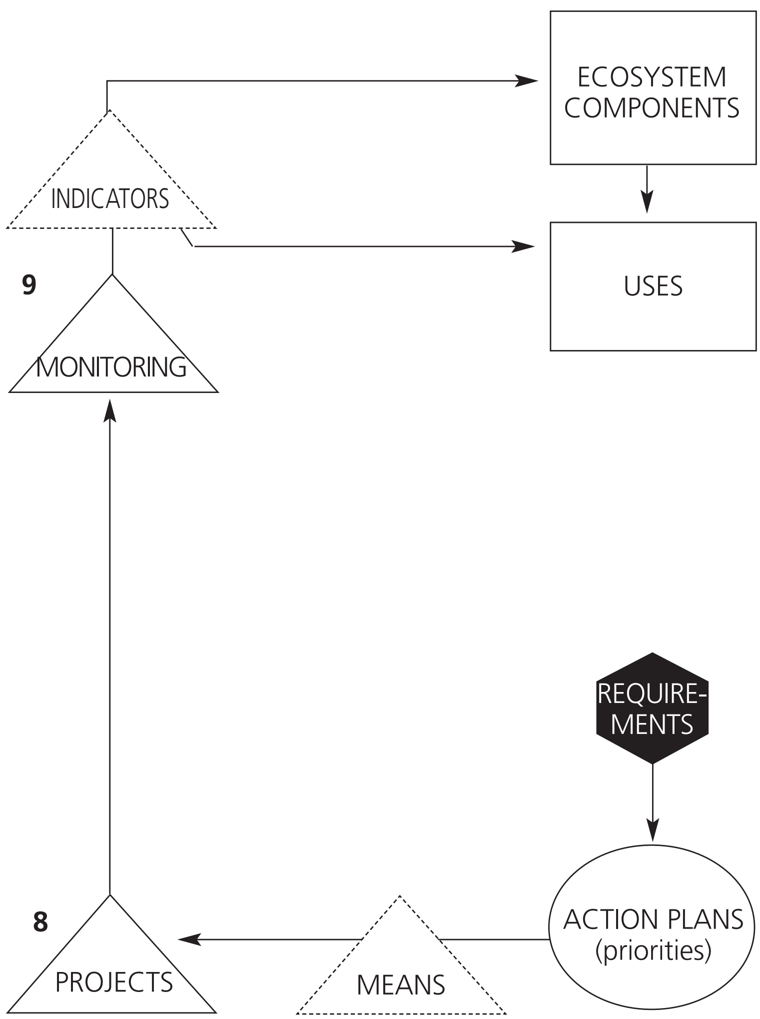
- **Issues: importance for whom, established by whom?**
- **Problems: scope (in space and time).**
- **Sectors affected: overall uses and biological resources targeted by this plan.**
- **Partners: Why them?**
- **Funding: Where can it come from and why?**
- **Conditions for success: technical, financial, human aspects.**

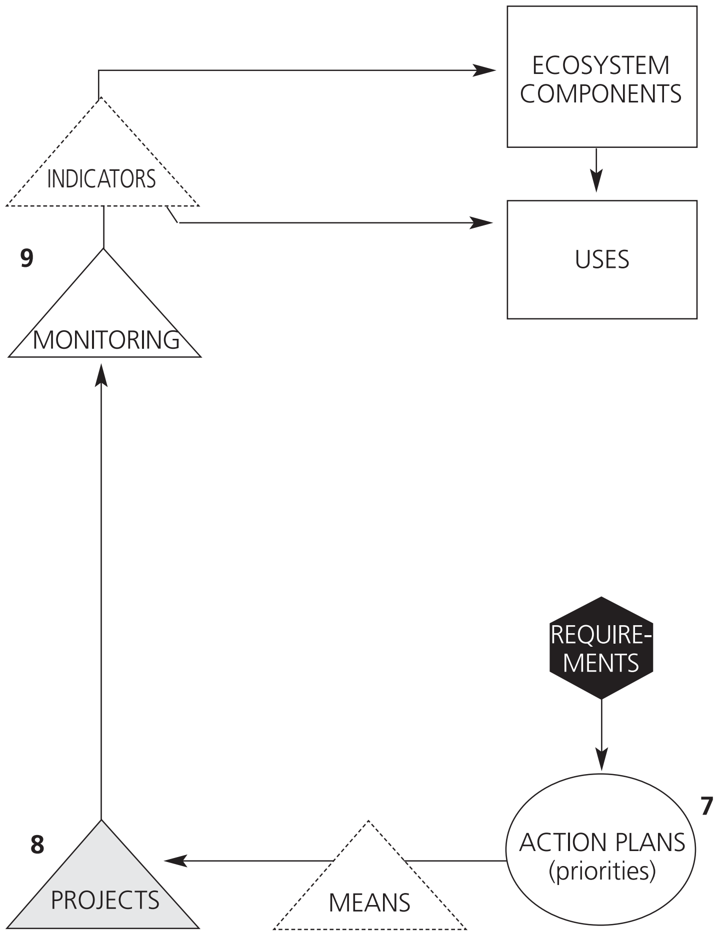
  A blank copy of Table 22 is presented in Appendix 6

THE ACTION PHASE

The third phase of the river basin management framework — Action — puts in place the necessary means and makes sure that projects have the expected effects, even if it means reviewing planning and projects if this is not the case. The Action Phase is made of two overlapping stages (Figure T-4); action itself (projects) whose extent may vary with time and space (Stage 8) and monitoring in order to measure the effects of these interventions (Stage 9)

FIGURE T-4
The Action Phase





STAGE 8

Projects

OBJECTIVE

- To define projects and carry them out in line with objectives and means.

MEANS

- Project management.

RESULTS

- A series of well-defined projects (objectives, human and financial resources, schedule, etc.).

THE ACTION PHASE

STAGE 8: PROJECTS

PROJECT ANALYSIS

After Stage 7, we are now at the implementation stage for the projects identified in the action plan. During this seminar, we do not address project management as such. There already exist several management methods in this regard. We are interested in the information that enables the manager to follow the progress of a project with respect to the objectives set at the beginning. In the context of an action plan, whether local, national or regional, many projects are carried out at the same time, and it quickly becomes impossible to follow every one in detail.

Unless they share a coordination responsibility among these projects, managers are interested first in knowing whether the objectives set at the outset can be achieved, according to the agreed schedule. This overall management comes into its own when there is some interdependence among projects, in time or space (upstream-downstream). These linked projects are particularly vulnerable to schedule delays.

In the case of an action plan combining several projects managed by different partners, access to "internal" project information, during implementation, is not easy for the action plan managers. But they cannot wait for final project reports before acting, since this may often be too late. They must be able to call on an effective, flexible network of contacts that will provide them with the essential information for managing the overall action plan.

Each project must be the subject of a descriptive sheet on which the following is noted:

– Objectives set at the beginning;

– Partners involved (management and funding);

– Conditions for success.

Two dimensions are added here that are essential for follow-up of the overall action plan;

- Foreseeable effects of delays, on this project and other projects in the action plan;
- Names and specific roles of individuals to be contacted for information.

Several descriptive sheets completed during the Segou Seminar (Table 23) are provided here for information.

The analysis of projects clearly emphasises the objectives, in terms of expected results. Partners' identification and conditions for success follow the same approach as that followed for action plans (Table 22).

About the delays issue, it is not so much the cause of delays but their effects that are of interest to the manager. They may result simply in a time-table being put back, without further consequences; however, delays may also cause the withdrawal of a portion of the project, with consequences on other projects within the action plan. In order to complete Table 23, we should select projects already under way, preferably in relation with the action plan described earlier. Clearly identify the project title, the localisation, start-up and completion dates in the space available at the top of the table.

Table 23A is a brief synthesis of the five 1992-1993 seminars. Project management is, without doubt, the process that participants master best. The last two columns of Table 23 were the subject of a lot of discussions; even though these questions are not raised on a daily basis, they were nevertheless perceived as important. The overall observation is that several projects are implemented simultaneously, often by different funding agencies without any coordination between them. At best, we may see a waste of human and financial resources; in the worst cases, antagonistic effects and more or less severe environmental deterioration will be observed in the short and medium term. These questions were actively debated:

How can we ensure a certain level of project coordination on the scale of basin or sub-basin?

Do practical approaches in the area of environmental impacts assessment exist which can be adapted to sectoral or multisectoral projects?

EXAMPLE OF APPLICATION: FISHERIES ON THE NIGER

As defined in the action plan, specific projects for restoration of species and spawning grounds may be defined.

In the case of spawning grounds, physical changes can be made to the environment (control structures, main channel-depth changes, etc.) or biological layout (planting or eradication of certain plants, etc.).

As to species themselves, direct action may be undertaken through fish farming and reintroduction of stocks, as well as the elimination of certain predatory or competitive species or the introduction of population management mechanisms (selective fishing, for instance).

All these projects cannot be initiated before knowledge is acquired concerning biological phenomena. It is necessary to be fully familiar with the causes of fish population fluctuations in order to avoid altering the river ecosystem balance.

RESULTS FROM STAGE 8

Based on projects already under way on the river:

- **One descriptive sheet per project (Table 23):**
  - **deliberation on the conditions for success,**
  - **deliberation on the effects of delays on overall planning,**
  - **identification of reliable sources of information (network of contacts among managers).**

From the multisectoral action plan drafted previously, design projects within it:

- **Objectives;**
- **Partners;**
- **Conditions for success;**
- **Effects of delays;**
- **Contacts for information.**

A blank copy of Table 23 is presented in Appendix 6.

TABLE 23
Projects

PROJECT TITLE: **RAF 87/036 OMVS-UNDP**
Monitoring-evaluation of Senegal River Basin Development
1981-1992 (with possible extension)

Objectives	Partners	Conditions for Success	Effects of Delays	Contacts for Information
Strenghtening of High Commission's analytical capabilities. Monitoring of performance of irrigated farming. Monitoring of multisectoral studies. Evaluation of flooded areas by remote sensing.	OMVS UNDP Member states	Participation of national units of member states in data collection.	In 1989, Mauritania did not provide its data: project postponed until 1991.	OMVS national units: communication channel for information.

PROJECT TITLE: **Pilot Representative Basin Development**
Bafing-source 1988 (Guinea)

Objectives	Partners	Conditions for Success	Effects of Delays	Contacts for Information
Short term: Control of degradation of natural resources. Medium term: Land use management test zone. Long term: Regulation of river flow.	National Forestry and Game Branch Technical sections of other ministries	Awareness of public. Dialogue with technical sections involved. Work contracts. Compliance with action schedule.	Partial disturbances: delay in cartography of implementation plans. Disturbances of concern: rural engineering has not completed structures providing access.	Documentation centre for the entire Fouta-Djallon Region. Within each facet, one person identified for gathering and passing on information.

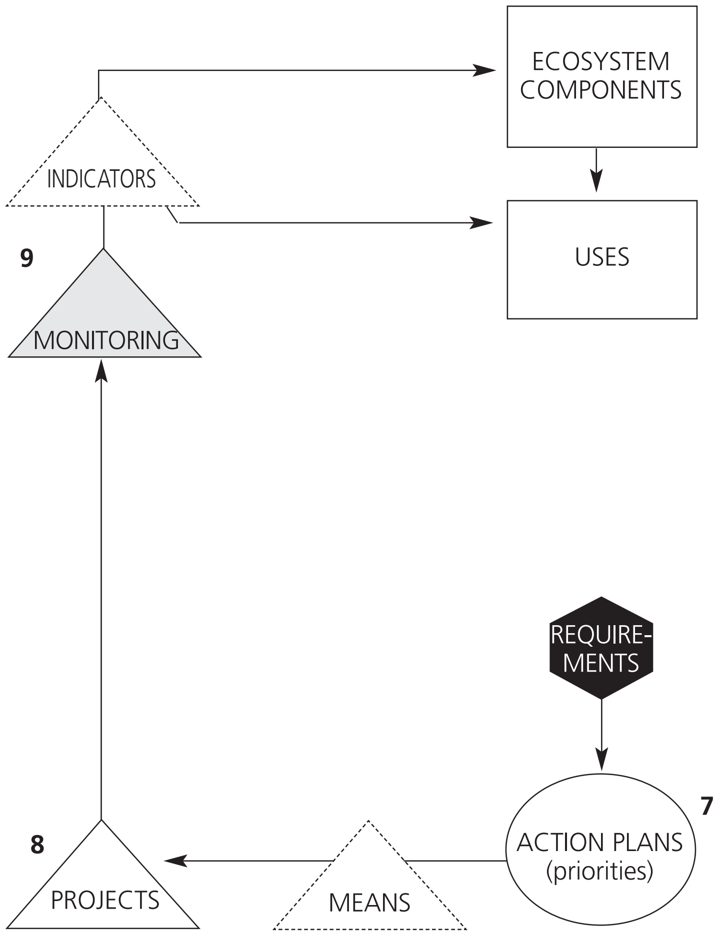
PROJECT TITLE: **Irrigated Perimeters: Accompanying Measures**
Niger River (Niger)

Objectives	Partners	Conditions for Success	Effects of Delays	Contacts for Information
Rice production. Fishing. Firewood production.	MAEL MHE	Obtaining hydrological data on time (December). Coordination among partners.	If MHE does not provide data on time, postponent of development work by one season. The firewood facet may be carried out separately.	Hydraulic Resources Branch (MHE). Coordinating committee for project monitoring.

TABLE 23A
Projects (1995)

1. PARTNERS AND CONDITIONS FOR SUCCESS Results similar to those shown in Table 22.
2. IMPACTS OF DELAYS a) **On the population** Food shortages, unemployment, poor state of public health, low standard of living. b) **On the environment and resources** Environmental deterioration, continued scarcity of firewood, reduced productivity of land and of stock breeding, delayed development of the fisheries and of stock breeding in the Yaeres. c) **Administrative** Diminished confidence of partners, extension of the project, limitation and declassification of reserved areas, redefining of the project. d) **Financial** Increased costs, requirement of complementary sources of financing, production losses. e) **Legal** Contractual difficulties.
3. INFORMATION CONTACTS Regional organisations and national or specialised committees, local authorities, government departments, consulting firms, funding agencies, project managers, technical services, development agencies, documentation centres, research centres.

Field trip during the Kigali Seminar.



STAGE 9

Monitoring

OBJECTIVE

- To evaluate the success of projects carried out by measuring their effects.

MEANS

- Monitoring programmes with a set of indicators to evaluate changes in uses, biological resources and ecosystem components.

RESULTS

- Implementation of a monitoring programmes.

STAGE 9: MONITORING

DEFINITIONS

We are now at the last stage of the river basin management framework where we evaluate the effects of projects. We will attempt to follow up on changes in uses and biological resources, along with modifications of ecosystem components that may have occurred since the implementation of the action plan. We cannot focus solely on the implementation of projects without being preoccupied by their effects on the river ecosystem, and, most of all, without verifying that solutions are brought forward to the problems that launched the whole process. Monitoring is meant to bring about a set of reactions on priorities, action plans, and projects. This process makes it possible to revise the projects being implemented and to react before it is too late.

The classification of monitoring activities is derived from Chapman (1992). All monitoring activities imply set of measuring points that become a network of stations. The networks which are of interest to river basin management are of three types:

- "*Monitoring:* Long-term, standardised measurement, observation, evaluation and reporting of the aquatic environment in order to define status and trends.
- *Survey:* Of finite duration, intensive programme to measure, evaluate and report on the quality of the aquatic environment for a specific purpose.
- *Surveillance:* Continuous, specific measurement, observation and reporting for the purpose of water quality management and operational activities." (Chapman, 1992, p. 20.)

In the case of monitoring, it is often interesting to have in parallel a reference network located in areas less altered by human activities. The surveillance network may include warning functions (floods). It is sometimes referred to as a "usage network" because it follows water quality, in time and space, in relation to human activities such as swimming, or "compliance network" when specific measures are gathered in view of legal requirements or to guarantee the quality of drinking water.

MONITORING NETWORK

We are looking here at the acquisition of knowledge in order to follow the evolution of an aquatic ecosystem. The focus is on ecosystem functions, biological indicators being the best integrators. We can also compare the ecosystem under study with either a pristine ecosystem or another one less impacted by human activities. This knowledge can be used by a broad range of users (researchers, managers, politicians, media, etc.) interested in the river ecosystem. The data are often collected by a wide variety of players, each acting independently, which is not without causing some difficulties when the time comes to integrate information in order to produce an overall portrait of the ecosystem.

Some monitoring programmes were created a long time ago using standardised collection and analysis protocols. Data collected are generally considered as scientifically valid; however, the scientific value of results may vary with the quality of different programme operators if the network covers a very large territory. Monitoring network characteristics vary in view of their objectives; sampling frequency, station location, duration are not the same for a programme defined for the local or regional scales versus continental or world-wide programmes such as GEMS/Water.

SURVEILLANCE NETWORK

A surveillance network is also established for the long term. The main difference with monitoring is that the objective is to ensure that water quality (or any other ecosystem component) meets use-specific or multi-use predefined criteria. A surveillance network may be quite broad (water quality monitoring) or very focused in the case of a usage network (swimming waters). Parameter measures are closely linked to water quality; station location and sampling frequency are also defined in view of the uses to be monitored.

Surveillance networks become warning networks when data, analysed on the very short term (if not in real time) are used for immediate decision-making in the context of public security enforcement. These warning networks also provide data that can be analysed on the longer term, in a surveillance model.

Third variation, the measure network that provides data in response to legal requirements or to guarantee water supply safety. This type of network shares with the warning network the same requirement for information on a continuous basis and a role for short-term advice to decision-makers.

SURVEY

The task here is to define the state of the territory before any intervention, with the help of a diagnosis conducted beforehand, then to verify afterwards if interventions have produced the expected results. This type of network may also be used to define orientations for the management of aquatic ecosystems, to provide a basis for legal or management activities, and finally to inform users and water managers. One characteristic of this type of network is the density of sampling stations and the list of parameters to be measured in view of the type of intervention; moreover, sampling frequency will have to be adapted to the local context. The accuracy of the network should allow for the comparison of results with the objectives set at the very beginning. This is not a long-term network, but the duration must be sufficient to evaluate the effects of the interventions.

In several exercises designed for the preparation of a basin management plan, information is unsatisfactory at the outset and it might be necessary to set up a process to collect information to meet our specific needs. For instance, portions of the territory have not been surveyed or information does not cover all sectors that are part of the planning exercise. But before moving ahead, we have to identify existing networks and potential synergy or their complementary nature.

We should also note that all three types of networks may measure the same parameters. It is definitely beneficial to take into account this possible multiple use of the data gathered while designing the network (variables, frequency, location of stations, partners). For instance, a water quality monitoring network (physical, chemical, toxic and bacteriological parameters) provides basic knowledge on the current level of water quality. The same data gathering and processing effort allows for evaluation of the effects of certain actions (reduced industrial loads, treatment of domestic wastewater, greater agricultural use of pesticides) if planned beforehand.

Some examples of monitoring activities or programmes were identified at the Segou Seminar (Table 24).

