Environmental Information in European Transboundary Water Management

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Preface

This book is the result of one of the activities within the framework of the RTD project "Integrated Strategies for the Management of Transboundary Waters on the Eastern European fringe - the pilot study of Lake Peipsi and its drainage basin (MANTRA-East). Thirteen partners from Russia, Estonia, Sweden, the Netherlands, Poland and Norway are involved with Jordforsk - Centre for Soil and Environmental Research, Norway, as co-ordinator. The aim of the project is to analyse and develop strategic planning methodologies and scientific tools for the integrated water management in transboundary watersheds located on the existing and future borders of the European Union. Following the EU Water Framework Directive, the project will develop recommendations for institutional mechanisms and policy instruments for decision-making on water management of transboundary watercourses and international lakes located on the fringes of the European Union. The project consists of four modules: Module 1 "Ecological Status and Strategic Nutrient Tools", Module 2 " Environmental Information for Policy- and Decision making", Module 3 "Policy Instruments and Institutional Mechanisms" and Module 4 "Integration, synthesis and end-user participation". More information on the MANTRA-East project can be found at http://www.mantraeast.org/.

As a part of module 2, a European specialist meeting on the Use and Role of Environmental Information in European Transboundary River Basin Management was organised in Arendal, Norway, 9 – 11 September 2002. Organisers were KTH Royal Institute of Technology (http://www.kth.se/) in Stockholm and RIZA Institute for Inland Water Management and Waste Water Treatment (http://www.riza.nl/) in Lelystad with the support of IWAC International Water Assessment Centre (http://www.iwac-unece.org/) in Lelystad and UNEP/GRID-Arendal (http://www.grida.no.) in Arendal. This closed multi-disciplinary specialist meeting aimed at examining the role and use of environmental data and information in transboundary water contexts to be able to improve the information supply to decision-makers, stakeholders and the public. With 'environmental' we also include factors that influence water quality and quality. This book is the result of the meeting.

The discussions during the meeting contributed to improve the different chapters of this book and resulted in the main conclusions, as included in chapter 17. We would like to thank Hugo Ahlenius, Ana Barreira, Carel de Villeneuve, Nickolai Denisov, Geoffrey Gooch, Frederik Hannerz, Sarah Hendry, Matthijs Hisschemöller, Carolin Lorenz, Rosa Matos, Susanna Nilsson, Gulnara Roll, Gerd Schröder, Kerry Turner and Jim Woodhill for their contributions to the meeting and discussions, and their efforts to produce the various chapters and review those of others. Karen Folgen, Luana Karvel and Wenche Lien did the hard work of making all the necessary arrangements before and during the meeting in Norway. Ilonka Zaborszky kept track of the progress of the work and provided invaluable support in preparing the meeting and this book.

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1

Introduction

Sindre Langaas and Jos G. Timmerman

1.1 EUROPEAN TRANSBOUNDARY RIVER BASINS: NEW MANAGEMENT UNITS AND INFORMATION NEEDS

In 2003 the European maps will be redrawn. Besides the black lines indicating international and sub-national borders reflecting the conventional administrative and political units, new blue lines will be drawn. These lines will represent the boundaries of the newly established River Basin Districts (RBD) that the EU member states and accession countries have to define according to the European Union (EU) Water Framework Directive (WFD) (Commission of the European Communities 2000). The number of RBDs in each country and their extent is a decision that each country is responsible for and is pre-conditioned by the actual number of river basins from which all surface run-off eventually flows into the sea at a single river mouth, estuary or delta.

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In most countries the number of RBDs will be few because the administrative cost involved in establishing the required River Basin Authority for each RBD will be considerable. Consequently, most RBDs will be large and in many cases of transboundary nature. For example, the Netherlands plans to establish four RBDs of which all will be transboundary in nature. Likewise, Sweden and France intend to designate five RBDs, two of these being transboundary as seen from both a hydrological and a WFD perspective. Hungary, as another example, is entirely confined within the Danube river basin district. It should be noted that a single RBD might include several individual river basins that may all end up in the sea. While the transboundary RBD cases in the preparation of the WFD text were treated as rare and exceptional cases, it now seems that a very high percentage, possibly close to 50%, of the RBDs will be of transboundary nature. This may have profound implications for the implementation of the Directive. In contrast to those RBDs that are fully intra-state, those being transboundary do not necessarily have to comply with the WFD in all implementation matters. Article 3 of the WFD tries to regulate how the international RBDs are to be treated and implementation carried out. While the intention is that international RBDs shall also be implemented according to the text of the WFD, it is quite clear that in practice the WFD implementation efforts will be relaxed relative to national RBDs, in particular for those international RBDs with countries not being EU or Candidate Countries. At the time of writing, how this will handled from case to case remains unknown.

From a European perspective the WFD is an innovative development in surface and ground water protection and management, both from the substantive content of the proposal and the manner in which it was developed. The aim of the Directive is the sustainable use of the surface freshwater, estuaries, coastal and groundwater resources of the Community. The WFD will achieve sustainability using a three-tier policy which:

(1) requires that surface and ground water reach ‘good’ status by the year 2015, combining emissions regulation with water quality standards;
(2) stimulates rational water use through recovery of full costs; and
(3) utilises the river basin as the management unit and performs Integrated River Basin Management.

Production, communication and use of various types of environmental information are central activities in the implementation of the WFD. Given that a high proportion of the RBDs will be of transboundary nature, we can also add that exchange of information across international boundaries will be instrumental in achieving the goals.

International co-operation with focus upon freshwater quality and quantity is, however, not new to many transboundary rivers and lakes in Europe. For some

transboundary rivers and lake basins there has been extensive co-operation for many decades. One example is the Lake Constance environmental co-operation where the riparian countries established the first legal instrument and started to work jointly already back in 1893 (Schröder, Chapter 14, this volume). The oldest European examples of freshwater-related transboundary co-operation, such as the Lake Constance case, started up entirely due to jointly perceived water-related conflicts or problems within the transboundary region concerned. For many of the more recent bi- or multilateral agreements dealing with water quantity and quality issues, the United Nations Economic Commission for Europe (UNECE) Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) completed at Helsinki on 17 March 1992 have been instrumental. This convention is intended to strengthen national measures for the protection and ecologically sound management of transboundary surface waters and groundwaters. The Convention obliges the Parties to prevent, control and reduce water pollution from point and non-point sources. The Convention also includes provisions for monitoring, research and development, consultations, warning and alarm systems, mutual assistance, institutional arrangements, and the exchange and protection of information, as well as public access to information.

Thus – as is the case for the WFD – production, communication, exchange and use of various types of environmental information have been core activities in those co-operative agreements established under the auspices of the Water Convention. A recent survey carried out by the UNECE Secretariat indicates the relative importance given to various obligatory tasks among the 25 joint transboundary water bodies that responded (Enderlein 2001). Figure 1.1 clearly shows that almost all of these activities are related to environmental information production and use.

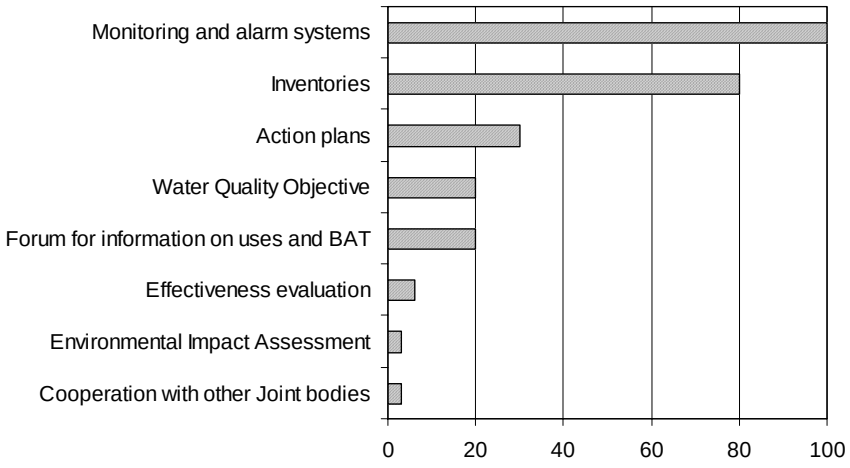

Figure 1.1 The relative frequency (in %) of the major obligations carried out by European joint water bodies (n=25). Source: Enderlein (2001).

There are many similarities between the UNECE Water Convention and the EU Water Framework Directive. Thus, there are good reasons to assume that the WFD will gradually transform the already existing bi- or multilateral water agreements established under the Water Convention due to the stronger enforcement and compliance measures associated with the WFD. In cases where new transboundary RBDs without prior agreements will be defined, most likely the WFD will become the incentive for the establishment of one.

Irrespective of this, given the significance of various types of environmental information in the context of the UNECE Water Convention and the international agreements established because of it and more recently of the WFD, much effort and many resources have been and will be allocated to improve the availability and quality of the environmental information pertinent to integrated river basin management. For instance, the UNECE Task Force on Monitoring and Assessment has developed strategic guidelines on monitoring and assessment of transboundary rivers, groundwater and lakes in support of the UNECE Water Convention (UNECE 2000a, 2000b, 2002). Likewise, to harmonise the implementation of the WFD among the Member States and Accession Countries, the European Water Directors have developed a common implementation strategy. A number of working groups have elaborated guidance documents to assist in the implementation of the WFD as a core component of this strategy. Most guidance documents concern various aspects of environmental information production, use and dissemination.

Typically, the documents developed in support of the UNECE Water Convention and for the WFD have a quite narrow view on environmental information matters. The dominating perspective is of a technical and natural science nature and aims for greater availability and quality of the environmental information - thus the production side, reflecting the backgrounds of those involved in the elaboration of these guideline documents.

Comparatively less effort has been devoted to examine the actual role and use of environmental information in integrated transboundary river basin management with multiple actors and public participation, or to develop guidelines on these findings. This is mirrored in the numerous Research, Technology and Development (RTD) projects under the EU 5th Framework programme in support of the WFD. Far too often environmental information is looked upon as an objective input into supposedly rational decision-making and policy processes, ignoring issues such as uncertainty and implicit policy choices based upon values, norms and beliefs. Rarely are information and information tools seen as a means also to promote and inform discussions between stakeholders and thus foster social learning. The additional complexity in transboundary river basin policy-making and management offered by the international relation dimension has not attracted much scientific interest.

Only a very small minority of the EU 5th Framework RTD projects has been designed with the aim of investigating the role and use of environmental information. An example of a project that has taken this broader perspective with a specific transboundary focus is the MANTRA-East project, in which the role and use of environmental information in transboundary river and lake basin policy-making and management is given a strong focus.

1.2 ENVIRONMENTAL RIVER BASIN INFORMATION: WHAT IS IT?

The term 'environmental information' has so far been used as if the readers of this book have a common and unified definition of the term. Our experience suggests this is clearly not the case. What is considered environmental information varies considerably among academics, professionals and stakeholders concerned with river basin and water management, and is often a reason for confused discussions on priorities when it concerns data and information collection. Two useful perspectives on or definitions of environmental information are offered by the UN ECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (the Aarhus Convention) and the European Environmental Agency's DPSIR framework for state of environment reporting. Lorenz (Chapter 13, this volume) gives a comprehensive account of the latter perspective in a transboundary river basin context, where DPSIR stands for Driving forces, Pressures, State, Impact and (societal) Response. When considering the combined and river basin approach promoted by the EU WFD, the legal (and comprehensive) definition of environmental information provided by the Aarhus Convention appears a most appropriate one:

> 'Environmental information' means any information in written, visual, aural, electronic or any other material form on:
>
> (a) The state of elements of the environment, such as air and atmosphere, water, soil, land, landscape and natural sites, biological diversity and its components, including genetically modified organisms, and the interaction among these elements;
>
> (b) Factors, such as substances, energy, noise and radiation, and activities or measures, including administrative measures, environmental agreements, policies, legislation, plans and programmes, affecting or likely to affect the elements of the environment within the scope of subparagraph (a) above, and cost-benefit and other economic analyses and assumptions used in environmental decision-making;

(c) The state of human health and safety, conditions of human life, cultural sites and built structures, inasmuch as they are or may be affected by the state of the elements of the environment or, through these elements, by the factors, activities or measures referred to in subparagraph (b) above.