TABLE 24
Monitoring Programmes

PROGRAMME TITLE: **Hydro-Niger**

Responsible Agency	Type of Network: Monitoring or Surveillance	Survey	Indicators
NBA Hydraulics departments of member states	Platforms (21) installed from 1980-1981		Rate of flow (m^3/sec) Height (cm) Rainfall (mm) Temperature (°C)

PROGRAMME TITLE: **Follow-up on Objective of Regulating River Regime (Representative Pilot Basin: Guinea)**

Responsible Agency	Type of Network: Monitoring or Surveillance	Survey	Indicators
National Forestry and Game Branch		Global effects measured before and after project implementation	Component: water quantity Rate of flow (m^3/sec)

TABLE 24A
Monitoring Programmes (1995)

1. TYPES OF MONITORING PROGRAMMES

a) Monitoring and Surveillance

Pastoral resources, grain markets, agricultural production and risk zones (grazing), hydraulic network and flood forecast, hydro-meteorological networks, fisheries, underground waters.

b) Survey

Village hydraulics, drainage projects, reforestation projects, intensive stock breeding projects,
upstream and downstream effects of hydroelectric projects, irrigation projects, drinking-water supply projects.

c) Mixed monitoring

Hydraulic model (control structures impact on the river system), agricultural development (effect on soils, birds, etc.). .

2. OPERATORS

Regional organisations, national committees, government departments, offices, agencies, local committees, government-owned corporations, funding agencies, village organisations, NGOs, research institutes.

INDICATORS

Owing to the complexity of ecological systems, it is not possible to measure everything or to monitor everything in time and space. Indicators will be used, variables chosen for their representativeness and reliability. The use of indicators is not a panacea; any simplification must allow for a margin of error.

The development of indicators is as yet a young research field. Calibration of an indicator, on the basis of the use that will be made of it, is a necessity and represents a genuine challenge for science. In addition to its scientific reliability, the indicator must be pertinent, representative, easy to interpret and as encompassing as possible.

According to Bertram and Stadler-Salt (1998, p. 6-7), three criteria were used to select the indicators used in the Great Lakes monitoring programme:

- Necessary — Do we really need to monitor a particular indicator? We want to gather information that is necessary to assess ecosystem health.
- Sufficient — Will the set of indicators give us enough information to assess the health of the Great Lakes ecosystem? We don't want to make an overall assessment of ecosystem health from too few indicators.
- Feasible — Can the information be reasonably gathered, considering budgetary and monitoring constraints? The ideal situation would be if a monitoring program is already in place to gather the information.

Monitoring, using indicators, may be carried out at the level of ecosystem components. This approach allows for a more comprehensive view of changes in the environment in response to the overall action undertaken. The monitoring of uses and resources is more direct, and may require another series of indicators.

The introduction of a monitoring programme is not an end in itself, but rather an essential planning tool that must be shaped to the specific needs of the action plan. Information needs define the monitoring programme, not the other way around.

Table 24A presents a few results gathered during the 1992-1993 seminars. Discussions brought forward some interesting aspects of monitoring. This is a complex issue in scientific, technical and financial terms. It is quite a challenge to define the scientific parameters of any programme, be it monitoring, surveillance or survey. Information is expensive to gather and choices are difficult to make, given the few financial and human resources allowed for this type of activity. Participants at the seminars raised serious questions:

How can we clearly define the real needs (strict minimum) in the area of a monitoring programme?

How can we select the characteristics of a monitoring programme that can really guide actions, even during project implementation?

How can we design and operate a monitoring programme in such a way that a broad range of users can benefit from the data?

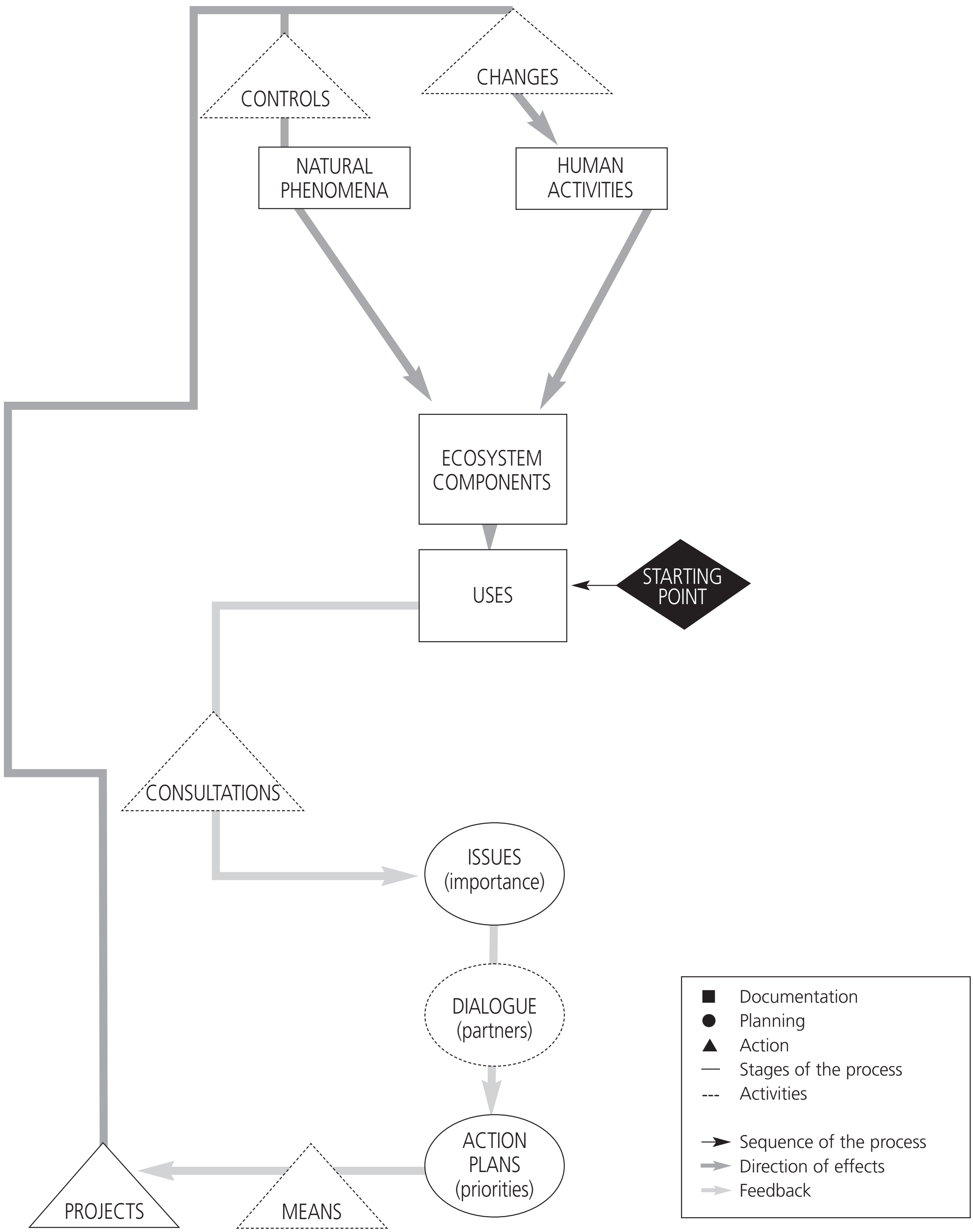
FEEDBACK

A feedback mechanism is included in the river basin management framework (Figure T-5). Indicated with a dark dotted line, projects have a measurable effect on ecosystem components, and as a consequence, on uses and biological resources, either through control of natural phenomena or the modification of human activities.

If the effects observed do not correspond to the objectives targeted by the action plan and the projects that form part of it, a feedback mechanism is triggered. Planning must be reviewed, public consultation and dialogue with partners reactivated. If the priority list is still valid, we must revise the action plan and projects. Perhaps means were not sufficient, technical choices poorly adapted, or even the cause of the problem was poorly identified to start with; with new information, actions can now be more focused. On the other hand, in a continuous participatory process, we will have to keep partners and the communities informed as to whether the action plan and the projects have met their objectives.

FIGURE T-5

Feedback



Whatever the reasons for results not to materialise, we must put in place a feedback mechanism; we cannot wait for the completion of projects without acting if we already have information that allows us to foresee a project failure. A lot of financial and human resources could thus be put to a better use, without mentioning delays in responding to pressing populations and ecosystem needs.

EXAMPLE OF APPLICATION: FISHERIES ON THE NIGER

Monitoring Network

In the case of fisheries, a great deal of basic information is required to grasp clearly any changes in this activity closely associated with a biological resource.

Networks that will be put in place will provide information on:

– Ecosystem components: water, habitat, sediment;

– Human activities: agriculture, forestry, industrialisation, fishing;

– Natural phenomena: rainfall;

– Biological resource: surveys, distribution charts.

Socioeconomic aspects are just as important as the purely biological aspects in monitoring.

Surveillance Network

In the case of a project focusing directly on a species of fish, the survey will cover, among other things:

– Population parameters (age groups, sex ratio, fertility, growth, etc.);

– Habitat parameters (spawning, young fish stocking, feeding areas, migratory paths, etc.);

– Fishing parameters (gear, fishing areas, population of fishermen, landings, etc.).

Survey

A survey can be conducted on fish health or fish contamination, at a given time or specific location.

RESULTS FROM STAGE 9

From monitoring networks already in place:

- **Examples of indicators already used;**
- **One descriptive sheet per monitoring programme (responsible agencies, type of network, indicators; Table 24).**

From the action plan and projects defined previously, design a joint network (surveillance and monitoring) stressing the variables to be measured.

A blank copy of Table 24 is presented in Appendix 6.

Working group during the Hanoi Seminar.

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LARGE RIVERS OF THE WORLD

(http://www.oieau.org/ReFEA/module5b.html)

"RÉSEAU FRANCOPHONE SUR L'EAU ET L'ASSAINISSEMENT"

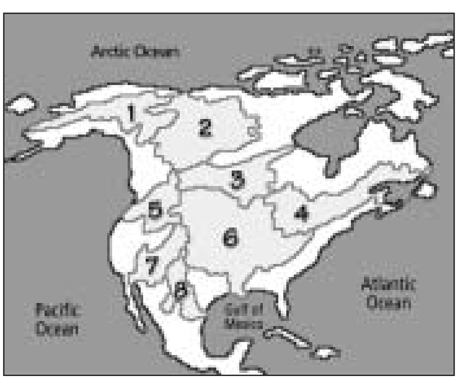
This section presents data on basin areas, length and mean average flow for forty large rivers. These data come from several reference sources.

Rivers are grouped by continent, in the same order as on the map, from left to right.

AFRICA

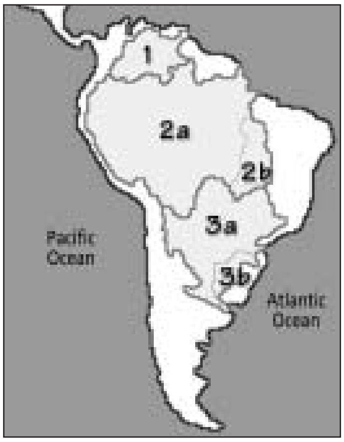
River/Lake	Basin Area (km²)	Length (km)	Mean Annual Flow (m³/s)
1. Senegal	419,660	1,700	700
2. Niger	1,950,000	4,100	6,100
3. Lake Chad	2,497,900	nd	nd
4. Nile	2,849,000	6,670	2,830
5. Congo	3,730,470	4,630	39,200
6. Zambezi	1,332,600	2,650	7,100
7. Orange	941,400	2,250	300

NORTH AMERICA



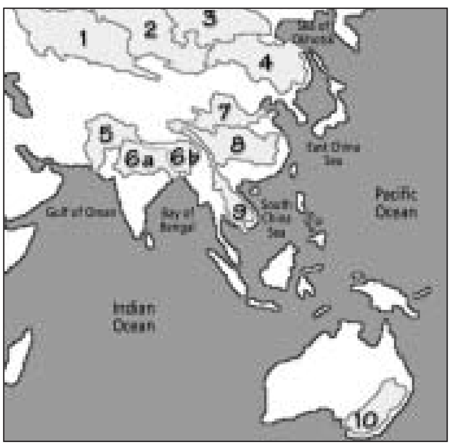
River/Lake	Basin Area (km²)	Length (km)	Mean Annual Flow (m³/s)
1. Yukon	847,600	3,180	6,200
2. Mackenzie	1,787,000	4,240	10,600
3. Nelson	1,093,400	2,570	3,500
4. Great Lakes/ St. Lawrence	1,609,000	3,260	12,600
5. Columbia	657,500	2,240	7,960
6. Mississippi-Missouri	3,290,000	5,970	18,400
7. Colorado	703,100	2,330	640
8. Rio Grande	608,000	3,030	100

SOUTH AMERICA



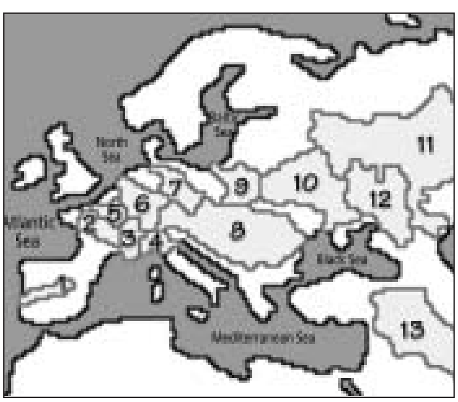
River	Basin Area (km²)	Length (km)	Mean Annual Flow (m³/s)
1. Orínoco	953,600	2,140	30,000
2a. Amazon	6,144,700	6,570	175,000
2b. Tocantins	764,180	nd	11,000
3a. Paraná-Río de la Plata	2,582,670	4,880	25,000 (with Uruguay)
3b. Uruguay	297,200	nd	nd

ASIA-OCEANIA



River	Basin Area (km²)	Length (km)	Mean Annual Flow (m³/s)
1. Ob-Irtysh	2,972,500	5,410	12,350
2. Yenisei	2,554,480	5,870	17,200
3. Lena	2,306,770	4,400	16,300
4. Amur	1,930,000	5,780	11,000
5. Indus	1,081,700	2,880	6,700
6a. Ganges	1,016,100	2,510	11,600
6b. Brahmaputra	651,300	2,840	19,300
7. Hwang Ho	752,400	4,840	1,300
8. Yangtze	1,808,500	6,300	34,000
9. Mekong	795,000	4,200	15,000
10. Murray	1,059,000	3,750	350

EUROPE



River	Basin Area (km²)	Length (km)	Mean Annual Flow (m³/s)
1. Tagus	78,460	1,006	300
2. Loire	115,270	1,020	810
3. Rhône	96,000	810	2,200
4. Po	76,990	620	1,400
5. Seine	75,000	400	780
6. Rhine-Meuse	185,000	1,320	2,500
7. Elbe	149,000	1,160	300
8. Danube	817,000	2,860	6,550
9. Vistula	180,250	1,200	1,100
10. Dnieper	531,800	2,200	1,650
11. Volga	1,350,000	3,530	8,400
12. Don	458,700	1,870	870
13. Tigris and Euphrates	765,830	2,430	1,500

GLOSSARY AND DEFINITIONS

Internet: http://www.ec.gc.ca/water/en/info/gloss/e_gloss.htm

acid mine drainage — Low pH drainage water from certain mines usually caused by the oxidation of sulphides to sulphuric acid. Mine drainage can also contain high concentration of metal ions.

acid rain — Rainfall with a pH of less than 7.0. One source is the combining of rain and sulphur dioxide emissions, which are a by-product of combustion of fossil fuels. Also referred to as acid deposition and wet deposition.

algae — Simple rootless plants that grow in sunlit waters in relative proportion to the amounts of nutrients available. They can affect water quality adversely by lowering the dissolved oxygen in the water. They are food for fish and small aquatic animals.

algae blooms — Rapid growth of algae on the surface of lakes, streams, or ponds; stimulated by nutrient enrichment.

alkali — Any strongly basic substance of hydroxide and carbonate, such as soda, potash, etc., that is soluble in water and increases the pH of a solution.

aquatic ecosystem — Basic ecological unit composed of living and nonliving elements interacting in an aqueous milieu.

aquifer — The underground layer of water-soaked sand and rock that acts as a water source for a well; described as artesian (confined) or water table (unconfined).

arid — Describes regions where precipitation is insufficient in quantity for most crops and where agriculture is impractical without irrigation.

atmosphere — The layer of gases surrounding the earth and composed of considerable amounts of nitrogen, hydrogen, and oxygen.

atmospheric water — Water present in the atmosphere either as a solid (snow, hail), liquid (rain) or gas (fog, mist).

bioaccumulation (bioconcentation) — A term used to describe a process that occurs when levels of toxic substances increase in an organism over time, due to continued exposure.

biodegradable — Capable of being broken down by living organisms into inorganic compounds.

biological diversity (biodiversity) — The variety of different species, the genetic variability of each species, and the variety of different ecosystems that they form.

biomagnification (biological magnification) — A cumulative increase in the concentrations of a persistent substance in successively higher levels of the food chain.

biota — Collectively, the plants, microorganisms, and animals of a certain area or region.

bog — A type of wetland that accumulates appreciable peat deposits. It depends primarily on precipitation for its water source and is usually acidic and rich in plant matter, with a conspicuous mat or living green moss.

boundary water — A river or lake that is part of the boundary between two or more countries or provinces that have rights to the water.

climate — Meteorological elements that characterize the average and extreme conditions of the atmosphere over a long period of time at any one place or region of the earth's surface.

climate change — The slow variations of climatic characteristics over time at a given place.

coliform bacteria — A group of bacteria used as an indicator of sanitary quality in water. Exposure to these organisms in drinking water causes diseases such as cholera.

combined sewers — A sewer that carries both sewage and storm water runoff.

condensation — The process by which a vapour becomes a liquid or solid; the opposite of evaporation. In meteorological usage, this term is applied only to the transformation from vapour to liquid.

conservation — The continuing protection and management of natural resources in accordance with principles that assure their optimum long-term economic and social benefits.

consumptive use — The difference between the total quantity of water withdrawn from a source for any use and the quantity of water returned to the source; e.g., the release of water into the atmosphere; the consumption of water by humans, animals, and plants; and the incorporation of water into the products of industrial or food processing.

contaminant — Any physical, chemical, biological, or radiological substance or matter that has an adverse affect on air, water, or soil.

cooling tower — A structure that helps remove heat from water used as a coolant; e.g., in electric power generating plants.

cubic metre per second (m^3/s) — A unit expressing rate of discharge, typically used in measuring streamflow. One cubic metre per second is equal to the discharge in a stream of a cross section one metre wide and one metre deep, flowing with an average velocity of one metre per second.

dam — A structure of earth, rock, concrete, or other materials designed to retain water, creating a pond, lake, or reservoir.

delta — A fan-shaped alluvial deposit at a river mouth formed by the deposition of successive layers of sediment.

demand — The numerical expression of the desire for goods and services associated with an economic standard for acquiring them.

depletion — Loss of water from surface water reservoirs or groundwater aquifers at a rate greater than that of recharge.

dioxin — Any of a family of compounds known chemically as dibenzo-p-dioxins. Concern about them arises from their potential toxicity and contamination in commercial products.