Environmental information is a basic ingredient in decision- and policy-making that aims to prevent or reduce environmental problems caused by society. Environmental information therefore needs to be relevant to the policy-makers in these sectors who are charged with identifying environmental concerns and finding solutions in complex and diverse situations, such as industries and communities (WCMC 1998). Thus, in cases where detailed and very specific scientific information on the environment, e.g. water quality, does not play any role in decision- or policy-making, this remains scientific information and has not become environmental information.

The process of water management implies a cycle of policy preparation, policy implementation and policy evaluation. Policy-makers or decision-makers assess the situation in the area under their responsibility, decide about the actions they should take, and then realise these actions. In the policy preparation phase there are three stages: intelligence, design and choice. In the intelligence stage, to do the initial assessment, information on relevant aspects of the water system is needed. In the design stage options are identified and their consequences forecast on the basis of available information; finally, a preferred course of action is chosen (WCMC 1998). These decisions are seldom strictly rational but, nevertheless, information plays an important role (Bemelmans 1989). In the policy implementation phase, decisions are put into action. Information about policy actions in this phase is needed to be able to make a comparison between the actions actually implemented and the desired water management results in the policy evaluation phase (for instance Dunn 1994). Then, while the results of policy actions are never fully known in advance, it is essential to have monitoring systems that allow for assessment of the impact of the policy actions after they have occurred. Consequently, for good water management, ‘proper information on the status of water systems is indispensable’ (De Jong and Timmerman 1997).

The importance of satisfactory information in transboundary water management is therefore evident, and constitutes a major challenge for scientists today. Science is expected to provide accurate information in a present-day situation where issues are highly complex and uncertainties profound, in what is sometimes termed post-normal science (Scott 2001).

1.3 THE PURPOSE OF THIS BOOK

The present books aims to examine the role of information in transboundary river basin and water management and the way it is used (or not) in policy- and decision-making within the wider European area. While having a forward-looking perspective justified by the on-going implementation of the EU Water Framework Directive among EU Member States and Candidate Countries, many of the chapters draw upon the experiences gained from past and existing transboundary river basin co-operation experiences. There is much literature covering the technical and natural science aspects of monitoring and environmental information collection as, for example, represented by the Monitoring Tailor-Made series of workshops and proceedings (http://www.mtm-conference.nl). Thus, the focus of this book is much more oriented towards the socio-political context in which such information (hopefully) is being used. However, the dominating technical/natural science paradigm is touched on, but with the intention of expanding the views on these tools and activities, for example indicators, Geographical Information Systems and monitoring activities, as means of integrative and communicative tools in a broader decision-making context. Our ambition is that the book, irrespective of the reader's background, offers a deeper understanding of the wider perspectives, and hopefully sows some seeds of curiosity that eventually will lead to improved priorities and practices in environmental information production and use.

The book has two primary target audiences. The first, and most important one, is the professionals that are or will become involved in the various aspects of the implementation of the EU WFD or transboundary river basin co-operation under the UN ECE Water Convention both on strategic and operational levels. The second target audience is the academic community concerned with the study of transboundary river basin or water management. In practice, these two target audiences are often intimately connected and in reality a mixed community with comparatively few examples of pure representatives. While not being an intended target audience, we also acknowledge that the book might become a textbook for graduate students in university courses in (transboundary) river basin management.

1.4 THE STRUCTURE AND CONTENT OF THE BOOK

This book is a result of a specialist meeting held in Arendal, Norway, in September 2002. The meeting was organised within the context of the MANTRA-East project. While some of the specialists invited are participants in

this project, most of the invited specialists were selected for their unique ability to shed light on specific perspectives.

We have chosen to structure the chapters in the book according to the framework offered by Savenije and Van der Zaag (2000). In this framework, integrated water resources management is the foundation upon which three pillars are built: politics, technical co-operation, and institutions that support the vision of fair and equitable sharing of international water resources. This framework will also be used in the concluding chapter.

The political pillar is basically concerned with enabling the sharing of water resources. This includes the recognition of differences in riparian interests and international collaboration.

In Chapter 2, Gooch describes a process of communication between institutions that takes place on various administrative levels. The different institutions that are involved in water management each have their own characteristics that largely determine the role of information in the management processes. Since in a transboundary situation various institutions on different administrative levels are involved, the communication process is the determining factor when it concerns information.

Roll, in Chapter 3, discusses the role of information and usable knowledge in implementation of the European water policy. The European Water Framework Directive, a central part of the European water policy, and other documents relevant to its implementation, contain highly technical information. The local actors have to be able to understand the available information in order to act on it. This also requires generation of the knowledge base that, on the one hand, 'downloads' the globally available information and 'best practices' and, on the other, builds upon the local situation. The concept of usable knowledge is introduced to explain the necessity of information dissemination in a way that builds upon the global technical information as well as on the local conditions, and consequently enables actors in water management to understand the available information and knowledge and act upon it.

Institutional communication and public participation are coupled in Chapter 4, where Woodhill promotes social learning as a process to stimulate dialogue, where the dialogue is the basis for communication. Social learning is based on an interactive approach that supports exchange of 'worldviews' and interests. Woodhill presents a framework that facilitates this interactive process.

The legal-institutional pillar deals with institutions and legal instruments. It finds its basis in internationally laid down principles of cross-border co-operation. The institutions must be organised in such a way that these principles can be implemented.

In Chapter 5, de Villeneuve describes the international legal framework that regulates the availability and use of information, within and between countries.

In the European context, the Aarhus Convention of 1990 and the EU directive on the freedom of access to information on the environment determine the institutional context of information. While on the one hand the importance of free access to information is self-evident, de Villeneuve describes why there are inherent limitations to this freedom.

Next to legal restrictions in access to information as de Villeneuve describes them, Hendry describes the more practical limitations in Chapter 6. She shows that the European legislation, when applied to the specific situation of Scottish law, implies a consultative process to ensure a meaningful use of information without imposing excessive burdens on the authorities that dispose of the information. As in the social learning process, this is also an interactive, multidisciplinary activity.

Another institutional issue of river basin management is public participation. In Chapter 7, Barreira and Kallis describe the provisions in the EU Water Framework Directive on public participation in relation to access of information. To achieve public participation, the need for active involvement of the public is eminently clear. The major impediment to public participation in transboundary river basin management is that river commissions operate on an (inter)national level, whereas the public, as Roll also concludes in Chapter 3, is mainly approachable on the local level. This scale issue is not easily resolved.

The pillar of technical co-operation is finally concerned with concrete co-operation. The issues in this pillar are, with increasing level of co-operation:

(1) exchange of information;
(2) procedures to manage crises;
(3) exchange programmes with the aim of human resources development;
(4) joint research programmes;
(5) joint river basin plans; and
(6) joint ventures, jointly performed water management actions.

The challenge here is to make arrangements such that joint actions can take place. Also here, the need for interactive processes is evident.

In Chapter 8, Timmerman describes the information cycle as a framework for an interactive process directed towards providing information. Effective use of this framework implies both awareness of the character of information, and understanding of the different interests that the various stakeholders involved in the process may have.

Denisov et al., in Chapter 9, dwell on the method of conveying information once it is produced. They stress the significance of knowing what one wants to achieve as the basis for developing a strategy for conveying information. This

strategy includes presentation of information, communication media and target groups, the selection of which is dependent on the goal of the information.

Exchange of information requires a carrier. Langaas et al. in Chapter 10 provide a concept for a river basin information system (RBIS) based upon GIS and Internet technology to be developed as a public good. GIS provides the technical opportunity to combine and analyse river basin data in such a way that it supports decision-making, while the Internet provides a key channel to reach the intended target groups. The spatial character of the information and the availability of maps as presentation medium are invaluable when it comes to communication to stakeholders and the public. A key concern in the development of a RBIS as a public good is the present restrictive cost- and copy-right regimes for GIS data produced by public sector actors. Currently they effectively prevent re-use and open dissemination to stakeholders.

An integrated approach is necessary to support the three pillars of sharing international water resources. In the framework of Savenije and Van der Zaag (2000), integrated water resources management as the foundation of transboundary water management has to focus on three interrelated dimensions:

(1) the physical dimension: the physical characteristics of the resource (basically characterised on the basis of the location of the resource as related to the overall basin), the type of resource (for instance, surface water, groundwater) and its quality (expressed as both quality and quantity; a shortage of water is a situation of bad quality);
(2) the non-physical dimension: the uses and values attributed to the resource; and
(3) the time perspective: the characteristics over time, especially in the future to ensure sustainability.

Turner in Chapter 11 looks at Integrated Environmental Assessment (IEA) as a means to support the integrated approach. He describes IEA as a continuous process that requires dialogue in a multidisciplinary environment. Scoping of the problem at hand and mapping of the stakeholders is needed in this process.

Chapter 12 describes an integration framework for evaluation of transboundary river basin management. In this chapter, Hisschemöller describes four stages through which policy programmes can be evaluated. His first and most important stage is to get an adequate understanding of the policy programme at hand. Next, he advises stakeholder participation and interaction as a means to give support to the complexity of the unstructured, multi-party nature of policy problems.

Lorenz in Chapter 13 describes an increasingly important mechanism to facilitate dialogue and communication between scientists, decision-makers and

stakeholders, namely the use of indicators. Indicators may become the linguistic building blocks that enable the various interested parties to communicate.

The actual process of sharing international water resources is experienced at many different levels of co-operation. In this part of the book, three examples will be described.

An extensive history of transboundary co-operation for the Lake Constance region is presented by Schröder in Chapter 14. The development of issue-based co-operation towards comprehensive co-operation becomes clear, as well as the formation of institutions to support this. While the historical background of the co-operation can be seen as a restricting factor in the development of an integrated approach, it may also be considered a solid institutional platform upon which integrated approaches can build.

Matos, in Chapter 15, on the Spanish–Portuguese transboundary water management and information model, provides valuable insight into how information is used in the transboundary water management between Spain and Portugal, where the joint issues concern both water abstraction and quality. Recent developments suggest that the upstream country, Spain, has become less motivated to include transboundary dimensions in their planning and information activities.

Nilsson and Langaas, in Chapter 16, present a rare comparative study of environmental information management in three transboundary water regimes, namely Lake Neusiedl, Lake Constance and the Elbe river. While there were significant differences in the information needs, data collection and information use between the regimes, a technical/scientific paradigm appeared to dominate all three. This paradigm was characterised by an information needs perspective focusing upon the needs of the Commission, the data collection devoted primarily to State and Impact information, and the use of passive channels for communication with other stakeholders and the public.

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2

The communication of scientific information in institutional contexts: The specific case of transboundary water management in Europe

Geoffrey D. Gooch

2.1 INTRODUCTION

Transboundary water management presents a significant number of special challenges to politicians, planners, administrators and scientists. Looking at the issues at stake in the European context, it can be seen that the physical nature of the problems that exist include both water quality, and water quantity. While water quantity is as yet primarily a problem in Europe's dryer, southern regions, water quality problems are acute in many countries, and exist all over Europe to

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a greater or lesser extent. These problems are intensified when a water body stretches over more than one country. Seventy-one of the world's 261 international river basins are located in Europe (Wolf et al. 1999, p. 391ff), and the secretariat of the United Nations Commission for Europe states that the pollution of transboundary waters is a widespread phenomenon in the region. Transboundary waters are seen to be threatened by untreated or insufficiently treated municipal sewage, chemical pollution from industries and agriculture, seepage from old and new landfills, accidental pollution and atmospheric depositions. Another problem is the damage caused by discharges of phosphorus and nitrogenous compounds, which stimulate eutrophication and sediment contamination, and by toxic and persistent substances (UNECE 1994, p. 171). This is, however, only one side of the problems facing transboundary water management, and as such it represents the view that management problems are mainly dependent on physical conditions. According to this view, difficulties with water quality may be solved by technical means, and water quantity problems by engineering. However, as the World Bank has noted, environmental problems are 'at their root, social problems', and it is necessary to 'develop competent rule and institutions to address environmental, social and economic problems' (World Bank 2002). In order to meet the challenges presented by water management, policy-makers therefore need access to reliable and relevant information, both on the physical attributes of water systems, and also on the special political and administrative conditions, cultures, and institutional contexts that characterise transboundary water policy-making and implementation. The approach used in this chapter suggests that the role of state (central and sub-central) actors and institutions, non-state actors such as the business sector and civil society, as well as inter- and intra-institutional contexts, must also be analysed as an integrated aspect of management. Botterweg and Rodda (1999) have pointed out that transboundary water management is a complex process with many actors at different levels. They note that both the development and the implementation of the actual work has to be conducted at a local level, and that national authorities, as well as the international agreements, are dependent on the compliance of actors they cannot force by traditional government measures. As the success of management initiatives in systems that are difficult to regulate is dependant on persuasion, incentives, and the flow of information between these actors, analyses of the ways in which networks of actors and institutions communicate internally and externally is vital. As there is no single actor capable of forcing all actors to comply, these networks play a crucial role in management processes. Huisman et al. (2000) note this, and point out that most transboundary commissions cannot force the member states to adopt laws, or companies to use the best available technology; their role is often simply to advise the governments.

Problems affecting water management and water policy implementation include economic, political, cultural and social issues, geographical discrepancies, shortage of financial resources, training and organisational problems, and administrative capacity. Behind many of these problems, however, lie institutional norms, values and beliefs. Jordan, for example, states that; 'institutional procedures are not neutral but embody beliefs and ideas that provide an advantage to some actors over others' (Jordan 2000). The Committee on Global Change Research (1999, p. 318) also state that 'Policy is often strongly path dependent in that early decisions may constrain or determine later ones, thus making discussion of alternative policies extremely difficult at later stages.' These statements stress the importance of institutional values and beliefs in policy-making and implementation processes. The role of these in European post-decisional politics has however not yet been sufficiently examined (Jordan 1997), and the study of the implementation of European transboundary water management suffers from the lack of systematic, cross-national research. In this respect it shares the problem with other forms of comparative studies of public administration, such as studies of administrative change (Knill 2001). According to Peters (1988) this is partly a result of an earlier lack of systematic theoretical development in public administration research, where descriptive and normative studies have dominated. Lack of comparative studies may also have led to a belief that little variation occurred between countries. A recent study (Gooch et al. 2002) has also shown that much research into European transboundary water management has taken what might be termed either a legal or technical point of departure, that is, it has begun either with legal principals of agreements and conventions, or with a natural science/engineering perspective. Less work has been conducted on the role of the political and administrative cultures of the institutions and organisations engaged in transboundary water management in a European context. It is these institutions and organisations, often at the regional and local levels, that have responsibility for the practical implementation of nationally and internationally formulated policies, and it is unfortunately often within this area that our knowledge is particularly insufficient.

Transboundary water issues are mostly managed by organisations and institutions, public or private, in which institutionalised communication plays a vital role. As the terms 'organisation' and 'institution' are often seen as more or less synonymous, it is perhaps necessary to characterise the ways in which they will be seen here as complementary but distinct concepts. Selznick has claimed that while both 'organisation' and 'institution' can be used to refer to a group that works purposely together within a context of common rules, 'organisation' suggests 'a lean no-nonsense system of consciously coordinated activities.

It refers to an expendable tool, a rational instrument engineered to do a job', while 'institution' 'is more nearly a natural product of social needs and pressures – a responsive adaptive organism' (Selznick 1957, p. 5). The distinction highlights the ways in which both the external environment and internal, informal social systems must be taken into account. Communication involves a flow of information, and an underlying premise in most studies of transboundary water management is that decision-makers need access to reliable and understandable information on environmental and water-related issues in order to make functional, logical and rational decisions (Gooch et al. 2002). In other words, communication of scientific information from the scientific and technical community to politicians and civil servants should function according to previously agreed-upon, and predominantly rational, criteria. However, while the significance of institutionalised communication has long been accepted in studies of business administration, where communication and organisation structures are often seen as intertwined (Gortner et al. 1987), the importance of institutional context in communication processes in public administration has not always found such wide acceptance.

The actors involved in communication may be individuals, specific groups, or the public. In the first case theories that analyse individual, psychological aspects of communication may provide insights. In the second case group psychology, cultural analyses, institutional theory, theories of socialisation etc. can be used. In the case of the general public mass communication theories may be relevant. All three types of actors and forms of communication may be found in the context of transboundary water management. Individual communication takes place when, for example, a policy-maker and a scientific expert, or two landowners, meet to discuss water-related issues. Group communication occurs when a decision-making body such as a transboundary commission meet to formulate policy. Mass communication takes place when the results of these decisions, as well as perceptions and news of water management problems, are communicated to the public through the mass media, Internet, or other media. While all three forms of communication have their specific characteristics there are a number of points that they have in common, which will be discussed in one of the following sections.

2.2 THE INSTITUTIONAL CONTEXT

Regime theory is now well established in the study of international environmental issues (Young 1989), and it has made major contributions to the field. According to Holsti (1995), a regime is a form of international co-operation between two or more states in specific issue areas. States are traditionally seen as preoccupied with maintaining national interests

(Dunne 1997), and power is seen as a central feature of regimes (Little 1997). Regime theory alone cannot however fully explain the complexities of water management implementation, as implementation of policy is primarily the responsibility of institutions at the regional and local administrative levels, not exclusively at the central state level. In 1999 the National Research Council highlighted a number of research imperatives for the coming decade (Committee on Global Change Research 1999, p. 294). Among these were 'understanding institutions' and 'improving methods for decision making'. Although the Committee report was primarily concerned with global change, the highlighting of these research imperatives is also relevant for European transboundary water management. The report noted that substantial work had been conducted on both international and national environmental policy instruments, and especially on the formation of international regimes, but that more knowledge needed to be gained to be able to 'identify specific international and national institutions that can effectively link the international, national, and local levels' (Committee on Global Change Research 1999, p. 318). These statements demonstrate that more attention needs to be given to the ways in which the systems of actors and institutions involved in water management are changing. Policy and implementation processes are no longer monopolised by central government agencies; instead, a system of multi-level governance is developing in which representatives of trade and industry, local communities, and NGOs play an increasingly important role. *Governance* is replacing *government*, and the political sphere, the business sectors and civil society are becoming increasingly intertwined and interdependent. Besides these complicated new conditions, transboundary water management is also faced with the difficult task of successfully managing problems dependent on the specific conditions created by the interaction of two or more different political and administrative systems.

Traditional regime theory has however been enriched by the inclusion of new-institutional theory that also accepts that in the case of transboundary water management, power and national interests may of course be central, but central state actors are not the only ones involved in the policy and implementation processes. Sub-central government actors and non-state actors can also formulate and aggregate interests and focus attention on specific issues, and it is therefore vital to analyse their role in the creation and reformation of international institutions (Levy et al. 1995, p. 280). In this respect state-centric theories such as traditional regime theory can be complemented by multi-level governance theory that can contribute to our understanding of transboundary water management by stressing the importance of civic and business institutions and their inter-play and inter-dependence with political and administrative institutions at various levels. As the concept of governance is often defined in

different ways, it may be useful to note here that the Commission on Global Governance (1995, p. 2) uses a broad definition, in which it is stated that: 'At the global level, governance has been viewed primarily as an intergovernmental relationship, but it must now be understood as also involving non-governmental organisations (NGOs), citizens' movements, multi-national corporations, and the global capital market. Interacting with these are global mass media of dramatically enlarged influence.'

Governance theory may also include analyses of flexible network relationships that are constantly changing (Smouts 1998, p. 86) and can provide insights into these important yet under-researched aspects of water management implementation. The concept of governance also provides a way of understanding the behaviour of actors in situations characterised by uncertainty, a condition that has also been pointed out by Young, who claims that actors are only vaguely aware of possible outcomes (Young and Osherenko 1993). Theories of governance can also take into account cognitive aspects of transboundary co-operation such as norms, values and perceptions, and recognise the importance in regimes of learning (Haggard and Simmons 1987). Gerry Stoker (1998) identifies five different aspects of governance. These include complex sets of institutions at different spatial levels and the involvement of civic sectors; the blurring of boundaries of responsibility between state, private and voluntary sectors; the ways in which institutions become interdependent; the concept of networks; and the development of new tools and techniques. In this multilevel structure of governance, state and sub-state, public and private, trans-national, and supranational actors all deal with each other in complex networks of varying horizontal and vertical density. This does not mean that the state no longer plays an important, perhaps the most important, role in the decision-making system, but it suggests that the state no longer monopolises in policy-making processes in the EU or at the domestic level (Payne 2000, p. 211; Hooghe and Marks 2001).

It is generally accepted that the participation of stakeholders and citizens in the process of building trust and joint institutional arrangements between states is important. Olem and Duda, for example, state that stakeholders should be a part of the institutional arrangements, together with government actors from different levels (1995, p. 348). They acknowledge the difficulties in implementing transboundary water management policy without legitimacy at the various local levels. Blöch (1999) points out that the success of the EU Water Framework Directive requires the involvement of citizens, interested parties and NGOs, and that when the river basin management plans are established information and consultation with these groups will be a necessity. Nevertheless, in a recent study of the literature on European transboundary water management (Gooch et al. 2002), it was shown that the role of public

participation enjoys relatively little interest in studies in this field, with the notable exception of the groups such as NGOs that have public participation specifically as their main focus. There are of course exceptions. Auer, for example, stresses the public's and local communities' role in successful international environmental governance (Auer 2000). According to Auer global environmental governance can be described as a multi-level, multi-actor process that bridges local, national and supranational environmental and policy contexts. Auer stresses that global solutions require local approaches when environmental crisis results from the aggregation of local resource decisions. Non-state actors, mostly NGOs and intergovernmental organisations (IGOs), are in fact playing an important role in European transboundary water management, in particular knowledge building, information gathering and dissemination, policy promotion and policy assessment, yet many public officials are passive or even negatively inclined towards this form of co-operation (Gooch et al. 2002). Some even see the involvement of the public and NGOs as a potential problem. The existence of such institutionalised opposition to participation will obviously influence the communication strategies of these organisations.