discharge — In the simplest form, discharge means outflow of water. The use of this term is not restricted as to course or location, and it can be used to describe the flow of water from a pipe or from a drainage basin. Other words related to it are runoff, streamflow, and yield.

dissolved oxygen (DO) — The amount of oxygen freely available in water and necessary for aquatic life and the oxidation of organic materials.

dissolved solids (DS) — Very small pieces of organic and inorganic material contained in water. Excessive amounts make water unfit to drink or limit its use in industrial processes.

diversion — The transfer of water from a stream, lake, aquifer, or other source of water by a canal, pipe, well, or other conduit to another watercourse or to the land, as in the case of an irrigation system.

domestic use — The quantity of water used for household purposes such as washing, food preparation, and bathing.

drainage basin — See: *Watershed*.

dredgeate — The material excavated from lake, river, or channel bottoms during dredging.

dredging — The removal of material from the bottom of water bodies using a scooping machine. This disturbs the ecosystem and causes silting that can kill aquatic life.

drought — A continuous and lengthy period during which no significant precipitation is recorded.

dry deposition — Emissions of sulphur and nitrogen oxides that, in the absence of water in the atmosphere (i.e., rain), settle to the ground as particulate matter.

dyke — An artificial embankment constructed to prevent flooding.

ecosystem — A system formed by the interaction of a group of organisms and their environment.

effluent — The sewage or industrial liquid waste that is released into natural water by sewage treatment plants, industry, or septic tanks.

environment — All of the external factors, conditions, and influences that affect an organism or a community.

environmental assessment — The critical appraisal of the likely effects of a proposed project, activity, or policy on the environment, both positive and negative.

environmental monitoring — The process of checking, observing, or keeping track of something for a specified period of time or at specified intervals.

erosion — The wearing down or washing away of the soil and land surface by the action of water, wind, or ice.

estuary — Regions of interaction between rivers and nearshore ocean waters, where tidal action and river flow create a mixing of fresh water and saltwater. These areas may include bays, mouths of rivers, salt marshes, and lagoons. These brackish water ecosystems shelter and feed marine life, birds, and wildlife.

eutrophic lake — Shallow, murky bodies of water that have excessive concentrations of plant nutrients causing excessive algal production.

eutrophication — The natural process by which lakes and ponds become enriched with dissolved nutrients, resulting in increased growth of algae and other microscopic plants.

evaporation — The process by which a liquid changes to a vapour.

evapotranspiration — The loss of water from a land area through evaporation from the soil and through plant transpiration.

fen — A type of wetland that accumulates peat deposits. Fens are less acidic than bogs, deriving most of their water from groundwater rich in calcium and magnesium.

flood — The temporary inundation of normally dry land areas resulting from the overflowing of the natural or artificial confines of a river or other body of water.

flood damage — The economic loss caused by floods, including damage by inundation, erosion, and/or sediment deposition. Damages also include emergency costs and business or financial losses. Evaluation may be based on the cost of replacing, repairing, or rehabilitating; the comparative change in market or sales value; or the change in the income or production caused by flooding.

flood forecasting — Prediction of stage, discharge, time of occurrence, and duration of a flood, especially of peak discharge at a specified point on a stream, resulting from precipitation and/or snowmelt.

flood fringe — The portion of the floodplain where water depths are shallow and velocities are low.

flood peak — The highest magnitude of the stage of discharge attained by a flood. Also called peak stage or peak discharge.

floodplain — Any normally dry land area that is susceptible to being inundated by water from any natural source. This area is usually low land adjacent to a stream or lake.

floodproofing — Any combination of structural and nonstructural additions, changes, or adjustments to structures that reduce or eliminate flood damage.

floodway — The channel of a river or stream and those parts of the adjacent floodplain adjoining the channel that are required to carry and discharge the base flood.

flow — The rate of water discharged from a source; expressed in volume with respect to time, e.g., m^3/s.

flow augmentation — The addition of water to a stream, especially to meet instream flow needs.

food chain — A sequence of organisms, each of which uses the next, lower member of the sequence as a food source.

food web — The complex intermeshing of individual food chains in an ecosystem.

fresh water — Water that generally contains less than 1000 milligrams per litre of dissolved solids such as salts, metals, nutrients, etc.

glacier — A huge mass of ice, formed on land by the compaction and re-crystallization of snow, that moves very slowly downslope or outward due to its own weight.

greenhouse effect — The warming of the earth's atmosphere caused by a build-up of carbon dioxide or other trace gases; it is believed by many scientists that this build-up allows light from the sun's rays to heat the earth but prevents a counterbalancing loss of heat.

groundwater — The supply of fresh water found beneath the earth's surface (usually in aquifers) that is often used for supplying wells and springs.

groundwater recharge — The inflow to an aquifer.

habitat — The native environment where a plant or animal naturally grows or lives.

hazardous waste — Waste that poses a risk to human health or the environment and requires special disposal techniques to make it harmless or less dangerous.

hydroelectricity — Electric energy produced by water-powered turbine generators.

hydrologic cycle — The constant circulation of water from the sea, through the atmosphere, to the land, and back to the sea by over-land, underground, and atmospheric routes.

hydrology — The science of waters of the earth; water's properties, circulation, principles, and distribution.

infiltration — The movement of water into soil or porous rock. Infiltration occurs as water flows through the larger pores of rock or between soil particles under the influence of gravity, or as a gradual wetting of small particles by capillary action.

inflow — The entry of extraneous rainwater into a sewer system from sources other than infiltration, such as basement drains, sewer holes, storm drains, and street washing.

inorganic — Matter other than plant or animal and not containing a combination of carbon, hydrogen, and oxygen, as in living things.

instream use — Uses of water within the stream channel, e.g., fish and other aquatic life, recreation, navigation, and hydroelectric power production.

integrated resource planning — The management of two or more resources in the same general area; commonly includes water, soil, timber, grazing land, fish, wildlife, and recreation.

interbasin transfer — The diversion of water from one drainage basin to one or more other drainage basins.

irrigation — The controlled application of water to cropland, hayland, and/or pasture to supplement that supplied through nature.

jökulhlaup — Destructive flood that occurs as the result of the rapid ablation of ice by volcanic activity beneath the ice of a large glacier.

kilowatt (kW) — A unit of electrical power equal to 1000 watts or 1.341 horsepower.

kilowatt hour (kWh) — One kilowatt of power applied for one hour.

lagoon — (1) A shallow pond where sunlight, bacterial action, and oxygen work to purify wastewater. (2) A shallow body of water, often separated from the sea by coral reefs or sandbars.

lake — Any inland body of standing water, usually fresh water, larger than a pool or pond; a body of water filling a depression in the earth's surface.

leaching — The removal of soluble organic and inorganic substances from the topsoil downward by the action of percolating water.

litre — The basic unit of measurement for volume in the metric system; equal to 61.025 cubic inches or 1.0567 liquid quarts.

marsh — A type of wetland that does not accumulate appreciable peat deposits and is dominated by herbaceous vegetation. Marshes may be either fresh water or saltwater and tidal or non-tidal.

megawatt — A unit of electricity equivalent to 1000 kilowatts.

model — A simulation, by descriptive, statistical, or other means, of a process or project that is difficult or impossible to observe directly.

NAPLs — Nonaqueous phase liquids; i.e., chemical solvents such as trichloroethylene (TCE) or carbon tetrachloride — often toxic. Many of the most problematic NAPLs are DNAPLs — dense nonaqueous phase liquids.

natural flow — The flow of a stream as it would be if unaltered by upstream diversion, storage, import, export, or change in upstream consumptive use caused by development.

navigable waters — Traditionally, waters sufficiently deep and wide for navigation by all, or specific sizes of, vessels.

non-renewable resources — Natural resources that can be used up completely or else used up to such a degree that it is economically impractical to obtain any more of them; e.g., coal, crude oil, and metal ores.

nutrient — As a pollutant, any element or compound, such as phosphorus or nitrogen, that fuels abnormally high organic growth in aquatic ecosystems (e.g., eutrophication of a lake).

oligotrophic lake — Deep, clear lakes with low nutrient supplies. They contain little organic matter and have a high dissolved oxygen level.

organic — (1) Referring to or derived from living organisms. (2) In chemistry, any compound containing carbon.

organism — A living thing.

parts per million (PPM) — The number of "parts" by weight of a substance per million parts of water. This unit is commonly used to represent pollutant concentrations. Large concentrations are expressed in percentages.

pathogenic microorganisms — Microorganisms that can cause disease in other organisms or in humans, animals, and plants.

percolation — The movement of water downward through the subsurface to the zone of saturation.

permafrost — Perennially frozen layer in the soil, found in alpine, arctic, and antarctic regions.

pesticide — A substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture of substances intended to regulate plant or leaf growth. Pesticides can accumulate in the food chain and/or contaminate the environment if misused.

pH — An expression of both acidity and alkalinity on a scale of 0 to 14, with 7 representing neutrality; numbers less than 7 indicate increasing acidity and numbers greater than 7 indicate increasing alkalinity.

photosynthesis — The manufacture by plants of carbohydrates and oxygen from carbon dioxide and water in the presence of chlorophyll, using sunlight as an energy source.

phytoplankton — Usually microscopic aquatic plants, sometimes consisting of only one cell.

plankton — Tiny plants and animals that live in water.

polychlorinated biphenyls (PCBs) — A group of chemicals found in industrial wastes.

pond — A small natural body of standing fresh water filling a surface depression, usually smaller than a lake.

precipitation — Water falling, in a liquid or solid state, from the atmosphere to a land or water surface.

rain — Water falling to earth in drops that have been condensed from moisture in the atmosphere.

receiving waters — A river, ocean, stream, or other watercourse into which wastewater or treated effluent is discharged.

recharge — The processes involved in the addition of water to the zone of saturation; also the amount of water added.

recyclable — Refers to such products as paper, glass, plastic, used oil, and metals that can be reprocessed instead of being disposed of as waste.

renewable resource — Natural resource (e.g., tree biomass, fresh water, fish) whose supply can essentially never be exhausted, usually because it is continuously produced.

reservoir — A pond, lake, or basin (natural or artificial) that stores, regulates, or controls water.

resource — A person, thing, or action needed for living or to improve the quality of life.

river — A natural stream of water of substantial volume.

river basin — A term used to designate the area drained by a river and its tributaries.

runoff — The amount of precipitation appearing in surface streams, rivers, and lakes; defined as the depth to which a drainage area would be covered if all of the runoff for a given period of time were uniformly distributed over it.

saltwater intrusion — The invasion of fresh surface water or groundwater by saltwater.

sanitary sewers — Underground pipes that carry off only domestic or industrial waste, not storm water.

sediment — Fragmented organic or inorganic material derived from the weathering of soil, alluvial, and rock materials; removed by erosion and transported by water, wind, ice, and gravity.

sedimentation — The deposition of sediment from a state of suspension in water or air.

seiche — A periodic oscillation, or standing wave, in an enclosed water body the physical dimensions of which determine how frequently the water level changes.

septic tank — Tank used to hold domestic wastes when a sewer line is not available to carry them to a treatment plant; part of a rural on-site sewage treatment system.

sewage — The waste and wastewater produced by residential and commercial establishments and discharged into sewers.

sewage system — Pipelines or conduits, pumping stations, force mains, and all other structures, devices, and facilities used for collecting or conducting wastes to a point for treatment or disposal.

sewer — A channel or conduit that carries wastewater and storm water runoff from the source to a treatment plant or receiving stream.

sewerage — The entire system of sewage collection, treatment, and disposal.

silt — Fine particles of sand or rock that can be picked up by the air or water and deposited as sediment.

sludge — A semi-solid residue from any of a number of air or water treatment processes.

solvent — Substances (usually liquid) capable of dissolving or dispersing one or more other substances.

spoils — Dirt or rock that has been removed from its original location, destroying the composition of the soil in the process, as with strip-mining or dredging.

spring — An area where groundwater flows naturally onto the land surface.

storm sewer — A system of pipes (separate from sanitary sewers) that carry only water runoff from building and land surfaces.

stream — Any body of running water moving under gravity flow through clearly defined natural channels to progressively lower levels.

streamflow — The discharge that occurs in a natural channel. Although the term "discharge" can be applied to the flow of a canal, the word "streamflow" uniquely describes the discharge in a surface stream. The term "streamflow" is more general than the term "runoff", as streamflow may be applied to discharge whether or not it is affected by diversion or regulation.

surface water — All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.); also refers to springs, wells, or other collectors that are directly influenced by surface water.

suspended solids (SS) — Defined in waste management, these are small particles of solid pollutants that resist separation by conventional methods. Suspended solids (along with biological oxygen demand) are a measurement of water quality and an indicator of treatment plant efficiency.

sustainable development — Development that ensures that the use of resources and the environment today does not restrict their use by future generations.

swamp — A type of wetland that is dominated by woody vegetation and does not accumulate appreciable peat deposits. Swamps may be fresh water or saltwater and tidal or nontidal.

temperature — The degree of hotness or coldness.

thermal pollution — The impairment of water quality through temperature increase; usually occurs as a result of industrial cooling water discharges.

toxic — Harmful to living organisms.

transpiration — The process by which water absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface, principally from the leaves.

tributary — A stream that contributes its water to another stream or body of water.

tsunami — A Japanese term that has been adopted to describe a large seismically generated sea wave capable of considerable destruction in certain coastal areas, especially where sub-marine earthquakes occur.

turbidity — Cloudiness caused by the presence of suspended solids in water; an indicator of water quality.

underground storage tank — A tank located all or partially underground that is designed to hold gasoline or other petroleum products or chemical solutions.

urban runoff — Storm water from city streets and adjacent domestic or commercial properties that may carry pollutants of various kinds into the sewer systems and/or receiving waters.

vapour — The gaseous phase of substances that are liquid or solid at atmospheric temperature and pressure, e.g., steam.

waste disposal system — A system for the disposing of wastes, either by surface or underground methods; includes sewer systems, treatment works, and disposal wells.

wastewater — Water that carries wastes from homes, businesses, and industries; a mixture of water and dissolved or suspended solids.

wastewater treatment plant — A facility containing a series of tanks, screens, filters, and other processes by which pollutants are removed from water.

water (H_2O) — An odourless, tasteless, colourless liquid formed by a combination of hydrogen and oxygen; forms streams, lakes, and seas, and is a major constituent of all living matter.

water conservation — The care, preservation, protection, and wise use of water.

water contamination — Impairment of water quality to a degree that reduces the usability of the water for ordinary purposes or creates a hazard to public health through poisoning or the spread of diseases.

water management — The study, planning, monitoring, and application of quantitative and qualitative control and development techniques for long-term, multiple use of the diverse forms of water resources.

water pollution — Industrial and institutional wastes and other harmful or objectionable material in sufficient quantities to result in a measurable degradation of the water quality.

water quality — A term used to describe the chemical, physical, and biological characteristics of water with respect to its suitability for a particular use.

water quality guidelines — Specific levels of water quality that, if reached, are expected to render a body of water suitable for its designated use. The criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.

water supply system — The collection, treatment, storage, and distribution of potable water from source to consumer.

water table — The top of the zone of saturation.

watershed — The land area that drains into a stream.

well — A pit, hole, or shaft sunk into the earth to tap an underground source of water.

wet deposition — See *acid rain.*

wetlands — Lands where water saturation is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the surrounding environment. Other common names for wetlands are bogs, ponds, estuaries, and marshes.

withdrawal use — The act of removing water from surface water or groundwater sources in order to use it.

zooplankton — Tiny aquatic animals eaten by fish.

zone of saturation — A subsurface zone in which all the pores or the material are filled with groundwater under pressure greater than atmospheric pressure.

WATER QUALITY

(Source: http://www.envionnement.gouv.fr/dossier/eau/bassin/bassin4.htm) (Our translation)

Good water quality is essential to human health, the health of biological resources, and recreation activities. National institutions responsible for water quality define standards for those elements susceptible to be present in water. Once targets have been set, it should be rather easy to define water quality. Water should taste good, without any unpleasant odour, be aesthetically acceptable and without physical, chemical and biological threatening agents. Some waters do not always meet all of these criteria.

How Do We Measure Water Quality?

Scientists collect water samples, living organisms, suspended solids and bottom sediments from water courses and lakes. They analyse them in the laboratory, using instruments and specialised techniques. They then compare results with standards and water quality criteria defined for different water uses.

A Few Water Quality (or Pollution) Parameters

Oxygen absorption, in relation with the disposal of wastewater, is a function of the quantity of organic matter it contains. Hence the notion of biological oxygen demand (BOD) measured in milligrams of oxygen per litre of water. BOD_5 is measured in the laboratory, comparing the quantity of oxygen originally present in a sample with the amount present after five days of incubation at 20 °C, away from light and airflow. This is only a fraction of the final value, approximately 70%, as the complete mineralisation of organic matters may require up to 20 days or more. BOD is one way of presenting the concentration of the biodegradable matters present in water.

Suspended Solids

As a portion of the polluting charge of urban wastewaters, suspended solids are partially removed by primary treatments at municipal treatment plants using a decantation process (primary decanters). Suspended solids come in two categories: as fixed particles, and volatiles. This means that part of the suspended solids volatilise when heated at high temperatures (550 °C) which represents the organic and volatile inorganic salts fraction.

The measurement of suspended solids is achieved through the filtration of a used water sample on a standard fibreglass filter. We usually filter a 100 ml sample and then weigh the residue accumulated on the filter once dried at 103-105 °C for one hour. The filter will have been previously dried under the same conditions, and weighed.

Forms of Nitrogen

Organic matter often contain organic nitrogen. The nitrogen portion is rapidly transformed into ammonia (NH_3) or ammonium salts (NH_4^+) by a bacteriological process called ammonification; water pH defines the type of ammonia being produced. A large amount of ammonium nitrogen in a used water sample indicates that the pollution is recent.

The first two forms of nitrogen are degraded progressively in used waters over time. Bacteria of the *nitrosomonas* type oxidise ammonium nitrogen to form nitrites (NO_2^-), an intermediary form of nitrogen. Then, the process is moved forward by the action of *nitrobacter* bacteria producing nitrates (NO_3^-) directly assimilated by plants. Nitrification is an aerobic process that begins after about ten days; the additional oxygen demand induced by this process adds up to the final BOD, hence what is called total oxygen demand, which is the result of the mineralisation of organic matters and the nitrification of ammonia.

The lack of oxygen may produce the opposite phenomenon, called denitrification; nitrates (NO_3^-) are then transformed into nitrites (NO_2^-) or into molecular nitrogen (N_2). The reduction of nitrites into ammonium nitrogen is also possible under anaerobic conditions. In order to measure the different forms of nitrogen one must consult a water chemistry manual.

Other Usual Parameters

Phosphates. Detergents and fertilisers contribute to the enrichment of surface waters by phosphates. Inorganic phosphorus is considered an essential element to aquatic ecosystems. Hydrolysable orthophosphates and polyphosphates are in fact limiting factors and it is essential to control them in the fight against lake eutrophication. It is therefore important to eliminate them at treatment plants and to measure them. In order to do so, water technicians identify the following types of phosphorus: total phosphates, orthophosphates, hydrolysable phosphates and organic phosphates. Each category is divided into solution and suspension.