2.3 THE POLICY AND IMPLEMENTATION PROCESSES

Zaag and Savenije describe a desirable decision-making system that would be compatible with the integrated water resources management as a system that should involve the integration of different objectives, and a trade-off or priority setting between these objectives by carefully weighting these in an informed and transparent manner (Zaag and Savenije 2000). They describe a system where good communication and good arguments prevail, and different actors have possibilities to make their voices heard. Nachtnebel also notes that co-operation should involve joint communication, warning and alarm systems as important elements (Nachtnebel 2000). Monitoring and data production, and co-ordination of monitoring and assessment of the conditions of transboundary waters are also often seen as important activities for a joint commission (Gooch et al. 2002). This is of course a somewhat idealised view. A number of factors can hinder co-operation, such as lack of compatibility between monitoring, information and data management systems and lack of harmonisation of rules and criteria for assessment of data and information (UNECE 1994, p. 179). If the parties doubt the scientific facts, international co-operation can also be frustrated. According to Zaag and Savenije, sustainable transboundary co-operation needs indisputable, scientific assessment of facts (Zaag and Savenije 2000, p. 59). The problem here is obvious. How is this assessment of the facts to be conducted in an indisputable way, when a number of contradictory epistemological views exist?

There are constant disagreements between ecologists and engineers on all levels from international commissions to NGOs. An effective river basin organisation also requires a strong political and financial commitment from the member states. A clear definition of tasks, well-defined procedures for interaction between the river basin organisation and the national agencies and an organisational structure commensurate with responsibilities and legal status facilitates the work of a joint river commission (Savenije and Zaag 2000, p. 27). However, states are often reluctant to provide joint commissions with effective political and administrative power, and commissions are often relegated to tasks related to information and research (Dellapenna 1994). This usually leads to a situation in which the most basic activity for a joint commission, according to Zaag and Savenije, is the exchange of data concerning the state of the water resource between riparian countries (Zaag and Savenije 2000). Water management is often characterised by institutional complexity and insufficient economic base, and stakeholder expectations also differ considerably, as does the relative status of the parties involved in management. In this respect one of the issues that appears to be important when examining the possibilities of co-operation is the relative size of the potential partners. Lundqvist has proposed that co-operation is most feasible between actors with 'similar, parallel or contrary interests, where each actor perceives the others as possessing, controlling or using resources crucial to his or her own goal achievement' (Lundqvist 1998). If one of the actors has access to greater resources in the form of funding, competence, access to information, etc. then the co-operation may become one-sided, and the larger partner may be able to dictate the conditions for the co-operation.

2.4 THE COMMUNICATION OF SCIENTIFIC INFORMATION

In the early years of communication studies it was usual to utilise a linear transmission model as a metaphor for the flow of information (Hansen 1991). According to this model, information could be transmitted smoothly from supplier to receiver, and observed dissimilarities between access to, and utilisation of, information were often explained as dysfunction on three levels: as problems connected with obtaining relevant and reliable information, as discrepancies in the communication of information, and as the receiver's inability to comprehend the information (Davis and Robinson 1989, p. 60). The information cycle, as discussed in Chapter 9, has a number of characteristics in common with this model, and with the influential model of the policy cycle formulated by David Easton (1965). In its simplest form Easton's cycle

stipulates that policy-makers are influenced through the demands made upon them, they then take decisions, and these in turn are implemented. The outcomes of these decisions in turn affect the socio-economic environment, and this results in either support for or opposition to policies and the decision-making body. In a similar way, information cycle models present a view of information production as a number of distinguishable stages, and of a process that begins and ends with an input and output.

However, the policy/information cycle model has major weaknesses, the most acute being that the context and processes, by which policy or information is communicated and understood, are not sufficiently taken into account. In political science this debate has centred on the opening up of the 'black box' of policy-making, that is, in the elucidation of the processes at work in political and policy cultures. As regards information-cycle models, the problem is that the ways in which individuals and groups formulate and receive messages in a cultural, political and economic context need to be further analysed. For example, preconceptions often prevent the reception of information. These may be the result of professional belief systems, religion, core normative and casual beliefs (Sabatier 1988), or simply expectations of what will be presented (March and Olsen 1975). In organisations, these tendencies may be reinforced by standard operating procedures (Olsen and Peters 1996). This may be especially important when studying transboundary water management. Regarding organisational learning, for example, Olsen and Peters note that 'It is an old dream that the quality and efficiency of public policy and institutional design can be enhanced by the use of objective knowledge, scientific methods, and dispassionate analysis in the name of the common good, without any political pressure or interference' (Olsen and Peters 1996, p. 33). Therefore, while these models provide a useful point of departure and a practical way to organise studies of information flows in trans-boundary water management, they need to be developed and complemented so as to be able to incorporate explanations of how and why individuals and groups receive information, how organisations and individuals learn, and how policy can be changed through institutional learning.

In communication studies a number of alternative theories exist that can complement linear or cycle models. The 'knowledge gap' hypothesis, for example, attempts to explain discrepancies and problems in the communication of scientific information by looking at cognitive differences between scientists, policy-makers and stakeholders. The hypothesis postulates that well-educated people learn more from information, and that differences in knowledge then lead to increases in the knowledge 'gap' between the sources and receivers of information (Nowak 1977; Tichenor et al. 1980).

A number of scholars have examined not differences in knowledge but the role of personal and group perceptions, and the ways in which these are organised. It is claimed that, in a complex world, individuals and groups construct mental maps to help them understand the flood of information that is presented to them. The receiver's beliefs and cognitive frames of reference will influence and determine both which information is accepted, and the ways in which the accepted news is integrated into the receiver's perceptual structure. The impressions that most easily fit into the established cognitive schema of the individual or group, or into the social representations of society will be most easily accepted, while deviant impressions and views will be rejected, and ambiguous impressions will be treated as if they are compatible with the established mental frames of reference. Studies of the role of information in transboundary water management must therefore take into account the fact that information messages consist of knowledge, information, values and myths that are 'encoded' by the sender and 'decoded' by the receiver within social contexts (Burgess 1990). Actors in water management – scientific and technical experts, journalists, and the public – decipher the information that they receive (from their sources or the press), using personal and social schemata to order and interpret this information. These *schemata* can be seen as collections of personal and social beliefs, values and perceptions that influence and steer our reception of new knowledge. Van Dijk has used the concept of *scripts* (cognitive schemata) to explain the way in which individuals and groups relate new information to what they already know (Van Dijk 1988). Another term that has been used in this respect is *frames*. It is important to remember that the ways that information is treated, the *encoding* and *decoding*, are not necessarily the same for all actors involved in water management, that is, for experts, authorities and groups who are active in the field, the mass media and the public. Nor do the frames of reference that influence the reception of scientific information need to be static and exclusive. Individuals often possess multiple and conflicting opinions toward issues, and may be able to utilise a number of different schemata simultaneously (Tessar 1978). Linkages between societal and personal levels are also important but difficult to elucidate (Burgess 1990). In the case of water management, beliefs can be expected to determine our perceptions of the relative advantages and disadvantages of changes that lead to hydrological, biological and resource-related factors.

The ability to influence the agenda has been alleged in the agenda-setting hypothesis (Shaw and Martin 1992), and in the 'spiral of silence' hypothesis (Noelle-Neuman 1974). According to the agenda-setting hypothesis, an actor (scientist, politician, mass media, expert etc) can influence *which* issues people think about, although they may not be able to instigate changes in *how* people think. Agenda-setting theory is also applicable to public policy and water

management. Parsons, for example, states that 'We may all agree what an issue is but disagree as to what exactly the problem is, and therefore what policy should be pursued' (Parsons 1995, p. 87). The spiral of silence hypothesis stresses the effects of the presence or absence of certain views and opinions in an individual's social environment. Noelle-Neumann (1974, p. 45) claims that a dominant force in the construction of opinion is the fear of holding divergent views. By accepting certain points of view, and not accepting others, individuals and groups can contribute to the popularity of certain opinions, and to the negligence of others. It is claimed that self-censorship and selection of acceptable opinions is performed by experts, politicians, the mass media and the public. In the case of water management it is possible that some aspects of the problems are simply not on the political agenda, that is, that they are not even discussed, and therefore not open for debate.

While these theories provide a useful starting point for the analyses of the communication of information in transboundary water management, they do not sufficiently take into account the specific institutional settings of these forms of management. The next step is therefore to attempt to combine them with an analysis of institutional factors. In the case of transboundary water management the individuals and groups involved belong to the scientific and technical community, the political and administrative institutions that make and implement the decisions based on the scientific information, and the stakeholders and members of the public who are affected by the policies. The division between authorities and experts is, however, many times diffuse, as national, regional and local authorities often provide the very experts whose opinions are utilised in water-related disputes. Outside of the decision-making process, environmental groups also use expert opinions. The result is therefore that competing expert opinions often form the basic arguments used in disputes over water management. These expert opinions are not the only ones expressed, of course, as members of the public express other, non-scientific arguments, and moral and ethical issues are now an integrated part of many disputes. However, the special role of experts in conflicts calls for particular attention. It should be remembered that expert opinions are far from value-free, however much their proponents may like to claim them to be so, and that experts occupy their own world of myths and cultural resonance – their own paradigm, to use one of the (many) definitions of the word used by Kuhn (1970). Winch (1958, p. 23) puts this in another way, when he claims 'social relations are expressions of ideas about reality'. Winch also notes that both the institutions being studied, and the study of these groups, must be understood in relation to the rules governing the investigation. The cultural and political implications of these representations are also emphasised by Mary Douglas and her colleagues (Douglas 1982, 1985;

Schwarz and Thompson 1990; Thompson et al. 1990). Göran Sundqvist (1991, p. 227) has gone even further, and claims that 'environmental problems are defined within the confines of the researchers' laboratories', and Yearley has noted that, 'scientific expertise is increasingly at the forefront of environmental policy formulation and of contests over policy' (Yearley 1995, p. 458), especially in matters that have relevance for water quantity and quality problems.

In moving towards a new framework for developing information strategies for trans-boundary management it is therefore necessary to move from information cycles to communication strategies. A major difference between these is the focus on the *receiver* in communication strategies, as opposed to a focus on message content and *sender* characteristics.

2.5 TOWARDS A NEW FRAMEWORK FOR COMMUNICATION IN TRANSBOUNDARY WATER MANAGEMENT?

An important, related aspect in the move to communication strategies is the identification of the institutional models of the management structures. As political institutions define the framework within which politics takes place (March and Olsen 1989, p. 18), a lack of correspondence, or fit, between the cultures of the organisations at the different political and administrative levels can create major difficulties. What is needed here is the development of an approach for the specific institutional setting of transboundary water management. This context is characterised by the interaction of two or more organisational and institutional cultures, each embedded in their own nationally determined multi-tiered system of control and responsibility. Organisational and institutional cultures are composed of 'values, beliefs, assumptions, perceptions, behavioural norms, artefacts, and patterns of behaviour' (Shafritz and Ott 2001, p. 361). In other words, phenomena that are hard to observe. It is therefore important to develop ways to analyse the role of communication in institutional settings in the implementation process, and to analyse 'post-decisional politics' (Jordan 1997), that is, the ways that decisions are taken during implementation. In effect we are also here concerned with organisational politics, which 'involve intentional acts of influence to enhance or protect the self-interest of individuals or groups' (Allen et al. 1979, p. 77).

Post-decisional, or organisational politics, postulates that politicians and civil servants construct epistemic coalitions that compete with each other in their struggle to dominate and form the discourse, and that these coalitions can be studied as networks. Network analysis concentrates on the *relationships* between actors and stresses the importance of the interaction of beliefs and values.

It examines the *structure* of societal patterns, whether they be affective, economic or political, and interdependent relational ties between actors are studied as lasting patterns that provide both opportunities and constraints (Wasserman and Faust 1995, p. 4). These ties can be expressed as *evaluation (friendship, respect), transfer of material resources, association or affiliation, behavioural interaction, movement between places, physical connection, formal relations* and *biological relationships* (Wasserman and Faust 1995, p. 18). Wasserman and Faust name a number of important theoretical concepts such as 'social group, isolate, popularity, liaison, prestige, balance, transitivity, clique, subgroup, social cohesion, social position, social role, reciprocity, mutuality, exchange, influence, dominance, conformity' (Wasserman and Faust 1995, p. 14). A problem of the use of network analyses in transboundary water management can be the determination of network boundaries. However, the boundaries can also be determined by membership in the institutions being studied, an approach that comes from political science, where networking has been examined, for example, between sub-central government and the EU (Ward and Williams 1997). The policy network approach has earlier also been applied to policy communities by among others Richardson et al. (1992).

The Advocacy Coalition Approach (AFC) developed by Sabatier (Sabatier and Jenkins-Smith 1993) can also contribute to a theoretical model for the examination of communication in transboundary institutions. Sabatier defines an advocacy coalition as 'people from a variety of positions (elected and agency officials, interest group leaders, researchers, etc.) who share a particular belief system – for example, a set of basic values, causal assumptions, and problem perceptions – and who show a nontrivial degree of co-ordinated activity over time' (Sabatier 1988). In his revised version of the ACF Sabatier (1999) develops the concept of three levels of beliefs – *deep core, policy core* and *secondary aspects* – a typology of belief systems similar to that produced by others, such as Fishbein and Ajzen (1975) and Rohrschneider (1993). The ACF postulates that *deep core* beliefs are the most resilient to change, and that *policy core* and *secondary aspects* are less resilient. Regarding communication processes, it might be expected that actors within established institutional networks will show consensus on *deep core* beliefs, and that they will more easily give up *policy core* and *secondary beliefs* before accepting weaknesses in *deep core* beliefs. It might also be expected that policy-oriented learning between different belief systems is most likely to occur when the conflict is between, either, a secondary aspect of one system and a deep core element of another, or between two different secondary elements; and that policy-oriented learning and change will most likely occur where there exists a prestigious forum that can induce participants from different coalitions to participate.

The AFC could be a useful analytical framework as it can provide 'a means of aggregating large numbers of actors from different institutions at multiple levels of government into a manageable number of units' (Sabatier 1999, p. 154).

What then might be a productive method of approaching these issues in future research? Important questions should be: what are the dominant *deep core* beliefs and values of the people employed in organisations engaged at different levels of transboundary water management implementation, and how can these *deep core* beliefs and values be categorised into systems? How do these systems influence the preferred communication strategies utilised by these organisations? What are the main types of institutional networks and inter-organisational interaction, and how is this interaction influenced by belief systems? How do these informal institutional networks relate with policy-makers and the public? How do formal and informal institutions interact? Who are the main actors at different communicative levels in transboundary water policy and which of these function as gatekeepers or nodes in epistemic networks? How can organisational belief systems change, and how can such changes be expected to influence communication in networks and advocacy coalitions? Practically, it is proposed that the institutional context of communication should be analysed and main gatekeepers identified. The organisation of the institution should then be analysed to examine if the formal role and position of gatekeepers in the organisation is optimal. The informal organisation and non-formal networks of the existing gatekeepers should also be analysed to examine if their present role and position in the organisation is optimal. Suggestions might then be made on how to improve communication in the institutional context.

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3

Generation of usable knowledge in implementation of the European water policy

Gulnara Roll

3.1 INTRODUCTION

The Directive 2000/60/EC establishing a framework for Community action in the field of water policy (the Water Framework Directive) was adopted in 2000; a Common Implementation Strategy aiming at a coherent implementation of the Directive across Europe was developed and endorsed by a meeting of the EU Member States Water Directors in 2002. As the implementation of the Directive started, questions of effectiveness of water protection measures and efficiency of use of financial and human resources in the implementation process became central issues of discussions among water managers, experts and representatives

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of affected interest groups in Europe. These discussions included debates on the role of stakeholders in the implementation process and it was concluded that acceptance of proposed water use and protection measures by major stakeholder groups would promote more effective implementation of the EU and national water policies in Europe. Involvement of the stakeholders is especially important in the context of the *'full recovery cost' pricing system* – the institution of a pricing policy at a level that gives incentive to the wise use of water (Article 9) introduced by the Directive. By 2010 Member States will be required to ensure '*full cost recovery*', i.e. the price charged to water consumers – such as for the abstraction and distribution of fresh water and the collection and treatment of wastewater. All water users – individuals and organisations – will be receiving bills to pay for the Water Framework Directive implementation, and only if the water users are able and willing to pay for the proposed measures can the Directive be implemented.

The EU Water Framework Directive text does not mention 'stakeholders', but refers to 'interested parties' and 'users'; however, the Directive Guidance on Public Participation, prepared as part of the Directive Common Implementation Strategy, uses the term 'stakeholder' as a synonym of 'interested party' and defines it as: 'any person, group or organisation with an interest or 'stake' in an issue either because they will be affected or may have some influence on its outcome' (Guidance on Public Participation 2002). The Guidance divides stakeholders into the following groups:

- professionals – public and private sector organisations, professional voluntary groups and professional NGOs (social, economic and environmental). This also includes local authorities and government departments, statutory agencies, conservation groups, business, industry, insurance groups and academia;
- local groups – non-professional organised entities operating at a local level;
- individual citizens, farmers and companies representing themselves.

Stakeholder participation with respect to the requirement of the Water Framework Directive includes information supply, consultation (written and oral consultations) and active involvement where the 'active involvement' contains different collaborative participation approaches.

Although the importance of the idea of involving the stakeholders is recognised by decision-makers, actual involvement on national level, especially in Eastern Europe, is still weak, although it varies from one country to another. There is still little experience and tradition of organising consultations with diverse groups of stakeholders, especially in the EU accession states, and there is little knowledge of whom, when and how to inform about and to involve in

the process of designing and/or implementing national plans of water protection measures. Besides, river basin authorities are not yet much motivated to involve stakeholders in the implementation process, as the participatory process is time consuming, requires considerable human and financial resources and does not bring immediate benefits to the water management authorities.

Informing and involving stakeholders in implementation of the European water policy is especially difficult as it requires communication of a highly technical body of knowledge provided by the scientific community that is not easily understood by the other interested parties. The technical language used by scientists must be 'translated' into lay terms for the information to be useful. How should highly technical information stemming from different science disciplines be communicated to decision-makers and other stakeholders without oversimplifying, to ensure that this information is adequately understood and accepted as relevant and reliable and is utilised in the policy development and implementation process? How to ensure that this multidiscipline scientific information would be synthesised into 'usable knowledge'? Finding answers to these questions and resolving these challenges of translating the scientific information into usable knowledge on a practical level would be instrumental in promoting efficient use of resources and effective implementation of policy measures.

In the process of generating usable knowledge, consisting of the collection of information and its dissemination and communication, we are also confronted with many different cultural and ethnic backgrounds. According to Gooch (2001), 'personal experience, interpersonal interaction, and exchanges of information concerning environmental problems are instrumental in the formation of views and attitudes.' Different perceptions are based on different personal interpretations of water policy by persons and stakeholder groups and this may prove to be quite a challenge in the attempt to reach consensus on the policy implementation options.

Finally, it is also important to highlight that perceptions of the problems are formed by the selectivity of mass media that shapes public attitudes and often creates stereotypes in understanding of specific issues.

Thus, the challenges of effective implementation of the European Water Policy connected with information exchange and communication and generation of usable knowledge include finding ways to reconcile scientific data and public output, reconcile media bias with actuality, reconcile differing interpretations arising from diverse cultural, personal and societal experiences (Glicken, 2000). Accurate information dissemination would serve to overcome the challenges mentioned above.

3.2 GOAL AND OBJECTIVE

The purpose of this chapter is to discuss the production of *usable knowledge* under the broader horizon of implementation of the European Union Water Framework Directive, in the part of effective dissemination of relevant and accurate expert information to decision-makers and stakeholders involved in implementation of the water policy.

Discussion of information dissemination in the ontext of the implementation of the EU Water Framework Directive is urgently needed in the current stage of starting the policy implementation. Water managers, specialists and stakeholders on the ground have to be able to understand the essence as well as the details of the comprehensive European Water Policy, and should be able to use this global expert knowledge about the Directive locally to implement the Directives' requirements in the local context; but this is far from always being the case.

The chapter emphasises the importance of information dissemination in water policy implementation and discusses some relevant approaches to facilitating the flow of information between experts, policy-makers and various stakeholder groups.

The chapter is based on the experience of a pilot study conducted in the Estonian–Russian Lake Peipsi/Chudskoe Basin in 2001–2003 aimed at promoting dissemination of expert information to decision-makers and stakeholders. It highlights practical methods, including web-based and non-web related interactive approaches to disseminating expert scientific information to decision-makers and local stakeholders, and formulates recommendations for actions that should provide a basis for creating a political dialogue between the three parties involved in the development and implementation of water management policies: decision-makers, experts/scientist teams, and local stakeholders.

This political dialogue is a prerequisite for the creation of a usable knowledge base for the effective implementation of the water policies.

3.3 DEFINITION OF 'USABLE KNOWLEDGE'

According to Webster's Dictionary, knowledge is 'the fact or condition of knowing something with familiarity gained through experience or association'. Knowledge may be recorded in an individual brain or stored in organisational processes, products, facilities, systems and documents (Hatala 2000). Knowledge in the form of policies, products, technologies and especially the skills, know-how and expertise of people, is considered the source of innovation and growth. Knowledge is information put into a specific context where it can be used for actions.

Discussing the role of usable knowledge in encouraging sustainable economic growth, a report prepared by McNamara of the World Bank (2002) stressed that 'the ability to acquire and use knowledge is increasingly becoming a key factor in determining the competitiveness of a country's economy and may well mean the difference between prosperity and poverty, both between and within countries'. The European Union, at the 2000 Lisbon Summit, established the ambitious goal that Europe 'would become during the next decade the most competitive and dynamic knowledge-based economy in the world' through effective use of European science and technology achievements.

'Usable knowledge' in the context of the implementation of environmental policies is knowledge that could 'enhance our ability to control or regulate human actions that cause or threaten to cause disruptive … changes in human-dominated ecosystems' (Vitousek et al. 1997).

Nonaka and Takeuchi (1995) distinguish two types of knowledge: explicit and tacit. Explicit knowledge is formal and systematic, and thus easy to communicate and share; it is knowledge that is transmittable in a formal language and can be stored in databases, libraries, etc. Tacit knowledge is personal knowledge that is hard to transmit; it consists of mental models, beliefs and perspectives that cannot be easily articulated and shared. It is the movement between the two forms of knowledge that forms the process of creating new knowledge. The basic characteristics of the four modes of knowledge conversion are as follows. Knowledge socialisation generates new tacit knowledge by sharing and exchanging know-how and past experiences. Knowledge internalisation maps explicit knowledge onto internal knowledge. Internalisation happens when individuals, exposed to other people's knowledge, make it their own. People internalise knowledge by doing, but also by looking at what other people have done in a similar context and by example. Knowledge externalisation involves structuring knowledge and making it available to other users, while knowledge combination generates new knowledge by combining pre-existing explicit knowledge and bringing it together to produce new insight.