Aesthetic and Taste. Wastewater colour and odour provide information on the age of liquid wastes. Fresh domestic wastewater is greyish in colour with a rather tolerable odour which is not the case of older ones. This is caused by the formation of gas or the proliferation of microorganisms that limit conventional treatment processes.

Amongst other water quality parameters, extreme pH levels are synonymous with industrial effluents. Temperature is also important. Organic and inorganic toxic or harmful pollutants (PCB, dioxins, pesticides etc.) represent specific cases. Measures and controls vary between countries and regions according to their needs.

Microbiological Characteristics. Wastewaters often contain microorganisms which will end up sooner or later in water courses and lakes. As they may pose a threat to human health, water analysis always contains a microbiological component. The detection of coliform bacteria is the most standard practice. Two techniques are commonly used to detect total coli in water: membrane filtration and fermentation in multiple tubes.

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Pollution Types

(Source: http://www.oieau.org/refea/module2d.html)
(Our translation.)

Organic	Contaminants	Nutrients (Fertilisers)	Microbiological	Aesthetical	Thermal
Associated Pollutants					
Organic matters (BOD)	Organic – resin acids – fatty acids – oil and grease – pesticides – organochlorine substances – PAH, PCB, phenols, benzene, toluene, dioxins, furans, etc. Inorganic – heavy metals (e.g. As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn, etc.) – cyanides, sulphates sulphurs	Nutrients – nitrogen – phosphorus	Bacteria and viruses – fecal coliforms – streptococus – enterococus – *Escherichia coli* – *Pseudomonas aeruginosa* – *Giardia lambia*	– colorants – odours – suspended solids (turbidity) – floating objects, rubbish, oily matters – algae	Warm waters
Sources					
Organic matters discharge of human, animal and industrial origins (food-processing industries, pulp and paper, and municipalities).	Discharge of organic substances by industries (farming, petroleum, chemical, pulp and paper, etc.). Discharge of inorganic substances by industries (chemical, metallurgical, mining and surface treatment).	Domestic and farming discharges. Discharges of nitrogenous products by explosives and fertilisers production plants.	Human and animal discharges causing the production of pathogenic organisms in water.	Pulp and paper mills, petroleum and textile industries. Untreated municipal wastewaters. Farming activities.	Cooling water discharge from industrial processes.

Organic	Contaminants	Nutrients (Fertilisers)	Microbiological	Aesthetical	Thermal
Environmental impacts					
Decreased oxygen concentration in water causing the disappearance of certain fish species. Foul odours. Water enrichment by nutrients (nitrogen and phosphorus) causing the proliferation of aquatic vegetation.	Immediate or latent effects (may accumulate slowly in tissues and progressively affect living organisms). Depending on the nature of the substance, the amount released and the species, it may cause the elimination of animal and vegetal species, thus weakening a link in the food-web. Biomagnification processes may affect human beings.	Proliferation of algae and aquatic plants in rivers flowing in farming lands. The decomposition of these plants is responsible for dissolved oxygen depletion in water, creating an unfavourable environment for aquatic fauna. May cause aesthetic degradation of water bodies.	Creation of an environment favourable to the propagation of certain infectious diseases which: – forces the treatment of water destined to human consumption, – limits recreation activities, – is responsible for the closure of mollusc gathering areas.	Makes recreation activities less attractive. Certain types of aesthetical pollution, like suspended solids, may destroy spawning grounds.	Artificial warming of ecosystems close to the effluents.

THE PUBLIC INVOLVEMENT CONTINUUM

(Terms used in Figure 6)
From Donaldson, 1994

Public Information / Education. This point on the continuum generally deals with decisions that have already been made and that the public is being made aware of. There is normally no request for comment from the public. Examples of this might be a decision made in the public interest such as emergency measures procedures, municipal council decisions, or the results of polls or research.

Information on specific issues, such as how to conserve water or protect fish habitat, is often developed and distributed without public input into the decision to produce the document, nor its content.

Public Information Feedback. When a decision is made, and comments are requested, we move up the continuum a notch. Examples of this type of involvement would include comments requested on municipal decisions such as proposed bylaws, awarding of contracts to specific contractors for public works, etc.

Some policy decisions may also fall into this category. It is normally where experts or elected officials have discussed and decided on a policy, project or plan and they wish feedback from the public on the decision. It does not usually occur at the conceptual stage, and is, in fact, seeking affirmation for something already decided. There is generally no onus on the prononent to take public comment into account.

Public Consultation. This is the level of public involvement with which there is the most familiarity, particularly, through environmental impact assessment.

When a proponent submits a project (or plan, or policy), the approval authority may require an environmental impact assessment, as well as a socio-economic impact assessment. Under most circumstances, but not all, public consultation is required. The public is then notified of the project (usually through newspaper advertisements), and a public consultation process is carried out. This might consist of several stages such as sending out background documents describing the proposal, information meetings at which the proponent provides details, and then finally a session where the public gives comments in a formal setting (e.g. hearings).

It is key to note here that the public is not usually informed of the proposal until it is well developed and past the needs determination and conceptual stages. This type of consultation is by nature confrontational. The proponents and supporters are in one camp, and the objectors in the other. Often the government is seen to be in the camp of the proponent. It is a reactive process, i.e. the public is asked to react to a proposal, and often in such a manner that only criticism is possible. The public is not given the time to thoroughly discuss the proposal at any stage, nor given time to consider alternatives, all of this having been done by "experts" prior to the consultation.

A step beyond this type of consultation is the use of public advisory committee (the key word being advisory). A proponent may set up an advisory committee to help identify potential issues and concerns and use this information in the development of the project.

However, in none of the above does the public share in the responsibility or ownership of the project since they did not establish the need, and the ongoing implementation may also be totally out of their hands. There is, therefore, little incentive for the public to seek creative, alternative solutions — only act as critic. Typical public consultation processes often lead to adversarial situations resulting in lengthy approval timelines.

Joint Planning (Multi-stakeholder). The joint planning point on the continuum represents a considerable leap in involvement. Commonly referred to as multi-stakeholder processes, they are by nature inclusive and recognise the rights of all interested and affected parties to be at the decision-making table with government and the proponent.

The process begins at the needs identification and conceptual stage of the project, and provides a non-confrontational setting where all participants are in the same camp, whether they agree or not.

Joint planning allows for a full exchange of information that in turn assists informed decision-making. The decisions reflect a wide range of interests and ideas, and result in a better understanding of the constraints and opportunities facing each stakeholder. The group becomes the proponent and champion of the project leading to greater ownership and responsibility. Successful implementation is therefore more likely.

There are many benefits to the multi-stakeholder (joint planning) process. It enhances the credibility and legitimacy of the project through an open and accessible process; it minimises adversarial situations; it promotes consensus and conflict avoidance; it is an educational process leading to informed decision-making; and it develops beneficial and long-term relationships amongst stakeholders.

It should be noted that multi-stakeholder processes cannot be used effectively when decisions have been made that are irrevocable. Proponents entering into a multi-stakeholder process should be aware that the process must be flexible, open to new ideas, and they must also be willing to work in partnership with the stakeholders to design a mutually beneficial outcome.

Experience has shown us that some multi-stakeholder processes develop a life of their own, even when the original mandate has been fulfilled. [...] It might be argued that a significant measure of success in the multi-stakeholder process is when the group feels strongly enough that what they are doing will make a difference and that they outlive the program that gave them their original mandate.

Delegated Authority. In terms of the public involvement continuum, delegated authority means giving decision-making authority, and the ability to carry out decisions, to a non-elected body. […] These bodies are, however, constrained by the Acts that created them and are only allowed to make decisions within a prescribed framework. The examples we have thus far, because of their constraints, encourage a "new bureaucracy" which may or may not actually represent the communities they are intended to serve.

The potential, however, for this bold next step is immense. It will require true and lasting partnerships between all sectors of society based on trust, cooperation, and responsibility.

Self-Determination. Many view self-determination as a type of anarchy. Some people may be familiar with the term in the context of aboriginal self-government.

In the context of public involvement, however, it is more the act of a community planning and carrying out deliberate actions to become sustainable environmentally, economically, and culturally, in a way that is free from political interference. […] It is perhaps a utopian notion of how communities can become self-sufficient, more responsible for their activities, and more caring for the ecosystem and all its attendant parts, with no motivation other than it is the right thing to do.

EUROPEAN UNION MONITORING PROGRAMME

(Source: www.archive.panda.org/europe/freshwater/pdf)

1. SURFACE WATER STATUS

1.1 Quality elements for the classification of ecological status

1.1.1 Rivers

Biological elements

Composition and abundance of aquatic flora
Composition and abundance of benthic invertebrate fauna
Composition, abundance and age structure of fish fauna

Hydromorphological elements supporting the biological elements

Hydrological regime:
- quantity and dynamics of water flow
- connection to ground water bodies

River continuity

Morphological conditions:
- river depth and width variation
- structure and substrate of the river bed
- structure of the riparian zone

Chemical and physicochemical elements supporting the biological elements

General

Thermal conditions
Oxygenation conditions
Salinity
Acidification status
Nutrient conditions

Specific Pollutants

Pollution by all priority substances identified as being discharged into the body of water
Pollution by other substances identified as being discharged in significant quantities into the body of water

1.1.2 Lakes

Biological elements

Composition, abundance and biomass of phytoplankton
Composition and abundance of other aquatic flora
Composition and abundance of benthic invertebrate fauna
Composition, abundance and age structure of fish fauna

Hydromorphological elements supporting the biological elements

Hydrological regime:
- quantity and dynamics of water flow
- residence time
- connection to the ground water body

Morphological conditions:
- lake depth variation
- quantity, structure and substrate of the lake bed
- structure of the lake shore

Chemical and physico-chemical elements supporting the biological elements

General

Transparency
Thermal conditions
Oxygenation conditions
Salinity
Acidification status
Nutrient conditions

Specific pollutants

Pollution by all priority substances identified as being discharged into the body of water
Pollution by other substances identified as being discharged in significant quantities into the body of water

1.1.3 Transitional waters

Biological elements

Composition, abundance and biomass of phytoplankton
Composition and abundance of other aquatic flora
Composition and abundance of benthic invertebrate fauna
Composition and abundance of fish fauna

Hydro-morphological elements supporting the biological elements

Morphological conditions:
– depth variation
– quantity, structure and substrate of the bed
– structure of the inter-tidal zone
Tidal regime:
– freshwater flow
– wave exposure

Chemical and physico-chemical elements supporting the biological elements

General

Transparency
Thermal conditions
Oxygenation conditions
Salinity
Nutrient conditions

Specific Pollutants

Pollution by all priority substances identified as being discharged into the body of water
Pollution by other substances identified as being discharged in significant quantities into the body of water

1.1.4 Coastal waters

Biological elements

Composition, abundance and biomass of phytoplankton
Composition and abundance of other aquatic flora
Composition and abundance of benthic invertebrate fauna

Hydromorphological elements supporting the biological elements

Morphological conditions:
– depth variation
– structure and substrate of the coastal bed
– structure of the inter-tidal zone
Tidal regime:
– direction of dominant currents
– wave exposure

Chemical and physico-chemical elements supporting the biological elements

General

Transparency
Thermal conditions
Oxygenation conditions
Salinity
Nutrient conditions

Specific Pollutants

Pollution by all priority substances identified as being discharged into the body of water

Pollution by other substances identified as being discharged in significant quantities into the body of water

1.1.5 Artificial and heavily modified surface water bodies

The quality elements applicable to artificial and heavily modified surface water bodies shall be those applicable to whichever of the four natural surface water categories above most closely resembles the heavily modified or artificial water body concerned.

Normative definitions of ecological status classifications

TABLE 1.2
General definition for rivers, lakes, transitional waters and coastal waters

The following text provides a general definition of ecological quality. For the purposes of classification the values for the quality elements of ecological status for each surface water category are those given in tables 1.2.1 — 1.2.4 below.

Element	High status	Good status	Moderate status
General	There are no, or only very minor, anthropogenic alterations to the values of the physicochemical and hydromorphological quality elements for the surface water body type from those normally associated with that type under undisturbed conditions. The values of the biological quality elements for the surface water body reflect those normally associated with that type under undisturbed conditions, and show no, or only very minor, evidence of distortion. These are the type specific conditions and communities.	The values of the biological quality elements for the surface water body type show low levels of distortion resulting from human activity, but deviate only slightly from those normally associated with the surface water body type under undisturbed conditions.	The values of the biological quality elements for the surface water body type deviate moderately from those normally associated with the surface water body type under undisturbed conditions. The values show moderate signs of distortion resulting from human activity and are significantly more disturbed than under conditions of good status.

Waters achieving a status below moderate shall be classified as poor or bad.

Waters showing evidence of major alterations to the values of the biological quality elements for the surface water body type and in which the relevant biological communities deviate substantially from those normally associated with the surface water body type under undisturbed conditions, shall be classified as poor.

Waters showing evidence of severe alterations to the values of the biological quality elements for the surface water body type and in which large portions of the relevant biological communities normally associated with the surface water body type under undisturbed conditions are absent, shall be classified as bad.

Table 1.2.1

Definitions for high, good and moderate ecological status in rivers

Biological quality elements

Element	High status	Good status	Moderate status
Phytoplankton	The taxonomic composition of phytoplankton corresponds totally or nearly totally to undisturbed conditions. The average phytoplankton abundance is wholly consistent with the type-specific physicochemical conditions and is not such as to significantly alter the type specific transparency conditions. Planktonic blooms occur at a frequency and intensity which is consistent with the type specific physicochemical conditions.	There are slight changes in the composition and abundance of planktonic taxa compared to the type-specific communities. Such changes do not indicate any accelerated growth of algae resulting in undesirable disturbances to the balance of organisms present in the water body or to the physico-chemical quality of the water or sediment. A slight increase in the frequency and intensity of the type specific planktonic blooms may occur.	The composition of planktonic taxa differs moderately from the type specific communities. Abundance is moderately disturbed and may be such as to produce a significant undesirable disturbance in the values of other biological and physico-chemical quality elements. A moderate increase in the frequency and intensity of planktonic blooms may occur. Persistent blooms may occur during summer months.
Macrophytes and phytobenthos	The taxonomic composition corresponds totally or nearly totally to undisturbed conditions. There are no detectable changes in the average macrophytic and the average phytobenthic abundance.	There are slight changes in the composition and abundance of macrophytic and phytobenthic taxa compared to the type-specific communities. Such changes do not indicate any accelerated growth of phytobenthos or higher forms of plant life resulting in undesirable disturbances to the balance of organisms present in the water body or to the physico-chemical quality of the water or sediment. The phytobenthic community is not adversely affected by bacterial tufts and coats present due to anthropogenic activity.	The composition of macrophytic and phytobenthic taxa differs moderately from the type-specific community and is significantly more distorted than at good status. Moderate changes in the average macrophytic and the average phytobenthic abundance are evident. The phytobenthic community may be interfered with and, in some areas, displaced by bacterial tufts and coats present as a result of anthropogenic activities.

Benthic invertebrate fauna	The taxonomic composition and abundance correspond totally or nearly totally to undisturbed conditions. The ratio of disturbance sensitive taxa to insensitive taxa shows no signs of alteration from undisturbed levels. The level of diversity of invertebrate taxa shows no sign of alteration from undisturbed levels.	There are slight changes in the composition and abundance of invertebrate taxa from the type-specific communities. The ratio of disturbance sensitive taxa to insensitive taxa shows slight alteration from type specific levels. The level of diversity of invertebrate taxa shows slight signs of alteration from type specific levels.	The composition and abundance of invertebrate taxa differ moderately from the type-specific communities. Major taxonomic groups of the type-specific community are absent. The ratio of disturbance sensitive taxa to insensitive taxa, and the level of diversity, are substantially lower than the type specific level and significantly lower than for good status.
Fish fauna	Species composition and abundance correspond totally or nearly totally to undisturbed conditions. All the type specific disturbance sensitive species are present. The age structures of the fish communities show little sign of anthropogenic disturbance and are not indicative of a failure in the reproduction or development of any particular species.	There are slight changes in species composition and abundance from the type specific communities attributable to anthropogenic impacts on physico-chemical and hydromorphological quality elements. The age structures of the fish communities show signs of disturbance attributable to anthropogenic impacts on physicochemical or hydromorphological quality elements, and, in a few instances, are indicative of a failure in the reproduction or development of a particular species, to the extent that some age classes may be missing.	The composition and abundance of fish species differ moderately from the type specific communities attributable to anthropogenic impacts on physico-chemical or hydromorphological quality elements. The age structure of the fish communities shows major signs of anthropogenic disturbance, to the extent that a moderate proportion of the type specific species are absent or of very low abundance.

Hydromorphological quality elements[1]

Element	High status	Good status	Moderate status
Hydrological regime	The quantity and dynamics of flow, and the resultant connection to groundwaters, reflect totally, or nearly totally, undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.

River continuity	The continuity of the river is not disturbed by anthropogenic activities and allows undisturbed migration of aquatic organisms and sediment transport.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Morphological conditions	Channel patterns, width and depth variations, flow velocities, substrate conditions and both the structure and condition of the riparian zones correspond totally or nearly totally to undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
General conditions	The values of the physico-chemical elements correspond totally or nearly totally to undisturbed conditions. Nutrient concentrations remain within the range normally associated with undisturbed conditions. Levels of salinity, pH, oxygen balance, acid neutralising capacity and temperature do not show signs of anthropogenic disturbance and remain within the range normally associated with undisturbed conditions.	Temperature, oxygen balance, pH, acid neutralising capacity and salinity do not reach levels outside the range established so as to ensure the functioning of the type specific ecosystem and the achievement of the values specified above for the biological quality elements. Nutrient concentrations do not exceed the levels established so as to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Specific synthetic pollutants	Concentrations close to zero and at least below the limits of detection of the most advanced analytical techniques in general use	Concentrations not in excess of the standards set in accordance with the procedure detailed in section 1.2.6 without prejudice to Directive 91/ 414/ EC and Directive 98/ 8/ EC. (< eqs)	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Specific non synthetic pollutants	Concentrations remain within the range normally associated with undisturbed conditions (background levels = bgl).	Concentrations not in excess of the standards set in accordance with the procedure detailed in section 1.2.6[2] without prejudice to Directive 91/ 414/ EC and Directive 98/ 8/ EC. (< eqs)	Conditions consistent with the achievement of the values specified above for the biological quality elements.