3.4 USABLE KNOWLEDGE AND IMPLEMENTATION OF ENVIRONMENTAL POLICIES

Global public knowledge exemplifies knowledge that is general and explicit. In the case of implementation of the EU Water Framework Directive, to 'download' the global expert knowledge on Directive implementation and to make it usable in a local context, specific approaches need to be used; but most important is that the local actors, first of all, water experts, should take the active role ('be in the driver's seat') in the local learning process (Stiglitz 2000).

According to Stiglitz, the knowledge can be locally applicable, and local 'doers' who adapt this global knowledge and 'make it their own' through active learning can do the adaptation. The active learning ensures that the global explicit knowledge is put into a specific socio-economic and cultural context and therefore is usable locally. The role of local experts and scientists is therefore very important in generation of usable knowledge.

To translate the explicit technical knowledge into locally usable knowledge, it is important to provide 'an ongoing dialogue between analysts and practitioners [that] can … generate new insight on the one hand and assist practitioners to broaden their thinking and to avoid simplistic analogies or inappropriate responses to specific problems on the other' (Young 2002). This political interaction between decision-makers, water users and other stakeholder groups, the three-way dialogue, is a necessary condition for 'usable knowledge' generation.

Developing a knowledge base for water management is a long-term process; establishing and strengthening institutional arrangements that would support this long-term and regular communication and information exchange between knowledge producers and knowledge users is an imperative in promoting ideas of sustainable development and developing the capacity of, especially, local actors for implementation of these water policies.

One of the essential steps in creating the usable knowledge base in modern water management is 'building a dynamic information infrastructure, and a competitive and innovative information sector of the water management sector, that fosters a variety of efficient and competitive information and communications services and tools available to all sectors of society' (McNamara, 2002). Therefore, use of information technologies for wide and accurate information dissemination is important, and this topic of using information technologies for effective expert information dissemination should be discussed in more detail – how innovative IT solutions can promote effective information dissemination.

3.5. A PILOT STUDY ON EXPERT INFORMATION DISSEMINATION IN THE LAKE PEIPSI BASIN

A study aimed at investigating the use and role of information generation and communication for policy- and decision-making and management in European transboundary river basins was conducted as a part of an international research project 'Integrated Strategies for the **Man**agement of **Tra**nsboundary Waters on the **East**ern European Fringe' – the pilot study of Lake Peipsi and its drainage

basin (**MANTRA East**) supported by the EU Fifth Framework RTD Programme (Contract EVK1-CT-2000-00076),. The Lake Peipsi transboundary water basin was chosen as the pilot region for the project.

Lake Peipsi is the fourth largest lake in Europe with a large drainage basin. The lake basin's major environmental problem is connected with water eutrophication and reduced fish-stocks. The lake basin is shared by an accession state (Estonia) and one non-EU state (Russia). There are considerable disparities in the two legislations, procedures, monitoring strategies, environmental data and information gathering, and institutional organisation; these differences could create barriers to developing joint management of the shared transboundary waters. The situation of Lake Peipsi being located on the future external EU border makes information exchange process as a part of implementing water protection measures in this transboundary water basin between the EU and national levels, as well as across the border, very complicated; on the other hand, it is critically important to ensure information exchange, dissemination and development of the shared knowledge base for the joint water management.

Established in 1997 by the Estonian and Russian governments the Estonian-Russian Joint Commission on Transboundary Waters (hereafter, Commission) serves a formal mechanism for coordination of water management and protection activities across the lake, as well as between local interested parties and the two governments. Global Environmental Facility (GEF) through the United Nations Development Programme provided support for cooperative work in both countries worth to launch the 3-year Lake Peipsi Basin Management Programme implementation of which is to be coordinated by the Estonian–Russian transboundary water commission. The Lake Peipsi basin management programme is a joint programme of measures in the transboundary Estonian–Russian basin aimed at reducing and preventing pollution in the water basin and at promoting sustainable development.

To facilitate effective implementation of the Lake Peipsi Basin Management Programme, an Information and Communication Strategy for dissemination of scientific and technical information to local stakeholders in the lake region (hereafter, Communication Strategy) was prepared and tested. The Communication Strategy may serve as an example of some approaches to the generation of usable knowledge on an international river basin level.

A regional non-governmental organisation, Peipsi Centre for Transboundary Cooperation, that works to promote sustainable development and cross-border cooperation in the Lake Peipsi Basin, organised work on preparation of the Communication Strategy. Universities on both the Estonian and Russian sides of the border, as well as companies dealing with information management and technologies, also participate in the development of the Communication

Strategy for the Lake Peipsi basin. The local team actively utilised the knowledge existing in other regions of Europe and America in the preparation of this type of communication plan; results of earlier international projects conducted by international organisations and researchers in the Lake Peipsi Basin were also used extensively in the process.

Preparation of the Communication Strategy started with identification of the main water management issues and major stakeholder groups in the lake basin through organising expert interviews with specialists and officials involved in the implementation of national water policies in the respective countries, Estonia and Russia. On the basis of the expert interviews and additional research conducted, a joint database with contact information for people and organisations involved in water management issues was developed and set up on the Internet in three languages – English, Estonian and Russian.

Once the stakeholders had been identified, the next step was to determine their concerns and pressing issues. To identify interests of the stakeholder groups the following approaches were used: questionnaires, interviews, focus groups, and public forums. Based on the mapping of the stakeholders' needs, reports were prepared that contained specific recommendations for an information dissemination strategy, including formats for information presentation and channels of communication and dissemination.

The next step in the development of the communication included development of mechanisms to compile and 'translate' a tremendous amount of environmental information and turn this into 'usable knowledge' for the stakeholders. The data should have been customised to meet the needs of every stakeholder. However, efficiency should also have been taken into account, and therefore a mechanism that met the widest range of stakeholder needs was the ideal method for disseminating information. The conducted studies allowed the conclusion that the mechanism of 'translation' of the raw data into 'usable knowledge' should ensure that the information users receive is:

- easy to use/understand: users are seeking knowledge, and therefore information must be accessible through the most user-friendly method possible;
- accurate and relevant, tailor-made to the needs of stakeholders. The mechanism should provide the possibility to sift through this body of data and present only relevant, and therefore usable information;
- if the problem is geographic in nature, in maps that explain and identify the area in question, which are more useful than textual description;
- constructed to meet the needs of the most number of people. Highly specialised mechanisms that reach only few groups of stakeholders do little to meet the needs of the general public.

To develop such a mechanism was a serious challenge, especially in this lake basin area that can be considered with respect to environmental information as a combination of 'data-rich' and 'information-poor' area, as access to and availability of data is scattered in the region. Each country, Estonia and Russia, collects and analyses environmental information on the lake basin in its own manner. These data are occasionally exchanged between experts of the Estonian-Russian Joint Commission and its working groups. Estonia and Russia already have different monitoring methods and equipment as well as norms and standards. These differences cause different approaches towards environmental assessment that make joint assessment of the lake status very complicated. Information is presented in different languages and different formats on the Estonian and Russian sides. For example, in Estonia, Internet-based solutions are already widespread, even in rural areas, as the government provides support to promote a higher computer and Internet use by a maximum amount of the population in Estonia. On the Russian side of the basin, due to technological limitations, such as poor telephone lines or absence of appropriate computer technology, use of the Internet is limited.

Based on the analysis of the stakeholder information needs, Peipsi CTC developed the Communication Strategy that was based on a combination of diverse interactive approaches such as focus groups and group interviews, email lists in the local languages, interactive websites as well as an active use of mass media including newspapers, magazines, television, radio, etc.; meetings, campaigns, and conferences; cultural events including contests, tours as well as local community venues, including bulletin boards in schools, stores, community centres; and publications, such as brochures, pamphlets and flyers.

As a central instrument for the information dissemination on the lake basin environmental issues, Peipsi CTC has created a regional Lake Peipsi web portal to exist principally for the collection, processing and dissemination of information pertaining to the Lake Peipsi region. The portal, available in Estonian, Russian and English languages at http://www.peipsi.org/, with the aid of innovative web technologies has the potential to tailor otherwise highly specialised environmental information pertaining to the Lake Peipsi Region to the individual needs of any stakeholder, including municipal government officials, businessmen, schools, NGOs and the local public. The portal uses tools such as GIS software, which allows interactive use of maps and provides important information on Lake Peipsi fauna, flora and various environmental challenges to the area. In addition, to sort through the excessive information that may exist on the web, the portal also includes semantic web tools that limit information search results to relevant environmental information on the region in question. Semantic Web ('next generation web') is an extension of the current web in which information is given a well-defined meaning, better enabling

computers and people to work in cooperation. Information on the portal is structured using the DPSIR framework (driving forces-pressures-stress-impact-responses) (see more on the DPSIR framework at the European Environmental Agency at http://www.eea.int/). In order not to overwhelm the average user with information a pre-constructed hierarchical navigation system was implemented. There are four different ways to browse the contents of the portal: via a common hierarchical structure organised into main and sub-categories of which the main categories are accessible from every page; via a references system that is attached to every bit of information; via a direct keyword search; and via the GIS map. Visitors can run queries based on the GIS map of the Peipsi region. Altogether, the benefits of this portal are twofold. On the one hand, it facilitates the research process by allowing users to find only the most relevant information without having to waste time sifting through unnecessary sources. On the other, it helps users understand the extent of connections between different concepts and keywords encountered on a daily basis.

While the Internet has a great potential for disseminating information, it is not yet completely accessible to all for various logistical reasons. Furthermore, it does not serve as a substitute for more traditional means of information communication and dissemination. While the Internet promises to be the major media of the future, for those who are currently without access to the World Wide Web, Peipsi CTC has developed various other methods to disseminate important information mentioned above. Other approaches used include a three-way interaction between the experts and scientists, politicians, and local stakeholders. This organised three-way interaction should contribute to the social learning and development of the region-wide knowledge base for implementation of the Lake Peipsi Basin Management Programme.

Peipsi CTC has developed the Communication Strategy and the Lake Peipsi portal as a demonstration prototype of an effective tool for information dissemination. However, the actual work of using the knowledge for effective implementation of water policies is still ahead. The next steps in implementation of the Communication Strategy for the Lake Peipsi Basin are to implement mechanisms for dissemination of relevant and understandable information in a manner that would guarantee their future use and actual generation of usable knowledge. For example, in order for the information portal project to be successful, a marketing strategy has been elaborated to ensure that the portal evolves into the main source of information about the Lake Peipsi region: its political, geographical, biological and social development. This marketing strategy is to be implemented to ensure that the information resources of the lake regional portal are utilised.

Finally, for the implementation of the Communication Strategy, the feedback stage will be of paramount importance, for it is then that the target audience can determine the true value of data compiled and disseminated through the developed mechanisms. The feedback sessions should occur at staggered intervals over the course of a year after implementation, and then occasionally after this period. Feedback determines whether the dissemination strategy was successful, or whether the process must be started again.

3.5 CONCLUSIONS

Implementation of the EU Water Framework Directive is a large-scale and long-term Pan-European 'project'. Dissemination of international expert knowledge on implementation of the EU Water Framework Directive to diverse stakeholder groups on the national and especially local levels of governance where the actual implementation is taking place is critically important. To ensure development of the 'knowledge base' for implementation of water policies, regular interaction and information exchange among policy-makers and decision-makers, experts and water users should be organised. Political three-way dialogue is a prerequisite for the creation of the usable knowledge base.