1. The following abbreviations are used: bgl = background level, eqs = environmental quality standard
2. Application of the standards derived under this protocol shall not require reduction of pollutant concentrations below background levels: (eqs> bgl)

TABLE 1.2.2

Definitions for high, good and moderate ecological status in lakes

Biological quality elements

Element	High status	Good status	Moderate status
Phytoplankton	The taxonomic composition and abundance of phytoplankton correspond totally or nearly totally to undisturbed conditions. The average phytoplankton biomass is consistent with the type-specific physicochemical conditions and is not such as to significantly alter the type specific transparency conditions. Planktonic blooms occur at a frequency and intensity which is consistent with the type specific physicochemical conditions.	There are slight changes in the composition and abundance of planktonic taxa compared to the type-specific communities. Such changes do not indicate any accelerated growth of algae resulting in undesirable disturbance to the balance of organisms present in the water body or to the physico-chemical quality of the water or sediment. A slight increase in the frequency and intensity of the type specific planktonic blooms may occur.	The composition and abundance of planktonic taxa differ moderately from the type specific communities. Biomass is moderately disturbed and may be such as to produce a significant undesirable disturbance in the condition of other biological quality elements and the physico-chemical quality of the water or sediment. A moderate increase in the frequency and intensity of planktonic blooms may occur. Persistent blooms may occur during summer months.
Macrophytes and phytobenthos	The taxonomic composition corresponds totally or nearly totally to undisturbed conditions. There are no detectable changes in the average macrophytic and the average phytobenthic abundance.	There are slight changes in the composition and abundance of macrophytic and phytobenthic taxa compared to the type-specific communities. Such changes do not indicate any accelerated growth of phytobenthos or higher forms of plant life resulting in undesirable disturbance to the balance of organisms present in the water body or to the physicochemical quality of the water. The phytobenthic community is not adversely affected by bacterial tufts and coats present due to anthropogenic activity.	The composition of macrophytic and phytobenthic taxa differ moderately from the type-specific communities and are significantly more distorted than those observed at good quality. Moderate changes in the average macrophytic and the average phytobenthic abundance are evident. The phytobenthic community may be interfered with, and, in some areas, displaced by bacterial tufts and coats present as a result of anthropogenic activities.

Benthic invertebrate fauna	The taxonomic composition and abundance correspond totally or nearly totally to the undisturbed conditions. The ratio of disturbance sensitive taxa to insensitive taxa shows no signs of alteration from undisturbed levels The level of diversity of invertebrate taxa shows no sign of alteration from undisturbed levels.	There are slight changes in the composition and abundance of invertebrate taxa compared to the type specific communities. The ratio of disturbance sensitive taxa to insensitive taxa shows slight signs of alteration from type specific levels. The level of diversity of invertebrate taxa shows slight signs of alteration from type specific levels.	The composition and abundance of invertebrate taxa differ moderately from the type-specific conditions Major taxonomic groups of the type-specific community are absent. The ratio of disturbance sensitive to insensitive taxa, and the level of diversity, are substantially lower than the type specific level and significantly lower than for good status
Fish fauna	Species composition and abundance correspond totally or nearly totally to undisturbed conditions. All the type specific sensitive species are present. The age structures of the fish communities show little sign of anthropogenic disturbance and are not indicative of a failure in the reproduction or development of a particular species.	There are slight changes in species composition and abundance from the type specific communities attributable to anthropogenic impacts on physico-chemical or hydromorphological quality elements. The age structures of the fish communities show signs of disturbance attributable to anthropogenic impacts on physicochemical or hydromorphological quality elements, and, in a few instances, are indicative of a failure in the reproduction or development of a particular species, to the extent that some age classes may be missing.	The composition and abundance of fish species differ moderately from the type specific communities attributable to anthropogenic impacts on physico-chemical or hydromorphological quality elements. The age structure of the fish communities shows major signs of disturbance, attributable to anthropogenic impacts on physicochemical or hydromorphological quality elements, to the extent that a moderate proportion of the type specific species are absent or of very low abundance.

Hydromorphological quality elements

Element	High status	Good status	Moderate status
Hydrological regime	The quantity and dynamics of flow, level, residence time, and the resultant connection to groundwaters, reflect totally or nearly totally undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Morphological conditions	Lake depth variation, quantity and structure of the substrate, and both the structure and condition of the lake shore zone correspond totally or nearly totally to undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Physico-Chemical quality elements[1]			
General conditions	The values of physico-chemical elements correspond totally or nearly totally to undisturbed conditions. Nutrient concentrations remain within the range normally associated with undisturbed conditions. Levels of salinity, pH, oxygen balance, acid neutralising capacity, transparency and temperature do not show signs of anthropogenic disturbance and remain within the range normally associated with undisturbed conditions.	Temperature, oxygen balance, pH, acid neutralising capacity, transparency and salinity do not reach levels outside the range established so as to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements. Nutrient concentrations do not exceed the levels established so as to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Specific synthetic pollutants	Concentrations close to zero and at least below the limits of detection of the most advanced analytical techniques in general use.	Concentrations not in excess of the standards set in accordance with the procedure detailed in section 1.2.6 without prejudice to Directive 91/ 414/ EC and Directive 98/ 8/ EC. (< eqs)	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Specific non synthetic pollutants	Concentrations remain within the range normally associated with undisturbed conditions (background levels = bgl).	Concentrations not in excess of the standards set in accordance with the procedure detailed in section 1.2.6[2] without prejudice to Directive 91/ 414/ EC and Directive 98/ 8/ EC. (< eqs)	Conditions consistent with the achievement of the values specified above for the biological quality elements.

1. The following abbreviations are used: bgl = background level, eqs = environmental quality standard
2. Application of the standards derived under this protocol shall not require reduction of pollutant concentrations below background levels

TABLE 1.2.3
Definitions for high, good and moderate ecological status in transitional waters

Biological quality elements

Element	High status	Good status	Moderate status
Phytoplankton	The composition and abundance of the phytoplanktonic taxa are consistent with undisturbed conditions. The average phytoplankton biomass is consistent with the type-specific physicochemical conditions and is not such as to significantly alter the type specific transparency conditions. Planktonic blooms occur at a frequency and intensity which is consistent with the type specific physicochemical conditions.	There are slight changes in the composition and abundance of phytoplanktonic taxa. There are slight changes in biomass compared to the type-specific conditions. Such changes do not indicate any accelerated growth of algae resulting in undesirable disturbance to the balance of organisms present in the water body or to the physicochemical quality of the water. A slight increase in the frequency and intensity of the type specific planktonic blooms may occur.	The composition and abundance of phytoplanktonic taxa differ moderately from type specific conditions. Biomass is moderately disturbed and may be such as to produce a significant undesirable disturbance in the condition of other biological quality elements. A moderate increase in the frequency and intensity of planktonic blooms may occur. Persistent blooms may occur during summer months.
Macroalgae	The composition of macroalgal taxa is consistent with undisturbed conditions. There are no detectable changes in macroalgal cover due to anthropogenic activities.	There are slight changes in the composition and abundance of macroalgal taxa compared to the type-specific communities. Such changes do not indicate any accelerated growth of phytobenthos or higher forms of plant life resulting in undesirable disturbance to the balance of organisms present in the water body or to the physicochemical quality of the water.	The composition of macroalgal taxa differs moderately from type-specific conditions and is significantly more distorted than at good quality. Moderate changes in the average macroalgal abundance are evident and may be such as to result in an undesirable disturbance to the balance of organisms present in the water body.

Angiosperms	The taxonomic composition corresponds totally or nearly totally to undisturbed conditions. There are no detectable changes in angiosperm abundance due to anthropogenic activities.	There are slight changes in the composition of angiosperm taxa compared to the type-specific communities. Angiosperm abundance shows slight signs of disturbance.	The composition of the angiosperm taxa differs moderately from the type-specific communities and is significantly more distorted than at good quality. There are moderate distortions in the abundance of angiosperm taxa.
Benthic invertebrate fauna	The level of diversity and abundance of invertebrate taxa is within the range normally associated with undisturbed conditions. All the disturbance sensitive taxa associated with undisturbed conditions are present.	The level of diversity and abundance of invertebrate taxa is slightly outside the range associated with the type-specific conditions Most of the sensitive taxa of the type-specific communities are present.	The level of diversity and abundance of invertebrate taxa is moderately outside the range associated with the type specific conditions. Taxa indicative of pollution are present Many of the sensitive taxa of the type-specific communities are absent
Fish fauna	Species composition and abundance is consistent with undisturbed conditions.	The abundance of the disturbance sensitive species shows slight signs of distortion from type specific conditions attributable to anthropogenic impacts on physicochemical or hydromorphological quality elements	A moderate proportion of the type specific disturbance sensitive species are absent as a result of anthropogenic impacts on physicochemical or hydromorphological quality elements

Hydromorphological quality elements

Element	High status	Good status	Moderate status
Tidal regime	The freshwater flow regime corresponds totally or nearly totally to undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Morphological conditions	Depth variations, substrate conditions, and both the structure and condition of the intertidal zones correspond totally or nearly totally to undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.

Physico-Chemical quality elements[1]

Element	High status	Good status	Moderate status
General conditions	Physico-chemical elements correspond totally or nearly totally to undisturbed conditions. Nutrient concentrations remain within the range normally associated with undisturbed conditions. Temperature, oxygen balance and transparency do not show signs of anthropogenic disturbance and remain within the range normally associated with undisturbed conditions.	Temperature, oxygenation conditions and transparency do not reach levels outside the ranges established so as to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements. Nutrient concentrations do not exceed the levels established so as to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Specific synthetic pollutants	Concentrations close to zero and at least below the limits of detection of the most advanced analytical techniques in general use.	Concentrations not in excess of the standards set in accordance with the procedure detailed in section 1.2.6 without prejudice to Directive 91/ 414/ EC and Directive 98/ 8/ EC. (< eqs)	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Specific non synthetic pollutants	Concentrations remain within the range normally associated with undisturbed conditions (background levels = bgl).	Concentrations not in excess of the standards set in accordance with the procedure detailed in section 1.2.6[2] without prejudice to Directive 91/ 414/ EC and Directive 98/ 8/ EC. (< eqs)	Conditions consistent with the achievement of the values specified above for the biological quality elements.

1. The following abbreviations are used: bgl = background level, eqs = environmental quality standard
2. Application of the standards derived under this protocol shall not require reduction of pollutant concentrations below background levels

TABLE 1.2.4

Definitions for high, good and moderate ecological status in coastal waters

Biological quality elements

Element	High status	Good status	Moderate status
Phytoplankton	The composition and abundance of phytoplanktonic taxa are consistent with undisturbed conditions. The average phytoplankton biomass is consistent with the type-specific physicochemical conditions and is not such as to significantly alter the type specific transparency conditions. Planktonic blooms occur at a frequency and intensity which is consistent with the type specific physicochemical conditions.	The composition and abundance of phytoplanktonic taxa show slight signs of disturbance. There are slight changes in biomass compared to type-specific conditions. Such changes do not indicate any accelerated growth of algae resulting in undesirable disturbance to the balance of organisms present in the water body or to the quality of the water. A slight increase in the frequency and intensity of the type specific planktonic blooms may occur.	The composition and abundance of planktonic taxa show signs of moderate disturbance. Algal biomass is substantially outside the range associated with type specific conditions, and is such as to impact upon other biological quality elements. A moderate increase in the frequency and intensity of planktonic blooms may occur. Persistent blooms may occur during summer months.
Macroalgae and angiosperms	All disturbance sensitive macroalgal and angiosperm taxa associated with undisturbed conditions are present. The levels of macroalgal cover and angiosperm abundance are consistent with undisturbed conditions.	Most disturbance-sensitive macroalgal and angiosperm taxa associated with undisturbed conditions are present. The level of macroalgal cover and angiosperm abundance show slight signs of disturbance.	A moderate number of the disturbance sensitive macroalgal and angiosperm taxa associated with undisturbed conditions are absent. Macroalgal cover and angiosperm abundance is moderately disturbed and may be such as to result in an undesirable disturbance to the balance of organisms present in the water body.

Benthic invertebrate fauna	The level of diversity and abundance of invertebrate taxa is within the range normally associated with undisturbed conditions. All the disturbance sensitive taxa associated with undisturbed conditions are present.	The level of diversity and abundance of invertebrate taxa is slightly outside the range associated with the type specific conditions Most of the sensitive taxa of the type specific communities are present.	The level of diversity and abundance of invertebrate taxa is moderately outside the range associated with the type specific conditions. Taxa indicative of pollution are present Many of the sensitive taxa of the type specific communities are absent

Tidal regime	The freshwater flow regime and the direction and speed of dominant currents correspond totally or nearly totally to undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Morphological conditions	The depth variation, structure and substrate of the coastal bed, and both the structure and condition of the inter-tidal zones correspond totally or nearly totally to the undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.

Physico-Chemical quality elements[1]

Element	High status	Good status	Moderate status
General conditions	The physico-chemical elements correspond totally or nearly totally to undisturbed conditions. Nutrient concentrations remain within the range normally associated with undisturbed conditions Temperature, oxygen balance and transparency do not show signs of anthropogenic disturbance and remain within the ranges normally associated with undisturbed conditions.	Temperature, oxygenation conditions and transparency do not reach levels outside the ranges established so as to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements. Nutrient concentrations do not exceed the levels established so as to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Specific synthetic pollutants	Concentrations close to zero and at least below the limits of detection of the most advanced analytical techniques in general use.	Concentrations not in excess of the standards set in accordance with the procedure detailed in section 1.2.6 without prejudice to Directive 91/ 414/ EC and Directive 98/ 8/ EC. (< eqs)	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Specific non synthetic pollutants	Concentrations remain within the range normally associated with undisturbed conditions (background levels = bgl)	Concentrations not in excess of the standards set in accordance with the procedure detailed in section 1.2.6[2] without prejudice to Directive 91/ 414/ EC and Directive 98/ 8/ EC. (< eqs)	Conditions consistent with the achievement of the values specified above for the biological quality elements.

1. The following abbreviations are used: bgl = background level, eqs = environmental quality standard)
2. Application of the standards derived under this protocol shall not require reduction of pollutant concentrations below background levels

TABLE 1.2.5

Definitions for maximum, good and moderate ecological potential for heavily modified or artificial water bodies

Element	Maximum ecological potential	Good ecological potential	Moderate ecological potential
Biological quality elements	The values of the relevant biological quality elements reflect, as far as possible, those associated with the closest comparable surface water body type, given the physical conditions which result from the artificial or heavily modified characteristics of the water body.	There are slight changes in the values of the relevant biological quality elements as compared to the values found at maximum ecological potential.	There are moderate changes in the values of the relevant biological quality elements as compared to the values found at maximum ecological potential. These values are significantly more distorted than those found under good quality.
Hydromorphological elements	The hydromorphological conditions are consistent with the only impacts on the surface water body being those resulting from the artificial or heavily modified characteristics of the water body once all mitigation measures have been taken to ensure the best approximation to ecological continuum, in particular with respect to migration of fauna and appropriate spawning and breeding grounds.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.

Physicochemical elements			
General conditions	Physico-chemical elements correspond totally or nearly totally to the undisturbed conditions associated with the surface water body type most closely comparable to the artificial or heavily modified body concerned. Nutrient concentrations remain within the range normally associated with such undisturbed conditions. The levels of temperature, oxygen balance and pH are consistent with the those found in the most closely comparable surface water body types under undisturbed conditions.	The values for physico-chemical elements are within the ranges established so as to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements. Temperature and pH do not reach levels outside the ranges established so as to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements. Nutrient concentrations do not exceed the levels established so as to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Specific synthetic pollutants	Concentrations close to zero and at least below the limits of detection of the most advanced analytical techniques in general use	Concentrations not in excess of the standards set in accordance with the procedure detailed in section 1.2.6 without prejudice to Directive 91/ 414/ EC and Directive 98/ 8/ EC. (< eqs)	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Specific non synthetic pollutants	Concentrations remain within the range normally associated with the undisturbed conditions found in the surface water body type most closely comparable to the artificial or heavily modified body concerned. (background levels = bgl)	Concentrations not in excess of the standards set in accordance with the procedure detailed in section 1.2.6[1] without prejudice to Directive 91/ 414/ EC and Directive 98/ 8/ EC. (< eqs)	Conditions consistent with the achievement of the values specified above for the biological quality elements.

1. Application of the standards derived under this protocol shall not require reduction of pollutant concentrations below background levels

PUBLIC PARTICIPATION

(Niagara Institute, 1989)

Keys to Success

Getting off to a good start

- Clearly identify stakeholders and their concerns.
- Commit your organisation to process before going public.
- Work with groups that support project, in advance.
- Broaden your thinking; understand internal goals; assess management commitment to public participation.
- Ensure, in advance, a clear understanding of guidelines, procedure rules and the consequences of events and regulations surrounding the project, process or policy at hand.
- Establish goals and objectives.

Managing the process

- Appreciate and understand the different stakeholder groups as different cultures with their own myths, values and history.
- Understand that public participation is a process of bridging the gaps created by different cultures.
- Plan.
- Give lots of advance notice to stakeholders of meetings, workshops, calls for briefs, public meetings, etc.
- Maintain and encourage information flow (displays/documents/press releases/technical data/etc.)
- Develop feedback processes that allow you to know what stakeholder reactions are.
- Adjust target dates and deadlines to stakeholder realities.
- Involve the public and stakeholders in setting guidelines and parameters.
- Recognise that stakeholders are not created equal; some groups have specialised interests.
- Encourage stakeholders to feel 'ownership' of the process.
- Provide intervener funding.

Communicating clearly

- Listen, hear, and understand.
- Encourage two-way communications; be fair, be open.
- Identify a mutually acceptable database.
- Involve news media from the beginning; be prepared to deal with potential consequences of publicising information.
- Develop a plan for public input (information/discussion/consultation).
- Exchange knowledge and information with key stakeholders.
- Carefully chose words in all communications.
- Establish early discussions and exchanges; encourage personal contact.

Allowing yourself to succeed

- Determine 'success' - define it.
- Recognise that consultation will not necessarily resolve all conflicts.
- Avoid autocracy.
- Solicit options then work towards solutions.
- Share responsibilities.
- Simplify the process; set clear terms of reference, objectives, procedures, time frames, and roles.
- Be flexible with the process.
- Establish a wide-open circle of 'consultants'.
- Be satisfied with something less than consensus in many processes.
- Share your power.

A Step by Step Planning Process

Public participation is not a discipline in itself. One of the opportunities it presents is a chance to apply a variety of techniques, processes and methods developed for other purposes. Those who have been involved in public participation have often been surprised to discover that the pressures of the situation have caused individuals to fail to use the managerial and organisational skills developed through other experience and training. They know what to do — how to structure a meeting, how to listen, how to plan, how to overcome resistance — but don't always do it.

Public participation processes can be greatly improved by making use of standard planning techniques, systems and methods. Many of us have a comfortable step-by-step process we use in a variety of situations. Don't forget to apply it!

Here is a simple step-by-step process for those that do not use one now.

Step 1 What is your project?
What do you want to do?

Step 2 Scan the environment:
a) Identify the issues that surround what you want to do.
b) Identify the stakeholders involved in these issues.

Step 3 Select your critical relationships:
a) Why is this relationship important?
b) What do I want from this relationship?
c) How much involvement do we want and for what purpose?

Step 4 Select techniques, methods and processes to work within these relationships.

Step 5 Implement

Step 6 Seek and deal with feedback, and make necessary adjustments.

Step 7 Implement changes.

Step 8 Evaluate. Communicate results.

Step 9 Recycle your learning to enhance the process

Comments on Culture and Public Participation

- Culture is not a quaint thing. It is something that allows us to survive in the circumstances in which we find ourselves.
- Culture is a significant socialisation process.
- Cultural values are learned and we always learn them as part of a group.
- Our culture establishes frameworks in our minds that help us shape and understand our world.
- If we can understand our own culturally defined frameworks, we can enhance poor communications.
- Good public participation leadership bridges cultures and the frameworks used for understanding:

What are the characteristics of the culture involved in your public participation process?