Generation of usable knowledge on European Water Policy implementation includes both information collection and information dissemination. Traditionally, in the process of environmental planning, much attention is paid to raw data collection and storage, but the necessary activities for effective information dissemination to end-users are often neglected. This situation has to change and tailor-made information dissemination approaches should be elaborated and actively used to deliver relevant and understandable information to the stakeholders involved in implementation of water policies.

Research and testing activities on the use of information and communication innovative technologies that make the information dissemination more effective are also very important, as today there seems to be little awareness among environmental experts about the need to develop innovative technological solutions to facilitate information dissemination. It is important to implement actions aimed at promoting awareness among all three parties on the use of innovative information technologies for information management and communication. In today's world where we are all overwhelmed with diverse but not always relevant information a greater use of innovative technologies is an imperative.

Lessons learned during the preparation and partial implementation of the Lake Peipsi Basin Communication Strategy are the following.

- For the generation of usable knowledge the existence of local expert organisations that are capable of and interested in adapting this global

knowledge and 'making it their own' through active learning is critically important.

- These experts should be capable of providing the 'translation' of the global expert knowledge to the local stakeholders, such as politicians, authorities and NGOs, through a political dialogue with policy-makers, decision-makers and other stakeholders.
- In the process of creating usable knowledge for water management, close and regular cooperation between local expert organisations – consulting companies and/or professional NGOs with education and research institutions as well as with companies dealing with innovative information and communication technologies development – is important for success.
- The learning process is often very lengthy, as it requires considerable time to build awareness among the stakeholders and to develop their skills to implement the necessary actions.
- Use of innovative IT technologies could facilitate a faster learning process.
- The process of developing the water management knowledge base is resource and time consuming; the information management and communication costs should be carefully planned as costs of the river basin management plans preparation and implementation.
- The process of 'usable knowledge' generation includes the following steps: mapping stakeholders, assessing their information needs, compiling available data and information to generate the knowledge and developing mechanisms for interactive approaches to information dissemination, implementing these information dissemination mechanisms in a manner that will guarantee their future use and finally developing feedback mechanisms that would allow evaluation of the whole process of the generation of usable knowledge.
- Methods that help transfer general knowledge into local usable knowledge include specific approaches such as interactive meetings and forums, twinning, seconding and use of other methods that usually require developing personal trust and cooperation between external experts and local staff over a possibly long period of time.
- Information dissemination, its content, format and channels used for communication, should be tailor-made to the needs of the stakeholders involved in implementation of water management regimes. At the same time, in selecting the information dissemination instrument to be used, it is necessary to ensure efficiency of information dissemination, i.e. to meet the needs of the largest number of stakeholders with the available, always limited, personnel and financial resources.

- Finally, the Lake Peipsi case pilot project demonstrated that the 'best practices' approach that is currently very popular among international water management organisations and experts should be used critically. Just writing up the experiences of one region in the implementation of specific water management approaches is only the beginning of the process of transferring specific practices from one region to another; there is an urgent need for more discussion and research on the processes of implementing 'best practices' and finding out the main factors that contribute to successful replication of the 'best practices'.

This chapter discussed some issues of generating usable knowledge connected with information dissemination. To understand better the processes of generation of 'usable knowledge' and role of knowledge in the effective implementation of environmental policies, the issue of perceptions, and resulting from that different personal interpretations of water policy as well as the role of the mass media in the information communication, should be studied in more depth.

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4

Dialogue and transboundary water resources management: towards a framework for facilitating social learning

A. Jim Woodhill

4.1 INTRODUCTION

Like sustainable development more generally, transboundary water resources management is a complex and 'messy' social problem. Improvements in water management ultimately depend on the capacity of different interest groups to communicate, negotiate and reach collective decisions. Dialogue implies a shift from seeing water resources management as primarily a scientific and technical task to seeing it as a systemic problem that requires an interdisciplinary approach.

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Dialogue and transboundary water resources management

This chapter explores the meaning of dialogue for transboundary water resource management within the broader context of social learning.

Humanity is becoming confronted with the failure of its existing institutions to achieve the goals of sustainable development (Beck 1992; Hemmati 2002; Knight et al. 2002). Our institutions and mechanisms of governance seem increasingly archaic: a global economic system that does not value adequately natural capital; technical, single-discipline and inflexible government agencies; inappropriate property rights; and social norms that value immediate individual material wealth over ecological integrity and social equity. We know that existing market mechanisms are often driving us away from rather than closer to sustainability and that many problems have no magical technological solutions. We know that because of globalisation and the free movement of capital, the power of economic interests and short-term electoral considerations, the nation state is often powerless to take radical decisions in the interest of the environment. Where does this leave us as citizens and scientists?

Despite this sobering picture, many positive examples of change are emerging (cf. Hemmati 2002; Leeuwis and Pyburn 2002): examples where different interest groups from government, business and civil society have worked together, explored problems, reached understanding, and negotiated for changes with a very positive for the environment and social and economic wellbeing. Such examples share several features: processes of social interaction that enable trust to be built, differing values, ideas and perspectives to be shared, assumptions challenged, consequences of different actions assessed, conflicts managed and collective action realised. These processes of engaging different stakeholders in collective learning, problem-solving and decision-making are often referred to as social learning (cf Dryzek 1997; Dunn 1984; Friedmann 1992; Irwin 1995; Lee 1993; Milbrath 1989; Woodhill and Röling 1998; Leeuwis and Pyburn 2002).

This chapter argues that transborder water resources management demands a social learning approach. Such an approach focuses on how different stakeholders, whether policy-makers, politicians, scientists, business interest groups, environmental interest groups or general community representatives communicate in a learning-oriented way. It aims to enable society and its mechanisms of governance to better manage and innovate in situations characterised by uncertainty, complexity, rapid change and conflicting interests.

The chapter initially examines the characteristics of transborder water resources management. Social learning is then defined and its relationship to dialogue and multi-stakeholder processes explained. The chapter finally focuses on four key elements necessary for facilitating social learning.

4.2 TRANSBORDER WATER RESOURCES MANAGEMENT – A COMPLEX HUMAN PROBLEM

Growing water scarcity threatens global food and environmental security. Water shortages are likely to affect 2.7 billion people by 2025. Agricultural scientists say that farm water use, especially irrigation, must be increased by 15 to 20% in the coming 25 years to maintain food security and reduce hunger and rural poverty for a growing world population. Meanwhile, environmental scientists say that water use will need to be reduced by at least 10% during the same period to protect rivers, lakes, and wetlands on which millions of people depend for their livelihoods, and to satisfy the growing demands of cities and industry (Dialogue of Water, Food and Environment, 2001). Many of these ecosystems have already been eliminated or damaged over the last decades. Meanwhile the pollution levels of many river systems have reduced the quality of this scarce resource to standards that have severe consequences for human and ecosystem health and even industrial use.

Such problems can only be resolved by taking a holistic river basin perspective. But the boundaries of river basins rarely conform to other political, administrative, social, cultural or economic boundaries. Even within national boundaries, the challenges are immense only to be dramatically compounded when rivers flow between different nations. Gooch et al. (2002) suggest that few see how the public can help manage transboundary water resources. The implication is that the problems can be resolved through regime development negotiated between interested governments. However, three issues emerge. First, without broad consensus from key interest groups governments generally find it difficult to bring about effective policy change. Second, even if policies can be introduced, implementation demands action at different scales by different actors. This requires a high degree of willing cooperation as governments simply do not have the resources to coerce, police and enforce unwilling cooperation. Third, the complexity and uncertainty involved in river basin management means that top-down ‘blueprint’ approaches are rarely effective. Adaptive, learning-oriented strategies are required which necessitate active engagement of different groups – this is essentially communication.

Water dilemmas have several features that demand such a communicative, rather than instrumental approach to developing and implementing river basin management plans:

- complexity of interconnected biophysical, social, economic and political factors;
- uncertainty of future consequences;
- multiple stakeholder interests at multiple scales;

- causes and effects and costs and benefits are often separated across time and space with significant implications for human motivation;
- the value-laden nature of water dilemmas;
- strong vested interests in the allocation and use of water resources both within and between nation states;
- need for coordinated action across political boundaries;
- water issues are essentially an externality in the economic system.

4.3 ON DIALOGUE AND SOCIAL LEARNING

Over the last decade, terms such as adaptive management, collaborative management, participation, citizen involvement, collaborative management, community participation, dialogue, multi-stakeholder processes, interactive decision-making and social learning have proliferated in the natural resources management (NRM) literature. These terms all embody the idea of bringing together different stakeholders (actors) who have an interest in a problem situation and engaging them in processes of dialogue and collective learning that can improve innovation, decision-making and action. For this paper, 'social learning' is the overarching term.

Social learning is defined here as the process by which communities, stakeholder groups or societies learn how to innovate and adapt in response to changing social and environmental conditions. One of the key features of modern society is that it must now respond to the (often negative) consequences of its own action. We find ourselves in a state of what Beck, Giddens and Lash (1994) refer to as 'reflexive modernisation'. This implies that modern societies need to learn more quickly and effectively than societies that were confronted with less dramatic change in their social and natural environment. A society that is unable to innovate in response to a changing environment runs the risk of crisis, if not annihilation. History does not lack examples of societies that have met this fate. Any social change requires learning of some form, but the question here is how societal-wide learning processes can be more, rather than less, effective and how this can be facilitated.

Social learning seeks an alternative to two classical strategies for governance: (1) that government and experts should make decisions for society and 'solve our problems', or (2) believing that social change should be left largely left to market forces with minimal guidance by government. Failure at both ends of this spectrum of governance mechanisms has fed the interest in social learning and more participatory forms of democratic governance. Improving the ways in which we learn as a society means building capacity to assess consciously and critically the consequences of our behaviour and how social structures

(institutions) shape the way we think and act. Social learning actively engages different groups in society in a communicative process of understanding problems, conflicts and social dilemmas and creating strategies for improvement. Thus social learning is more that just 'community participation' or learning in a group setting. It involves understanding the limitations of existing institutions and mechanisms of governance and experimenting with multi-layered, learning-oriented and participatory forms of governance.

Social learning takes the idea of the 'learning organisation' (Senge 1992; Cross and Israelit 2000) to contexts where solving problems, responding to new opportunities and innovating requires the collaboration of many different types of organisations and social groups from government, business and civil society. While certain core principles of organisational learning remain relevant, additional challenges and complexities are introduced when dealing with transboundary water issues. Social learning must deal constructively with significant conflicts, differing values and beliefs, complex power relationships and the inevitable dynamics of political life that do not occur in organisations.

To understand what social learning is, the distinction between technical, economic and interactive ways of 'getting things done' is helpful (Röling and Woodhill 2001; Röling 2002; based on Habermas 1984). The technical perspective relies on scientific discovery and technical solutions – for example, new agronomic practices that are more water efficient. The economic perspective tries to solve problems through markets and the valuation and pricing of goods and services. The interactive perspective brings people into negotiation with each other over their values, their goals, their differing interests and the development of collective interests and common strategies for action. Habermas (1984) and others argue that the technocentric paradigm of the twentieth century has led to a lopsided development in which the technical and economic perspectives have come to dominate at the expense of the interactive perspective. Yet it is the interactive perspective to which we must turn when existing ways of thinking and institutions prove inappropriate for solving the problems of our time.

Effective social learning as a form of interactive dialogue and decision-making does not just happen but needs to be consciously and proactively facilitated. The remainder of the paper presents a framework for guiding the facilitation of such social learning.