What gaps in understanding are created by the cultures represented by the different stakeholders in the process?

We are all members/participants in a number of cultures that affect our understanding framework.

- Our ethnic culture.
- Our age culture (youth, teen, senior).
- Our working culture (government, industry, voluntary, engineering)
- Our educational/training culture (accounting/social work/engineering)
- Our organisational culture

How do we get beyond the perceptual limitations created by our cultural frameworks? How do we gain clearer understanding of other views?

Some simple steps

- Let people talk to you about how you see things — come to understand your own framework well.
- Learn to listen patiently, while you control your own frameworks let other people's view in.
- Share your views.
- Discuss the different views and develop a common view.

INSTRUCTIONS TO TRAINERS

These instructions are destined for trainers who would like to organise a seminar following the river basin management framework described in this manual. We would like to share a few suggestions and comments based on our own experience. Particular conditions will vary from one seminar to another, but there are common traits that we would like to bring to the attention of future trainers.

SEMINAR ORGANISATION

Territory and Objective of the Seminar

The seminar may be organised to deal with an ecosystem defined by the river basin (national or international), a sub-basin or a stretch of a river; it could also deal with a lake ecosystem, national or international. The definition of the territory is the first decision the seminar organisers will have to make.

The second decision is about the scope of the seminar. Is it meant to be a capacity development exercise for managers in order to enhance the scope of their management instruments? Or is the seminar meant to be the first step of the development process of an action plan for the selected territory? Both approaches are realistic and have been used in the past.

Participants

On the one hand, territory and seminar objective have a direct influence on the choice of participants. On the other hand, a large part of the success of such a seminar lies with the participants themselves. Collectively, they must form a group representing the whole territory identified for the seminar and the main sectors where managers are to be found. Individually, participants must be selected for their expertise and their knowledge of the territory.

Preliminary Work

It is important to inform participants ahead of time of the particular nature of the seminar and to provide them with the checklist for preparing documentation (Appendix 7). The more prepared the participants, the more interesting the discussions during the seminar. This is even more important if the seminar is to be the beginning of a full-size planning process and not only a training exercise.

Transportation

The seminar schedule is quite tight and we will have to pay special attention to the time of the daily opening session. Travelling between the participants' lodging site and the seminar venue may be an issue; in some cases, we will have to provide transportation in order to begin the daily session on time.

Rooms

We have to allow for rooms large enough for participants, one for plenary and two for working group sessions. Participants will need a working space (table) to take notes and fill tables with information provided during the discussions. We should also make plans for audio visual equipment in the plenary session room; instructions and completed tables will have to be presented by the trainer on a daily basis. Moreover, the working groups' results will also be presented in plenary sessions daily. Overheads are the most flexible format. We may also go the computerised way with the blank tables presented on CD-ROM and compatible projector.

Interpretation

Experience from the 1992-1993 seminars has clearly shown the importance of being able to bring in participants from all over the basin whatever their working language. Four out of the five seminars were then held in a bilingual mode, both French and English, the trainer acting as the interpreter. Even under these conditions, some participants were not familiar with either language; we had to create a working group using another language, with translation of results for the plenary session. Simultaneous interpretation is an interesting but expensive option; on the other hand, we have to make sure that the translator-interpreters are familiar with technical terms.

Therefore, it is important to verify beforehand in which language participants have the most facility. We can then adjust the documentation and working organisation accordingly.

Material

Every participant should have a manual. Blank table copies in sufficient numbers will have to be prepared ahead of the event; three series of blank tables on overhead acetates will also have to be prepared. A projector and felt-tip pens are to be available on the premises.

If we choose the computerised approach, blank tables will have to be exported to the computers' hard disk; information will be transferred either through a network or on floppy disks. A projector will also be required for the duration of the seminar.

We need to have access to a photocopier on a daily basis, ideally close to the meeting site. The trainer will need to make copies of the results before the morning plenary session in order to distribute this information to the participants.

A map of the whole territory is an important educational tool; we will refer to it continuously to locate information provided by participants during the seminar. Select the smaller possible scale, taking into account the space available for hanging up the map.

PROPOSED SCHEDULE FOR A TWO-WEEK SEMINAR

DAY 1:

Morning: opening session
Plenary session: 1 hour

The opening session normally opens quite late in the morning; provide enough time for speeches by political representatives.

Afternoon: Introduction
Plenary session: 2 hours

Objectives of the seminar.

Working arrangements.

The river basin management framework.

Seeking information.

Working arrangements:

- Clearly explain the objectives of the seminar.
- Allow everyone around the table to introduce themselves.
- Make an inventory of fields of expertise available through the participants.
- Form two working groups if the number of participants exceeds 10-12.
- Prepare the list of participants, with full addresses.
- Obtain a consensus on the daily working schedule; continuous schedule or with a lunch break; time and length of coffee breaks.

Discussions:

- What do we know about the territory under study?
- Do we have maps we could hang on the wall?
- How does each participant perceive the importance of integrated management?
- Are there any obstacles to more integrated management frameworks?

DAY 2: STAGE 1

Plenary session: 1 hour (trainer)

Present the objectives.

Explain the definitions.

Present results as examples (Tables 1A, 1B, 1C, 2).

Provide instructions for the working group session.

Working group session: 3 hours (chair and secretary)

Identify a chair and a secretary.

Make up the list of uses and biological resources: collective work.

Fill Tables 1A, 1B and 1C with the results.

Complete Table 2: individual work. Each participant completes one or several forms.

Insist on the notion of "actual state" and the need for clear and precise statements, quantitative if possible; if not, use a qualitative mode. Each participant holds on to his copies of Table 2 for Stage 2 (following day).

The chair's role is important, mainly at the beginning of the seminar. He must let participants express themselves but avoid sterile debates.

Plenary session: 2 hours (trainer and working group secretaries)

Each working group present their results one after the other; no questions allowed during the presentations.

Clarification questions are then formulated; avoid lengthy debates at this point.

The discussion period should cover: the existence or not of a specific use or biological resource, the most appropriate measurement units, definitions.

Facts, knowledge and testimony from participants are the basis for discussion; we do not require documentary proof but we will make the best use of the documents the participants have brought with them.

Caution! We may lose a lot of time trying to harmonise at all costs the results from the two groups. The list of uses does not have to be exhaustive, but this is a very concrete starting point. It helps everyone realise that water uses and biological resources are quite diversified, each participant contributing information for a portion of the basin he knows best.

This initial exercise is quite demanding for several reasons: it requires order and logic; only what is important will be retained; similarities and particularities of sub-basins have to be clarified; finally, we have to learn how to reach a consensus on definitions. This is an excellent test for group dynamics; we rapidly perceive the level of participation of each participant and some equilibrium is established between the right of speech and the available discussion time. This first discussion period is important; we must create an environment favourable to valuable exchanges. There is no incompatibility between serious discussions and some level of humour to lighten the atmosphere.

At the end of Stage 1 (Day 2):

- Tables 1A, 1B and 1C are completed collectively.
- Table 2 is completed in parts by each participant.

N.B. We can be flexible regarding the time allotted for plenary and working group sessions; we must allow working groups to complete their work, while imposing a limitation to the discussions in plenary sessions. It is imperative to complete the stage before the closure of the day; once this convention is agreed on by participants, the effective time of closure of the daily work should be easier to finalise, always with some flexibility but without exaggeration.

Collective results are gathered on a daily basis, photocopied and distributed to the participants the following day.

DAY 3: STAGE 2

Plenary session: 1 hour (trainer)

Review briefly the results from Stage 1; insist on collective achievement and individual participation.

Stage 2:

- Present the objectives.
- Explain the notion of “changes”.
- Explain the notion of “criteria”.
- Present results as examples (Tables 3 and 4).
- Provide instructions for the working group session.

Working group session: 3 hours (chair and secretary)

The chair conducts an inventory of the items that the participants will be treating on the uses and biological resources lists (Tables 1A and 1B).

Each participant completes his own statements (Tables 2 and 3); be careful with measurement units and territory definition. Individual work, one hour maximum.

The chair then asks every participant to present his or her results, following the same order as with Tables 1A and 1B; the group discusse each result in order to really understand the meaning; once the discussion is over, the secretary writes down the final result in Table 4.

The first results presented by participants are generally quite detailed, with data of a quantitative nature. The chair will then try to complete the lists of uses and biological resources not already documented by participants, even if only qualitative statements can be formulated. Be careful with the identification of the territory corresponding to the statements (whole basin, sub-basin, national stretch).

The secretary can complete Tables 4A and 4B; keep in mind that the information should be presented in the same order as with Tables 1A and 1B.

Plenary session: 2 hours (trainer and working group secretaries)

Each working group present their results, one after the other; we may reverse the presentation order this time around, if participants so desire. Clarification questions are accepted, once presentations have been completed.

The discussion will be focused on:

- The statements themselves, as presenting more or less the reality of the basin;
- The localisation of a phenomenon described locally but that could be applied more broadly;
- The trends themselves;
- A hypothesis that could be formulated to explains these trends.

Discussions may face two obstacles:

- The phenomena are poorly localised; what is observed in one location may not be applicable somewhere else;
- The periods are too short to identify a trend, mainly for those phenomena with strong inter-annual variability.

At the end of the discussion period, a consensus should have been reached on trends, directions (increase, decrease, disappearance, stability), both for uses and biological resources, along with hypotheses on the causes of these changes. Of course, these are preliminary hypotheses and are more of a subjective than of a scientific nature; causal links will be established later in the framework (Stages 3 and 4). The consensus-building process, based on information sharing, is one of the pillars for the management framework; participants will get first-hand experience during this seminar.

At the end of Stage 2:

- Table 3 is completed (individually).
- Tables 4A and 4B are completed collectively.
- Tables 4A and 4B are photocopied and distributed to the participants.

DAY 4: STAGE 3

Plenary session: 1 hour (trainer)

Review briefly the results from Stages 1 and 2, insisting on observed trends (Table 4).

Stage 3:

Present objectives.

Present definitions (ecosystem, water, sediment, habitat).

Present results as examples (Tables 5, 6 and 7).

Provide instructions for the working group session.

Working group session: 2.5 hours (chair and secretary)

Working groups may be formed, this time on the three ecosystem components (water, sediment, habitat), if this seems more interesting, depending on the range of participants' expertise.

Each participant prepares statements for "current" and "modification" in Tables 5 and 6; one hour for individual work.

The chair then proceeds with an inventory of the available items and each participant presents his results. For habitats, we follow Table 1B, the results having already been identified (Table 4B); we may want to complete information already gathered at Stage 2.

The group discusse each result; the secretary fills in Table 7 with results provided by participants and accepted by the group. Be careful again with the localisation of the observed phenomena (Table 7, column on the left).

Plenary session: 2.5 hours (trainer, working group secretaries)

Each working group present their results, one after the other. Clarification questions are accepted, once presentations have been completed.

Discussions will touch upon the statements, the localisation of observed phenomena and trends.

At the end of the discussion period, a consensus should have been reached on ecosystem components trends (ups, downs, etc.). We will try to identify causes for these trends.

We then move to Table 8 (approximately 30 minutes). The matrix may be first completed individually, but we may also proceed directly with the collective work; in both cases, we have to introduce clearly what a matrix is and how it is completed.

To complete matrix on Table 8, we ask the following question:

*If water quantity changes, will this have a **direct** effect on…?*

We ask this question for all uses (Table 8A) and all biological resources (Table 8B) already identified, one after the other, from the top to the bottom of the column on the right.

We proceed with a vote: those who say yes, raise their hands, and we count votes; those who say no… we count votes again. There is no room for a neutral position (abstention), each participant being asked to give his opinion based on his best judgement. We write down the majority answer, either a yes or a no.

Caution! Do not allow discussion of the results along the way; it is difficult to entirely avoid discussion and comments from participants, but the trainer should be able to keep the group under control with a touch of humour, and to complete the task quickly.

The results are generally quite valid; it is the weight of the majority that expresses itself at every question, with "common sense" supreme when scientific data are lacking. This is often the case in the real world with environmental issues. That does not mean that some answers will not have to be revised, once the matrix has been completed; most opinion divergences come from the interpretation of the term "direct effect"; for some, the effect exists even after a long chain of repercussions, following a conservative approach based on the fact that everything in an ecosystem is interrelated. The trainer will have to insist on the "direct effect" notion, that is an effect that is observed at the very first level; a matrix is a simplification of reality necessary to initiate the completion of a diagnosis.

Note that the reverse matrix, that of effects of uses on ecosystem components, will be discussed in Stage 4; several uses having some effects on ecosystem components will be considered as human activities.

At the end of Stage 3:

- Tables 5 and 6 are completed individually.
- Tables 7, 8A and 8B are completed collectively.
- Tables 7, 8A and 8B are photocopied and distributed to the participants.

DAY 5: STAGE 4

Plenary session: 1 hour (trainer)

Review the results obtained until now (matrix) and insist on the particular position of Stage 4; this is where we identify the causes of changes, either nature or human beings.

Stage 4

Present objectives.

Present definitions (human activities, natural phenomena).

Present results as examples (Tables 9, 10, 11 and 12).

Provide instructions for the working group session.

Working group session: 2.5 hours (chair and secretary)

We make up the list of human activities, starting with the uses from Table 4A; which of these have an effect on ecosystem components? We complete the list using Table 13 as an example. We then prepare the list of natural phenomena using Table 14 as a guide. Both lists (human activities and natural phenomena) are provided to the trainer quickly to allow him to prepare the matrices (Tables 13 and 14) for the following plenary session.

Each participant prepares his own statements on "current" and their "evolution", human activities and natural phenomena, based on information he has (Tables 9 and 10). Allow one hour for this individual work.

The chair then proceeds with an inventory of the available items, and each participant presents his results. We follow the order of the uses list, and results already in Table 4A may be completed if necessary. We then add the other human activities (Table 11). We proceed the same way for the natural phenomena (Table 12); an inventory of the information provided by participants, followed by the search for qualitative information complements for the less documented natural phenomena.

Each result is discussed by the group; the secretary fills in Tables 11 and 12. Always pay attention to the localisation of observed phenomena.

Plenary session: 2.5 hours (trainer, working groups secretaries)

Each working group present their results, one after the other. Clarification questions are accepted, once presentations have been completed. Discussions will touch upon the statements, the localisation of observed phenomena and trends.

At the end of the discussion period, a consensus should have been reached on trends for each human activity and natural phenomenon (ups, downs, etc.). This is important, as we will later try to link these trends with modifications observed within ecosystem components.

We then move to Tables 13 and 14 (1 hour). As before, the matrices are completed collectively. Remind the participants of the "direct effect" concept, apply again the voting and result accounting technique. As with the previous exercise, some discipline will be necessary in order to be able to complete both matrices quickly.

At the end of Stage 4:

- Tables 9 and 10 are completed individually.
- Tables 10, 11, 12 and 13 are completed collectively.
- Tables 10 to 13 are photocopied and distributed to participants.

Field trip

After five days of intense work, and before moving to the second phase of the management framework, it is interesting to take a break. In every seminar organised within the Large Rivers Management Project this break was used for a field trip.

There are several reasons for this reality check with the environment:

- Showcase for local expertise. Some particularly interesting projects may offer an opportunity to illustrate managers' know-how from this portion of the basin;
- Facilitate informal exchanges between participants. This friendly setting provides moments for discussions at leisure between colleagues;
- Provide opportunities to apply certain notions acquired during the seminar. This is one of the roles of the trainer who can adapt to the field theoretical concepts derived from the management framework, but always with a touch of humour so as to keep this break light;
- Local authorities may also wish to benefit from the presence of an expert group to present local problems. This is an interesting opportunity to exchange between participants and local people.

However, field trips need to be well organised, in cooperation with local personnel, so that the visit will be educational, profitable but also devoid of logistical problems. There is nothing as a tiresome as transportation breakdown, a closed access because the local person has not been advised on time, or meal arrangements that have not been finalised. We have to pay the same attention to field trips as to the seminar itself.

DAY 6: STAGE 5

Plenary session: 1 hour (trainer)

Review the results obtained until now (matrix) and insist on the particular position of Stage 5, the Diagnosis; this is a synthesis stage at the end of the Documentation phase.

Stage 5

Present objectives.

Present the logical process.

Present results as examples (Tables 15A, 15B and 16).

Provide instructions for the working group session.

Working group session: 3 hours (chair and secretary)

First, make a list of gains (Table 15A) and then a list of losses (Table 15B); information comes from Tables 4A and 4B and is presented according to spatial and temporal aspects. The secretary takes notes of the results.

We then move to Table 16. The chair uses Table 4A and the results from Table 15A; each use is discussed, one at a time. We then proceed the same way with the biological resources.

Special attention is to be paid to the following two points: the causes of gains or losses, and the diagnosis validity. The secretary fills in Tables 16A and 16B.

Plenary session: 2 hours (trainer and secretaries)

Each working group present their results on Table 16A only, one after the other; clarification questions may be asked at the end of each presentation. Then each working group present results on Table 16B, one after the other; again, clarification questions may be asked at the end of each presentation. It seems more profitable to discuss uses and biological resources separately. Discussions are on gains and losses statements, causes of gains and losses, the diagnosis and its validity.

At the end of the discussion, a consensus should have been reached on gains and losses incurred within the basin and on some of the responsible causes. This is also the right moment to have a discussion on the available information and its validity, in very concrete terms.

We may be tempted to use the term "known", even though information may be very limited. The difference with the term "likely" is not always easy to make. We should insist on the difference between the two concepts: information does exist in both cases, but a causal link has been established only in the case considered as "known".

At the end of Stage 5:

Tables 15A, 15B, 16A and 16B are completed collectively and photocopied for participants.

DAY 7: STAGE 6

Plenary session: 1 hour (trainer)

Review the results from the diagnosis; this is the starting point for planning.

Stage 6

Present objectives.

Present results as examples (Tables 17 to 21).

Provide instructions for the working group session.

Working group session: 3 hours (chair and secretary)

Each working group have a different task to complete. The first working group will complete Table 17; we may proceed by sectors, if this is preferable. The secretary takes notes of the results.

The other working group complete Table 18; be careful to stay at the broad policy level. Here again, we may proceed by sectors rather that by countries, according to the participants' choice. The secretary takes notes of the results.

Table 19. If prepared ahead of time, the participants may complete it individually, time permitting; however, this exercise can just as well be completed collectively.

Table 21. Each participant provides one example to complete Table 21. These results will be discussed at Stage 7.

Plenary session: 2 hours (trainer and working group secretaries)

The first working group present Table 17, followed by a discussion period. This discussion should emphasise the importance of public consultation, but also concrete means that will have to be put in place in order for consultation to become an efficient planning instrument.

The other working group present Table 18, followed by a discussion period. We try to identify what should be harmonised at the scale of the territory under study in relationship with the whole basin.

Be careful to limit discussions in order to save time for discussions on Tables 19 and 20.

Table 19 is completed using a voting approach; for each use (Table 19A), and then for each biological resource (Table 19B), participants are asked to vote for one of three levels of importance (high, medium and low). Each participant votes only once so that the total of votes equals the number of participants at all times; one person is responsible for keeping the counts. We then proceed with results weighting (Tables 20A and 20B); this is a simple calculation that a working group of participants can complete during a coffee break. The results are noted directly in Table 20 and projected on the screen so that the participants may see the final results. This is a very revealing exercise for the participants; with a simple method like voting, it is possible to achieve an acceptable classification of uses and biological resources by order of importance. This is a practical illustration of the notion of "majority opinion" which, in most cases, resembles the "common sense" notion.

At the end of Stage 6:

Tables 17, 18, 19A, 19B, 20A and 20B are completed collectively and photocopied for participants.

DAY 8: STAGE 7

Plenary session: 1 hour (trainer)

Review the results from Stage 6, insisting on the uses and biological resources classified at the top level.

Stage 7

Present objectives.

Present results as examples (Tables 21 and 22).

Provide instructions for the working group session.

Working group session: 3 hours (chair and secretary)

Begin with Table 21; each participant provides an example of real conflict, along with corresponding solutions. The chair groups these examples by uses or sectors, which are then discussed by the group. Or, we can use Table 20 as a starting point, beginning with the most important use and looking for other uses with which it is in conflict. The secretary takes notes on Table 21.

We then move on to Table 22. Participants provide examples of action plans; the group will keep a few of the most interesting ones, one per country or portion of the basin. The discussions will be focused on objectives and partners, but most of all, on conditions for success. The secretary writes down the results of the discussion on Table 22.

Plenary session: 2 hours (chair and secretaries)

Each working group present first results from Table 21; discussions should be focused on solutions identified for each conflict, the sharing of experience between the two working groups casting new light on the discussion. We have to pay special attention to the following distinction: some conflicts are real while others are potential, which is the same for solutions. During discussions, we have to identify what is real versus what is not.

Each working group then present their results for Table 22. The difference between the objectives of the action plan and the criteria we will use to monitor the results of the plan have to be clarified; the quantitative parameters we will use to measure the success of the action plan are not the objectives the plan; for instance, an objective could be to provide drinking water to 50% of the population, while the measure of success will be the actual number of families with access to drinking water. The discussion on the conditions for success generates a lot of comments; some participants may be reluctant to criticise programs they are involved in. The trainer will have to guide the discussion with diplomacy in order to identify potential improvements in those action plans.

At the end of Stage 7:

Tables 21 and 22 are completed collectively and photocopied for the participants.

DAY 9: STAGE 8 AND 9

STAGE 8

Plenary session: 1 hour (trainer)

Review the results obtained at Stage 7. The focal point is the action plan, including partners and conditions for success.

Stage 8

Present objectives.

Present results as examples (Tables 23).

Provide instructions for the working group session.

Working group session: 1.5 hours (chair and secretary)

From action plans described at Stage 7 (Table 22), the participants identify a few projects coming from different sectors, if possible. Projects under implementation are preferable. The group discuss these projects and the secretary takes notes.

Plenary session: 1 hour (trainer and secretaries)

Each working group present their results. Discussions are focused on conditions for success, effects of delays, and contacts for information.

At the end of Stage 8:

Table 23 is completed collectively and photocopied for the participants.

STAGE 9:

The plenary session moves on: one half-hour (trainer)

Clearly establish the link with the preceding stage, that on projects

Stage 9:

Present objectives.

Present results as examples (Table 24) and the portion of the framework on monitoring (Figure T-5).

Provide instructions for the working group session.

Working group session: 1 hour (chair and secretary)

Identify examples of monitoring and surveillance programmes already in place within the basin; discuss their characteristics and provide information to the secretary (Table 24). Identify surveys already conducted for projects identified at Stage 8, or for other projects particularly interesting for this matter. If no such activities exist, what could they be? The secretary writes down the results also on Table 24.

Plenary session: 1.5 hours (trainer and secretaries)

Each working group present their results. The discussion is on all three types of programmes, monitoring, surveillance and survey, while insisting on what already exists in the basin but also on additions that may prove necessary.

At the end of the plenary session, we should go back to the river basin management framework (Figure 5) and recapitulate the path we have followed. This is the right time to discuss possible shortcuts and how to avoid an impasse, as presented in Chapter 1.

At the end of Stage 9:

Table 24 is completed collectively and photocopied for the participants.

N.B. Combining Stages 8 and 9. Both Stages 8 and 9 may be combined in the same one-hour plenary session, looking at results one stage after the other; there are direct links between these two stages.

Groups can work in one of two ways: each working group deals with both stages (2.5-hour session) or, one working group takes care of Stage 8 while the other deals with Stage 9. The second option allows for a reduction in the time required for this last working group session (less than 2 hours), with more time for the plenary session. This may be considered as a buffer period for accumulated delays in the completion of the work.

All work should be completed before the closing of Day 9, with this last plenary session, Day 10 being entirely devoted to the closing session.

DAY 10: CLOSING SESSION

Plenary: 1 hour (trainer)

Synthesis of the seminar by the trainer.

Discussions on the seminar:

Is the proposed framework useful?

How do participants envisage its application?

How can we improve it?

How to maintain contacts in the future?

Collects evaluation forms.

Closing ceremony: 1 hour (trainer and officials)

The trainer briefly presents the main conclusions of the seminar, thanks all participants for their efforts, thanks the hosting institutions and all persons involved in the organisation of the seminar.

Political representatives and officials declare the seminar closed.

Approximate use of time

Day	Activity	Trainer (presentations)	Working Group	Plenary
1	Opening			1 hr.
	Introduction	1.5 hrs.		
	Organisation			1 hr.
2	Stage 1	1 hr.	3 hrs.	2 hrs.
3	Stage 2	1 hr.	3 hrs.	2 hrs.
4	Stage 3	1 hr.	2.5 hrs.	2.5 hrs.
5	Stage 4	1 hr.	2.5 hrs.	2.5 hrs.
6	Stage 5	1 hr.	3 hrs.	2 hrs.
Field trip				
7	Stage 6	1 hr.	3 hrs.	2 hrs.
8	Stage 7	1 hr.	3 hrs.	2 hrs.
9	Stages 8 et 9	1 hr.	2.5 hrs.	2.5 hrs.
10	Synthesis	1 hr.		
	Closing			1 hr.

N.B.: Daily working period is evaluated at 6 hours, not including time for coffee breaks and lunch.

Evaluation

(Please complete according to form)

1. What is your general impression of this seminar?
   - Very satisfied ☐
   - Satisfied ☐
   - More or less satisfied ☐
   - Not satisfied ☐

2. What interested you most?

3. What interested you least?

4. What is your evaluation of the course presentations and theoretical explanations?
   As to their clarity?
   - Very satisfied ☐
   - Satisfied ☐
   - More or less satisfied ☐
   - Not satisfied ☐

   As to their usefulness?
   - Very satisfied ☐
   - Satisfied ☐
   - More or less satisfied ☐
   - Not satisfied ☐

Other comments:

5. Does the nature of the animation of this seminar lend itself to sharing and participation?
   Please elaborate beyond a “yes” or “no” response.

6. Are there points, elements or themes that you would have like to see considered
   during the seminar and that were not?
   If yes, which one(s)?

7. What is your evaluation of the physical setting in which the seminar took place (work place, lighting, etc.)?

8. Do you have any recommendations which would improve the quality of future seminars?
   If yes, what are they?

9. Other pertinent comments:

Thank you for your cooperation.

BLANK TABLES

TABLE 1A LIST OF USES

River:

Use	Units of Measurement	
	Quantity	Quality

TABLE 1B LIST OF BIOLOGICAL RESOURCES

River:

Biological Resource	Units of Measurement	
	Quantity	Quality

TABLE 1C GLOSSARY

River:

TABLE 2 DATA SHEET

River:

Use:
or
Biological Resource:

Current State:

Reference	Location	Medium	Timespan	Territory

TABLE 3 DATA SHEET

River:

Use:
or
Biological Resource:

Changes:

Reference	Criteria	Location	Medium	Timespan	Territory

TABLE 4A CHANGES OBSERVED IN USES

River:

Use	Trend	Past	Present

TABLE 4B CHANGES OBSERVED IN BIOLOGICAL RESOURCES

River:

Biological Resource	Trend	Past	Present

TABLE 5 DATA SHEET

River:

Ecosystem Component:

Current State:

Reference	Location	Medium	Timespan	Territory

TABLE 6 DATA SHEET

River:

Ecosystem Component:

Modifications:

Reference	Criteria	Location	Medium	Timespan	Territory

TABLE 7 TRENDS OBSERVED IN ECOSYSTEM COMPONENTS

River:

Component	Trend	Past	Present

TABLE 8A MATRIX OF RELATIONSHIPS BETWEEN ECOSYSTEM COMPONENTS AND CERTAIN USES

River:

Uses	Water		Sediment		Habitat					
	Quantity	Quality	Quantity	Quality						

TABLE 8B MATRIX OF RELATIONSHIPS BETWEEN ECOSYSTEM COMPONENTS AND CERTAIN BIOLOGICAL RESOURCES

River:

Biological Resources	Water		Sediment		Habitat					
	Quantity	Quality	Quantity	Quality						

TABLE 9 DATA SHEET

River:

Human Activity:
or
Natural Phenomenon:

Current State:

Reference	Location	Medium	Timespan	Territory

TABLE 10 DATA SHEET

River:

Human Activity:
or
Natural Phenomenon:

Evolution:

Reference	Criteria	Location	Medium	Timespan	Territory

TABLE 11 EVOLUTION IN HUMAN ACTIVITIES IN THE BASIN

River:

Human Activities	Trend	Past	Present

TABLE 12 EVOLUTION IN NATURAL PHENOMENA IN THE BASIN

River:

Natural Phenomena	Trend	Past	Present

TABLE 13 MATRIX OF RELATIONSHIPS BETWEEN HUMAN ACTIVITIES AND ECOSYSTEM COMPONENTS

River:

WATER:																
Quantity																
Quality																
SEDIMENT:																
Quantity																
Quality																
HABITAT:																

TABLE 14 MATRIX OF RELATIONSHIPS BETWEEN NATURAL PHENOMENA AND ECOSYSTEM COMPONENTS

River:

WATER:								
Quantity								
Quality								
SEDIMENT:								
Quantity								
Quality								
HABITAT:								

TABLE 15A SPATIAL AND TEMPORAL DIMENSIONS OF GAINS IN USES AND BIOLOGICAL RESOURCES

River:

Gains	Spatial Dimensions	Temporal Dimensions

TABLE 15B SPATIAL AND TEMPORAL DIMENSIONS OF LOSSES IN USES AND BIOLOGICAL RESOURCES

River:

Losses	Spatial Dimensions	Temporal Dimensions

TABLE 16A DIAGNOSIS OF THE STATE OF USES

River:

Use	Current State	Loss or Gain	Criteria Used	Causes	Reliability of Diagnosis

TABLE 16B DIAGNOSIS OF THE STATE OF BIOLOGICAL RESOURCES

River:

Biological Resource	Current State	Loss or Gain	Criteria Used	Causes	Reliability of Diagnosis

TABLE 17 LIST OF PUBLIC GROUPS TO BE CONSULTED

River:

Public Group	Reasons for Consulting	Means to be Used for Consulting

TABLE 18 POLICIES AND SOCIETAL CHOICES

River:

Themes	Description

TABLE 19A RANKING OF ISSUES IN THREE CATEGORIES OF IMPORTANCE

River:

Uses	Importance		
	Low	Medium	High

TABLE 19B RANKING OF ISSUES IN THREE CATEGORIES OF IMPORTANCE

River:

Biological Resources	Importance		
	Low	Medium	High

TABLE 20A WEIGHTED RANKING OF ISSUES IN THREE CATEGORIES OF IMPORTANCE

River:

Uses	Importance			
	Low (n × 1)	Medium (n × 5)	High (n × 10)	Total (points)

TABLE 20B WEIGHTED RANKING OF ISSUES IN THREE CATEGORIES OF IMPORTANCE

River:

Biological Resources	Importance			
	Low (n × 1)	Medium (n × 5)	High (n × 10)	Total (points)

TABLE 21 CONFLICTS AND POSSIBLE SOLUTIONS

River:

Between…	… and	Solutions

TABLE 22 ACTION PLANS

River:

Action Plan Title:

Objectives	Partners	Funding	Conditions for Success

TABLE 23 PROJECTS

River:

Project Title:

Objectives	Partners	Conditions for Success	Effect of Delays	Contacts for Information

TABLE 24 MONITORING

River:

Programme Title:

Type of Network: Monitoring
Surveillance
Survey
Mixed

Responsible Agencies	Information Gathering Methods	Parameters

CHECKLIST FOR PARTICIPANTS

Stages in the Process	Information Needed	Information Holders	Information Processing	Results	Observations
A – Documentation 1. *Uses and biological resources* Description of current state.	Ecological and socio-economic aspects. Quantitative and qualitative data. Thematic data on overall territory under study.	Government. International and national agencies. NGOs. Research organisations. Private corporations.	Description of current state. Automated (data banks, GIS). Non-automated (sheets, charts, transparencies). Processing for overall territory.	Thematic document in the form of tables, graphs, charts. List of uses and biological resources in the territory.	The description is drawn from synthesised information: caution is necessary when using data taken for various purposes in time and space. Information processing systems are often out of proportion to the quantity and quality of data. Qualitative data and local knowledge must be taken into account. A list of uses and resources is a starting point. This must be restricted to relevant elements alone.
2. *Changes* Evaluation by means of criteria.	Depending on the sector, choose: – standards, – quality criteria, – environmental objectives, – recognised reference levels used in the territory under study.	Government (codes, statutes, regulations). International agencies. Research organisations.	Changes in space and time. Compare current state against recognised criteria. Evaluate change in time and space. Automated (data bank, GIS) or non-automated processing.	Illustration of changes (time and space). Thematic documents on the "quality" of the use or biological resource. Graphs (trends over time). Charts (space).	The purpose of using criteria is to guarantee a degree of objectivity. The criteria may be qualitative. The application of criteria to data gathered for other purposes, spread out as to time and space, is a major challenge. Accept that there may be gaps in the information: do not wait until you know everything before making a judgment.
3. *Ecosystem components* a) Current state. b) Modifications. c) Identification of links.	Thematic data on ecosystem components (water, sediment, habitats). Quality criteria.	Government. International agencies. Research organisations. NGOs.	Establish the quality or current state of the ecosystem. Establish modifications in time and space. Establish links between these modifications and changes in uses and resources.	Thematic documents on ecosystem components. Graphs on modifications over time. Charts on ecosystem components. Interrelationship matrix.	Moving back up the causal sequence, we stop at ecosystem components which affect uses and resources (water quality and quantity, sediment, habitats). The links to be established may be real (measured) or potential (presumed).

Stages in the Process	Information Needed	Information Holders	Information Processing	Results	Observations
4. *Human activities* a) Current state. b) Evolution. c) Causal links.	Data on human populations. Data on sectors of activity. Data on loads, disposal, overexploitation.	Government. Local communities. International agencies. Research agencies. NGOs, cooperatives. Private corporations.	Identify links between human activities and ecosystem components. Establish evolution in time and space. Establish links between evolution in human activities and modifications in ecosystem components (through interrelationship matrices).	Thematic documents on human activities. Graphs on evolution over time. Charts on human activities. Interrelationship matrices with ranking of human activities in order of importance.	Only human activities which have effects on ecosystem components are selected. The links may be real (measured) or potential (presumed). The cumulative aspects may be taken into account by placing sources in order of importance.
Natural phenomena a) Current state. b) Evolution. c) Causal links.	Data on climate, desertification, etc. Data on natural disasters.	Government. International agencies. Research agencies.	Identify links between natural phenomena and ecosystem components. Establish evolution in time and space. Establish links between evolution in natural phenomena and modifications in ecosystem components (through interrelationship matrices).	Thematic documents on natural phenomena. Graphs on evolution over time. Charts on manifestations of natural phenomena. Interrelationship matrices with ranking of the effects of natural sources against effects associated with human activities.	Questions of scale are crucial: evolution in natural phenomena are generally more gradual and harder to predict in precise quantitative terms. The spatial scale often goes beyond the territory under study. Natural disasters are hard to predict but may have catastrophic effects. In several basins, structures regulate natural fluctuations.
5. *Integration and diagnosis*			Synthesis of overall gains and losses in uses and biological resources.	Integration document. List of gains and losses.	The documentation exercise is completed by the diagnosis which should be the subject of a consultation.
B – Planning 6. *Issues* Identification. Consultation.	Value scales based on societal choices (policies, directions, programs). List of interested public groups.	Government. Local communities. NGOs. Cooperatives. Individuals.	Establish the importance of each use and biological resource for society. Highlight conflicts. Define choices and their consequences. Identify the public groups to be consulted.	List of previously established policies and directions. List of issues in order of importance. List of conflicts and solutions. List of public groups to be consulted.	Value scales vary depending on societies and time. Consultation is essential for validating the list of issues since these represent societal choices; everything cannot be done at once. The issues may differ from one level to another (local, national and regional).

Stages in the Process	Information Needed	Information Holders	Information Processing	Results	Observations
7. *Action plans* Partnership.	From existing action plans: – administrative structures, – legal structures, – players with their responsibilities (formal and informal structure), – scientific and technical information: feasibility studies, environmental assessments, – funding structures.	Government. National and international agencies. Research organisations. Funding organisations.	Define clear objectives. Define "who does what". Responsibilities, powers of partners. Define how it is intented to act (methods, schedule). Define how human and financial resource are to be found.	For existing action plans: – objectives targeted, – partners, – funding, – conditions for success.	The action plan depends on the objectivity of the deliberation carried out previously. Realism is essential from the start, both technically (success rate observed elsewhere) and in terms of administration and funding. Adaptation to the specific conditions of the environment (human and natural) is the key to success.
C – Action 8. *Projects*	From existing projects: – information on project progress (technical and financial aspects), – information on problems encountered vs. anticipated schedule.	Implementing agencies. Government. Funding agencies.	Compare actual project progress with forecasts (specification). Evaluate the gravity of problems encountered and the effects of delays on overall planning.	Conditions for success. Effects of delays. Sources of information.	Project management is not part of this process: much information already exists on this topic. What we are interested in is information allowing for evaluation of project progress against the objectives set, in a national or regional planning context.
9. *Monitoring*	From existing networks: – information on indicators used, – information on types of networks.	Government. International and national agencies. NGOs. Local communities. Research organisations.	Establish the link between the type of network and the indicators used.	List of indicators. Example of existing monitoring networks.	There are three types of monitoring: monitoring, surveillance and survey. Monitoring may be conducted at two levels: ecosystem components; uses and biological resources. Indicators must be calibrated to the scale of the study. Monitoring has retroactive effects on issues, action plans and action taken.

CUMULATIVE EFFECTS MATRIX

Method used to assess the importance of cumulative effects (Adapted form Hydro-Quebec, 1985) and applied to the St. Lawrence River (Burton, 1991a)

Direction

The effect may be *positive* (beneficial) or *negative* (harmful). It may be difficult to determine the direction of the effect in some cases, because of a lack of pertinent data. In those cases, it will be described as *indeterminate*.

The direction of the effect plays no part in the calculation of its importance. The direction is used, however, to divide effects into two major categories (positive and negative), with the initial objective of fostering positive effects and reducing negative effects.

Extent

The extent of the effects may fall into four categories:

- Point: the immediate area of the source;
- Local: part of the ZIP;
- Regional: all of the ZIP and outside its boundaries;
- National: all of the St. Lawrence River; the threat extends to the Estuary and the Gulf.

For diffuse sources, the extent of the cumulative effect is considered. For example, do agricultural contaminants from tributaries affect the entire ZIP?

Intensity

The intensity of the effect is assessed according to three levels:

- Low: part of the resource or use is affected, with no deterioration in the use or general quality of the resource;
- Moderate: the reduction of the use or the deterioration in the quality of the resource call for or should require intervention (corrective notice, purification of the effluent or at the source, restrictions in uses) to ensure maintenance or conservation (standards occasionally exceeded). In the case of positive effects, the impact on resources or uses leads to measurable economic or social repercussions;
- High: the use of the resource or the quality of the environment is affected to such an extent that human health is endangered or animal and plant populations (or communities) are threatened. For example, the destruction of natural habitats and the continuous contamination of water or fish beyond consumption standards, leading to the closure of beaches and restrictions to commercialisation, fall into this category. Positive effects in this case represent important catalysts of development and economic activity, supported by government policies and the commitment of public and private funds.

Degree (Intensity versus Extent)

This is a second level of interaction, the degree of the effect being obtained by relating the *intensity* and the *extent* in a matrix. The effect may fall into three degrees: *first*, *second*, or *third*.

Matrix of Direct Cumulative Effects of Human Activities on Valued Ecosystem Components (Activities Grouped by Primary Effects)

Water Quantity

	WATER LEVELS	Control structures	FLOWS AND CURRENTS	Control structures	Infrastructures	– Shipbuilding	– Port	– Industrial	– Municipal	– Agricultural	– Tourism
Uses											
Water supply											
Municipalities	○	1	●	2	–	1	–	–	–	–	–
Industries	–	–	●	2	–	1	–	–	–	–	–
Agriculture	–	–	○	2	–	1	–	–	–	–	–
Recreation											
With contact	●	1	●+	2	–	1	3	3	3	3	–
Without contact	●	1	●+	2	–	1	3	3	3	3	–
Navigation											
Commercial	●+	1	▲+	2	–	1	–	–	–	–	–
Pleasure boating	●	1	●+	2	–	1	–	–	–	–	–
Fauna											
Commercial fishing	●	1	●	2	–	1	3	3	3	3	–
Sport fishing	●	1	●	2	–	1	3	3	3	3	3
Hunting and trapping	●	1	–	–	–	–	–	–	–	–	–
Milieu											
Tourism	●	1	–	–	–	–	–	–	–	–	–
Aesthetics	–	–	–	–	–	–	–	–	–	–	
Resources											
Habitats											
Water-plant communities	○	1	●	2	–	1	3	3	3	3	3
Marshes	○	1	●	2	–	1	3	3	3	3	3
Flood plain	–	–	–	–	–	–	–	–	–	–	–
Banks	–	–	–	–	–	–	–	–	–	–	–
Land and islands	–	–	–	–	–	–	–	–	–	–	–
Commercial species											
Fish	○	1	●	2	–	1	3	3	3	3	3
Amphibians	○	1	●	2	–	1	3	3	3	3	3
Mammals	○	1	–	–	–	–	–	–	–	–	–
Sport species											
Fish	○	1	●	2	–	1	3	3	3	3	3
Birds	○	1	–	–	–	–	–	–	–	–	–
Endangered or rare species											
Fish	○	1	○	2	–	1	3	3	3	3	3
Amphibians	–	–	–	–	–	–	–	–	–	–	–
Reptiles	○	1	○	2	–	1	3	3	3	3	3
Birds	○	1	○	2	–	1	3	3	3	3	3
Mammals	–	–	–	–	–	–	–	–	–	–	–

Water Quality

	PHYSICAL	Dredging	Wave induced erosion	Navigation (ports)	Suspended solids — Industries	Suspended solids — Municipalities	Soil erosion	EUTROPHICATION	Industries	Municipalities	Agriculture
Uses											
Water supply											
Municipalities	–	–	–	–	–	–	–	□	3	2	1
Industries	–	–	–	–	–	–	–	–	–	–	–
Agriculture	–	–	–	–	–	–	–	–	–	–	–
Recreation											
With contact	□	–	4	–	2	3	1	–	–	–	–
Without contact	–	–	–	–	–	–	–	–	–	–	–
Navigation											
Commercial	–	–	–	–	–	–	–	–	–	–	–
Pleasure boating	–	–	–	–	–	–	–	–	–	–	–
Fauna											
Commercial fishing	–	–	–	–	–	–	–	–	–	–	–
Sport fishing	–	–	–	–	–	–	–	–	–	–	–
Hunting and trapping	–	–	–	–	–	–	–	–	–	–	–
Milieu											
Tourism	–	–	–	–	–	–	–	–	–	–	–
Aesthetics	□	–	4	–	2	3	1	–	–	–	–
Resources											
Habitats											
Water-plant communities	–	–	–	–	–	–	–	■	3	2	1
Marshes	–	–	–	–	–	–	–	■	3	2	1
Flood plain	–	–	–	–	–	–	–	–	–	–	–
Banks	–	–	–	–	–	–	–	–	–	–	–
Land and islands	–	–	–	–	–	–	–	–	–	–	–
Commercial species											
Fish	–	–	–	–	–	–	–	□	3	2	1
Amphibians	–	–	–	–	–	–	–	□	3	2	1
Mammals	–	–	–	–	–	–	–	–	–	–	–
Sport species											
Fish	–	–	–	–	–	–	–	□	3	2	1
Birds	–	–	–	–	–	–	–	–	–	–	–
Endangered or rare species											
Fish	–	–	–	–	–	–	–	□	3	2	1
Amphibians	–	–	–	–	–	–	–	–	–	–	–
Reptiles	–	–	–	–	–	–	–	–	–	–	–
Birds	–	–	–	–	–	–	–	–	–	–	–
Mammals	–	–	–	–	–	–	–	–	–	–	–

Water Quality (continued)

	CONTAMINATION	Dredging	Commercial navigation	Ports	Industries	Municipalities	Agriculture	Pleasure boating	BACTERIOLOGY	Commercial navigation	Municipalities	Agriculture	Pleasure boating	Tourism
Uses														
Water supply														
Municipalities	△	4	4	3	1	3	2	5	–	–	–	–	–	–
Industries	●	4	4	3	1	3	2	5	▲	3	1	1	3	2
Agriculture	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Recreation														
With contact	–	–	–	–	–	–	–	–	▲	3	1	1	3	2
Without contact	–	–	–	–	–	–	–	–	■	3	1	1	3	2
Navigation														
Commercial	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Pleasure boating	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Fauna														
Commercial fishing	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sport fishing	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Hunting and trapping	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Milieu														
Tourism	–	–	–	–	–	–	–	–	△	3	1	1	3	2
Aesthetics	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Resources														
Habitats														
Water-plant communities	△	4	4	3	1	3	2	5	–	–	–	–	–	–
Marshes	△	4	4	3	1	3	2	5	–	–	–	–	–	–
Flood plain	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Banks	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Land and islands	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Commercial species														
Fish	▲	4	4	3	1	3	2	5	–	–	–	–	–	–
Amphibians	△	4	4	3	1	3	2	5	–	–	–	–	–	–
Mammals	△	4	4	3	1	3	2	5	–	–	–	–	–	–
Sport species														
Fish	▲	4	4	3	1	3	2	5	–	–	–	–	–	–
Birds	△	4	4	3	1	3	2	5	–	–	–	–	–	–
Endangered or rare species														
Fish	△	4	4	3	1	3	2	5	–	–	–	–	–	–
Amphibians	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Reptiles	△	4	4	3	1	3	2	5	–	–	–	–	–	–
Birds	△	4	4	3	1	3	2	5	–	–	–	–	–	–
Mammals	–	–	–	–	–	–	–	–	–	–	–	–	–	–

(Continued)

Sediments

	DYNAMISM	Dredging	Navigation (ports)	Suspended solids — Industries	Suspended solids — Municipalities	Soil erosion	CONTAMINATION	Dredging	Commercial navigation	Ports	Industries	Municipalities	Agriculture	Pleasure boating
Uses														
Water supply														
Municipalities	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Industries	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Agriculture	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Recreation														
With contact	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Without contact	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Navigation														
Commercial	●	4	4	2	3	1	–	–	–	–	–	–	–	–
Pleasure boating	●	4	4	2	3	1	–	–	–	–	–	–	–	–
Fauna														
Commercial fishing	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sport fishing	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Hunting and trapping	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Milieu														
Tourism	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Aesthetics	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Resources														
Habitats														
Water-plant communities	●	4	4	2	3	1	–	–	–	–	–	–	–	–
Marshes	●	4	4	2	3	1	–	–	–	–	–	–	–	–
Flood plain	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Banks	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Land and islands	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Commercial species														
Fish	○	4	4	2	3	1	▲	4	4	3	1	3	2	5
Amphibians	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mammals	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sport species														
Fish	○	4	4	2	3	1	▲	4	4	3	1	3	2	5
Birds	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Endangered or rare species														
Fish	○	4	4	2	3	1	△	4	4	3	1	3	2	5
Amphibians	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Reptiles	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Birds	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mammals	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Habitats

	FILL	Dredging	Shipbuilding infrastructures	Ports	Industries	Municipalities	Agriculture	Tourism	SPILLS	Commercial navigation	Ports	EROSION	Wave-induced erosion	Pleasure boating
Uses														
Water supply														
Municipalities	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Industries	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Agriculture	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Recreation														
With contact	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Without contact	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Navigation														
Commercial	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Pleasure boating	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Fauna														
Commercial fishing	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sport fishing	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Hunting and trapping	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Milieu														
Tourism	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Aesthetics	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Resources														
Habitats														
Water-plant communities	▲	1	2	–	–	–	–	–	△	1	2	●	1	2
Marshes	▲	1	2	–	–	–	–	–	△	1	2	●	1	2
Flood plain	▲	1	3	3	–	–	2	–	△	1	2	–	–	–
Banks	▲	3	4	2	1	1	3	3	△	1	2	■	1	2
Land and islands	▲	3	4	2	1	1	1	3	–	–	–	–	–	–
Commercial species														
Fish	○	1	3	3	1	1	2	–	△	1	2	○	1	2
Amphibians	○	1	3	3	–	–	2	–	△	1	2	○	1	2
Mammals	○	1	4	2	1	1	1	3	△	1	2	□	1	2
Sport species														
Fish	○	1	3	3	–	–	2	–	△	1	2	○	1	2
Birds	○	1	4	2	1	1	1	3	△	1	2	○	1	2
Endangered or rare species														
Fish	○	1	3	3	–	–	2	–	△	1	2	○	1	2
Amphibians	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Reptiles	○	1	3	3	–	–	2	–	△	1	2	○	1	2
Birds	○	1	4	2	1	1	1	3	△	1	2	○	1	2
Mammals	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Legend:	Importance	low	moderate	high	Direction
	real	●	■	▲	positive: +
	potential	○	□	△	negative: no indication

Sources of effects by decreasing order of importance: 1 > 2 > 3 > 4.

Note — Results obtained for the Saint-Pierre Lake ZIP (Burton, 1991b).

Determination of the Degree of the Effect

	Extent			
Intensity	**Point**	**Local**	**Regional**	**National**
Low	1	1	2	2
Moderate	1	2	2	3
High	2	2	3	3

Duration

We decided to classify the duration into four relatively wide categories. We use general terms (days, months, year, etc.) rather than arbitrary references (short, medium and long term) that mean different things to different authors. The definition of the duration is already subjective, since few environmental effects have been scientifically monitored over long periods. However, data on the persistence of toxic substances and the recovery rate of ecosystems from certain types of stresses are available and will be used to guide us.

For this purpose, we can refer to the exercise carried out by Colborn *et al.* (1989) in their work *Great Lakes — Great Legacy?* in which the authors combined evaluations of the recovery time of various components of the Great Lakes ecosystem in a table form.

Importance

Importance is determined by a third level of interrelation, in a matrix combining the *degree* and the *duration* of the effect.

	Degree		
Duration	**1**	**2**	**3**
Days or months	Low	Moderate	Moderate
Years	Low	Moderate	High
Decades	Low	High	High
Centuries	Moderate	High	High

IDENTIFICATION OF PRIORITIES

Quebec Ministry for Leisure, Hunting and Fishing, Canada (1990) and similar approaches (Stewart and Shamdasani, 1991)

Definitions and Utilisation Logic

The "nominal group" is a useful and efficient instrument to set priorities. This technique provides a good equilibrium between the time required to define choices, the quality of these choices and the participants' satisfaction. With this method the definition of six or seven priorities can be derived from a very long list, in a structured and open fashion, in about two hours. Moreover, the satisfaction level of the participants is generally quite high, both for the final results and for the process itself.

Procedure

Step 1 — Explain the procedure:

The organiser explains the participants the procedure and the time allowed for each step.

It is important that the number of people in the room remain the same throughout the exercise.

Step 2 — Produce the individual list of desired improvements:

The organiser asks every participant to make up his or her own list of desired improvements (targets).

Step 3 — Establish a common list of desired improvements:

The organiser asks the participants, in clock-wise order, to give one of their targets: he writes them down on a flip-chart or a black-board and gives every target a number in a continuous order.

A participant may pass his turn, saying "pass" as often as he desires, which does not precludes him to participate when his turn comes back again.

The participants are not limited to their original target list.

Comments or questions are not allowed during this period of establishment of a common list.

The organiser stops the exercise when the participants have no more targets to propose.

Step 4 — Clarification of the list of targets:

The organiser reviews with the participants the list of targets. The participants may ask clarification questions to the proponent, but no discussion is allowed at this stage.

Unless two statements are exactly the same, the organiser should avoid grouping statements; they belong to the participants.

Step 5 — Prepare choices and weights:

The organiser asks each participant to produce a list of his seven preferred targets from the common list. He reminds the participants that they will have the opportunity to revise their own choices before the final choice is made by the group.

The organiser then invites any participant to support or denounce any target and to explain the reasons why any target should be removed or remain on the list.

During this inter-influence step, no participant is allowed to speak for more than 30 seconds at a time. No discussion is allowed by the organiser. Each participant may express his view as often as he wishes, waiting for the right of speech given by the organiser.

Step 6 — Choose and organise individual priorities:

The organiser now asks the participants to review their list of seven desired improvements and to modify it according to the comments just heard. It may be practical to allow participants to stand up and move closer to where the statements are written; this allows participants to move around and facilitates the reading of the statements which could be difficult at a distance. Of course, discussions between participants are not allowed. Finally, the participants make up their own list of seven priorities.

The participants now have to evaluate their choices, giving 7 points to the top priority, 6 to the next, and so on to the last priority with 1 as a value. No target should have the same rating.

Step 7 — Choose and identify the priority list for the group:

The organiser asks each participant to present his list, in a decreasing order of importance: For instance:

Target 16	7 points
Target 4	6 points
Target 23	5 points
Target 32	4 points
Target 7	3 points
Target 21	2 points
Target 14	1 point

He writes down the results on a table prepared during the participants' working period (Step 6), with the number of points corresponding to each target.

The organiser then explains the calculation method (weighted average) and compiles results with the participants for every target:

$$\frac{\text{Total of points X number of participants that have voted for this target}}{\text{Number of participants}}$$

The weighted average provides a value relative to the number of participants that have chosen the target and also takes into account the value given by every participant.

Step 8 — Establish the priority list for the group:

The organiser writes on the board the list of selected priorities with the corresponding value. He asks the participants for comments on the results and the procedure itself and thanks people for their participation.

Practical Comments

We used this method several times during public consultations as part of the ZIP Programme, with groups of approximately 20 participants. The size of the group is important; with more than 20, the time required to complete the exercise increases exponentially and makes it difficult to maintain some discipline.

Moreover, this method requires a lot of discipline, mainly to limit debates that will inevitably erupt through the process; the organiser must act firmly, but equitably for all, and most importantly, with a touch of humour. This process will achieve very useful results, while remaining a game-like activity.

People should participate from the beginning to the end of the exercise; it is very important to maintain the same number of participants, which will be used to calculate the priority level at the end. Provide the participants with paper and pencils and have some sort of writing support to write down statements (flip-chart or black-board).

The organiser is the key person for this exercise; however, it has proven very handy to have a second person to assist with the writing down of statements at Step 3. Statements must be summarised, while maintaining their original meaning, without retarding the progression around the table.

LIST OF PARTICIPANTS FOR SEMINARS ORGANISED UNDER THE LARGE RIVER MANAGEMENT PROJECT

Kigali Seminar (Rwanda) Organized with KBO, October 26 to November 6, 1992

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KIYIMBA, Justin N.
Chief Librarian
NSABIMANA, Charles
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RUZINDANA, Charles
Agronome
SIBORUREMA, Joram
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BURUNDI

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Mrs BAZIRAKE, Lilian
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Hanoi Seminar (Vietnam) Organised with the Mekong Secretariat, February 12 to 24, 1993

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N'Djamena Seminar (Chad) Organized with the LCBC, April 19 to 30, 1993

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CBLT N'Djaména
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Ouagadougou Seminar (Burkina Faso) Organised with the CIEH, September 13 to 24, 1993

CIEH
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Chabi-Gonni Daniel
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Abdulmumin Salisu
National Water Resources Institute

Saint-Louis Seminar (Senegal) Organised with the OMVS, November 8 to 19, 1993

OMVS

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Integrated Water Resources Management on a Basin Level: A Training Manual is destined first to trainers who, through a national or a regional seminar, would bring the participants to produce a diagnosis of their basin and an action plan. A simple and field-tested framework will guide them throughout this learning process. On the other hand, those who would like to perfect their knowledge and improve their capacity to manage water uses in a more sustainable fashion can also use this manual.

The manual is divided into two sections. The first one, of a more conceptual nature, presents a review of several definitions and some of the most pressing issues related to integrated basin-wide management.

The second section of the manual, definitely aimed at training, takes the reader and the trainer through the steps of the management framework. The proposed formula is a two-week seminar that has already been applied six times in the past for national and international river basins in Africa and South-East Asia.

Above all, this is a methodological guide that puts the emphasis on an optimal use of existing information and expertise within the reach of those who know what to look for and where to find it. The manual emphasises the importance of the "human factor" within an exercise aimed at creating a consensus on the sharing of a collective resource, water.

We would also like to emphasise the fact that the framework proposed in this manual is not limited to basin-wide management. With the necessary adaptations, it is applicable to a wide range of planning exercises in which the satisfaction of human needs is to be balanced with the sustainable use of natural resources.

JEAN BURTON is a biologist. He has managed the "Large River Management Project" since 1990 and has been the coordinator of the Network of French-speaking Managers of Lake and River Ecosystems since its creation in 1991. Working first on the St. Lawrence River (Canada), he has been a trainer at several international seminars and has taken part in experience-sharing activities on several large rivers worldwide.