4.4 TOWARDS A FRAMEWORK FOR FACILITATING DIALOGUE AND SOCIAL LEARNING

Facilitation is often associated in a limited way with simply facilitating a meeting or workshop. In this chapter, facilitation is being used more broadly to refer to a process that may run over several years and which designs and establishes organisations and other institutional arrangements to make social learning possible. There are four key elements to the framework for facilitating social learning, each of which will be outlined below:

(1) theoretical foundations – from paradigms to practice;
(2) developing interactive learning processes;
(3) creating institutional support;
(4) enhancing facilitation and leadership capacity.

4.4.1 Theoretical foundations – from paradigms to practice

Whatever people do is based in some way on an underlying set of beliefs or assumptions about the world and the universe they inhabit. Often these are so internalised that their guiding influence is not perceived. The nature of these beliefs and assumptions (or 'worldviews') leads people to interact with their surroundings and each other in unique ways. A particular set of beliefs, assumptions and ways of acting is what is commonly referred to as a 'paradigm'.

Thinking about paradigms means being conscious and critical about the fundamental assumptions and philosophies that shape the way problems and opportunities are approached. Many of the problems of transboundary water resources management result from the dominant twentieth-century assumptions relating to the environment, the economy and technological progress. Improvement will often require not just trying to solve the problems within the boundaries of the paradigm that created them, but rather recognising the need for an alternative paradigm.

The processes adopted and methodologies used to bring about change and facilitate action are shaped dramatically by the particular paradigms (and associated theoretical foundations) of the stakeholders and facilitators. Unfortunately, people are often not conscious of the particular paradigm(s) from which they operate. For example, scientists who have been trained only in rigorous scientific methodology may be dismissive of participatory processes because they believe only scientists can contribute 'truthful' and unbiased knowledge that will be useful for solving problems.

Water resources management requires negotiating conflicts and differences between different stakeholders. Conflict is often a clash of paradigms. People act and rationalise things in a way that does not make sense to others because they are operating with a different set of assumptions, values and beliefs. In resolving such conflicts, those involved need to make their paradigms explicit and see others' paradigms – for which facilitation is critical.

Being aware of, and engaging in reflection about the appropriateness of various paradigms, requires at least some awareness of the theoretical foundations within philosophy and the social sciences. The emerging discourse on social learning draws on a diverse range of theories from the social sciences. Below six relevant and critical areas of theoretical discourse are presented.

1. The constructivist view of knowledge How is knowledge constructed by humans? How do we know what we know? What is 'truth'? What is the role and validity of scientific knowledge in society? These are all questions associated with the philosophy of knowledge. For a large part of the twentieth century, a positivist and realist philosophy associated with the classical biophysical sciences dominated intellectual thought. Positivism holds that there is a 'reality', independent of human experience, the true nature of which can be uncovered objectively by recourse to the empirical methods of science (Miller 1985, 179). Over the last 20 years or so an alternative paradigm called constructivism has emerged from the social sciences and the 'new' biophysical sciences. The constructivist paradigm assumes that knowledge and reality, as humans experience it, are socially constructed (Berger and Luckman 1991; Guba 1990; Maturana and Varela 1987). These different (epistemological) assumptions about knowledge have significant implications for how the role of science is to be understood in society, how social phenomena are viewed and explained, how research is conducted and for the role of dialogue and social learning in social change.

2. Human motivation and action The whole edifice of twentieth-century economic and political theory revolves on the assumption that human nature is inherently individualistic, self-interested and competitive. The roots of this assumption are multifarious and lie deep in Western thought and history. They can be traced to the Sophists in Plato's time, Hobbes' political theory (Mansbridge 1990, 3–12), the application of Darwin's 'survival of the fittest' human society (Dryzek 1996, 21–22; Pepper 1993, 9), and the Calvinist religious outlook (Daly and Cobb 1989, 55–7). The difficulty for current societies is that our economic and political institutions are largely based on these assumptions and that the notion of a fixed and selfish 'human nature' has become accepted social wisdom that legitimises these institutions. Repudiating, or at least questioning such assumptions, is a critical step in any debate about alternative economic and political arrangements.

3. Cognition and learning Closely aligned to the above theoretical discourses is that of cognition and learning. Cognition is the process by which humans acquire knowledge and understanding through thought, experience and the senses. It is important to recognise that humans are emotional beings who rationalise and make sense of their worlds in ways that may seem perfectly rational to one individual and quite irrational to another. This can be understood by seeing cognition as involving an interaction between four dimensions: values, emotions and goals; action; perception of context and theory (Röling 2002). These dimensions can also be applied at the level of collective cognition to try and help understand how groups, organisations or societies make sense of their worlds and reach consensus over what is 'rational' behaviour.

Allied to cognition are theories about learning. Very influential for participatory approaches has been Kolb's (1984) theory of experiential learning. This theory has proved to be extremely useful in the design of participatory/interactive processes (Bawden 1989; Bawden and Packham 1993).

4. Power, social change, conflict and negotiation One of the criticisms of participatory approaches based on ideas of collective learning is that they neglect issues of power and conflict and over-simplify dynamics of social change. When naively implemented, such approaches can indeed easily be captured and dominated by more powerful groups. Some theories emphasise conflict as the major driver of social change, while others emphasise cooperation or are concerned with the dynamics between conflict and cooperation. The key point is that, in facilitating social learning, ideas and assumptions about social change should be made explicit.

5. Holism and systems thinking Over the last 50 years, the field of systems thinking has emerged as a meta-discipline in response to the limitations of the reductionist and fragmented nature of traditional discipline-based approaches of science (Bawden 1996; Checkland 1981, 59–92). Systems thinking has a practical intent, as it aims to solve complex problems of both a physical and social nature through the conceptual and analytical insight provided by the metaphor of a 'system' (Capra 1997, 17–50). The critical point about taking a systemic, as opposed to a reductionist, analysis is that a 'system' has emergent properties, which means that the whole is more than the sum of its constituent parts. Hence, understanding a system requires looking at it holistically and recognising how the parts interact. Problems, such as those faced by transboundary water resources management, involve complex social and biophysical relationships. Systems thinking and methodologies can help stakeholders to understand, analyse and conceptualise this complexity.

6. Governance and democracy Over the last century, there has been a massive upward trend in the number of states that have, or at least claim to have,

democratic government (Giddens 1994, 104). Significantly, Giddens, Habermas and Beck 'all make the case, in one way or another, that more democracy and more radical democracy is an essential precondition of creating environmental sustainability' (Goldblatt 1996, 201). But how this translates to appropriate forms and structures of governance is intensely debated on practical and moral grounds (Held 1996, 1–3). In modern industrialised society, liberal democracy has become synonymous with democracy *per se*. However, people are becoming disillusioned with politics, Giddens (1994, 116) claims, because 'key areas of social life – some of them areas they are able reflexively to master, others of them areas which are sources of threat – no longer correspond to any accessible domains of political authority.' Authors such as Habermas, Giddens, Beck, Dryzek, Held and Pepper highlight common themes: a concern for ecological decay; the anti-democratic consequences of unbridled economic power; the consequences of an unbalanced use of instrumental reason; and the need for forms of democracy that open opportunities for constructive political dialogue between ordinary citizens. For social learning to be effective, communication processes are needed that view democracy as a platform for dialogue and debate.

4.4.2 Designing interactive learning processes

At the heart of facilitating social learning lies the capacity to design a process in which different stakeholder groups engage diverse forums and activities so that knowledge is generated; ideas, values and perspectives are shared and contested; conflicts are negotiated; principles for action defined; and collectively binding decisions are made. The skill and art of facilitating social learning is to create situations where people can learn collectively how to improve their situations. This does not necessarily mean trying to gather all interested stakeholders in one place at one time. Rather, a facilitated social learning process is likely to run over months, if not years, and will involve different combinations of stakeholders working together in diverse ways.

A process may be initiated with a gathering of representatives from all interested parties to clarify core issues. This may then lead to more extensive consultation, learning and negotiation amongst particular stakeholder groups. Research and investigation groups may be undertaken to gather necessary information. School education and media activities may play a role in generating broader understanding of the issues. Different combinations of stakeholders can be brought together to discuss specific subjects. A representative coordinating group may oversee and facilitate the entire process. Empowerment of some groups may be required for them to participate effectively and equitably. It is likely that the capacity of all stakeholders will need to be built in various ways to enable effective participation. Table 4.1 gives an example of a learning process for a river basin dialogue (Röling and Woodhill 2001).

Table 4.1 Indicative process for a national or basin level dialogue

1. Setting up and managing the dialogue process	• Clarify the reasons and motivation for a dialogue • Build stakeholder support and ensure government backing • Establish an appropriate steering group, focal point and dialogue forum • Outline the dialogue process • Secure resources to support the dialogue • Facilitate and co-ordinate the process • Review and adapt the process
2. Conducting an initial situation analysis	• Identify stakeholders and their perspectives and interests • Identify the key water resource issues, problems and trends • Conduct an institutional and policy assessment and identify existing processes and initiatives
3. Focusing the dialogue	• Agree on key issues for the dialogue • Establish the scope and boundaries of the dialogue in relation to other initiatives and available resources • Develop focusing questions to guide the dialogue • Establish a monitoring and evaluation framework for the dialogue
4. Gathering information and conducting investigations and research	• Establish sources of available information, information gaps and necessary knowledge gathering processes • Identify information needs for answering the focusing questions • Conduct necessary research, investigation and information gathering • Collate and synthesize information • Prepare knowledge for presentation and communication
5.Building scenarios	• Identify different plausible scenarios for the future of water, food and nature • Examine the implications of different scenarios for different stakeholders • Establish the most desirable scenarios from a sustainable development perspective
6. Negotiating principles and actions	• Establish the principles implied by the desirable scenarios • Establish the actions required to put these principles into practice
7. Communicating outcomes of the dialogue and facilitating change	• Establish and implement a communication strategy for the outcomes of the dialogue • Decide on how the dialogue can contribute to change • Establish a programme for change (funding, actions, monitoring)

The wide use of participatory planning processes has led to the development of diverse methodologies with varying purposes (see Table 4.2). A social learning process is likely to utilise some or many of these methodologies in various combinations. A skilled social learning facilitator will adapt such methodologies or create their own specific methodology to meet the unique circumstances of the particular situation. A key part of facilitating the learning process is to use methods and tools that enable people to visualise and understand issues, to communicate with each other, analyse options and reach decisions in structured way. Many different participatory tools have been developed to aid such interactive learning such as: rich pictures, brain storming; mapping; SWOT analysis; meta-plan; matrix analysis; conceptual modelling.

Table 4.2 Examples of different methodologies appropriate for facilitating dialogue and social learning

Adult learning circles	Citizens' juries
Learning systems methodology	Scenario analysis
Logical framework approach	Search conferences
Open space technology	Soft systems methodology
Participatory rural appraisal	System assessment
Gender analysis	Technology of participation

Methodological pluralism is essential for social learning. This means being able to develop and use diverse methodologies that may range from reductionist scientific research to creative artistic expression as a means of developing community understanding. Critical is the integration of scientific perspectives and political processes. Unfortunately, such integration is often difficult or simply does not occur due to an incompatibility in the paradigms and interests of biophysical scientists, social scientists, politicians, bureaucrats, social activists, resource users and community members. The art of designing a context-specific social learning process is to combine methods, tools, techniques and activities that will enable different actors to communicate and transcend such incompatibilities.

4.4.3 Creating supportive institutions

Traditionally, participatory approaches have focused primarily on the communication process between stakeholders and less on the institutional dimension. Here, the term 'institution' is not being used as shorthand for organisation, but in the broad sociological sense to mean any established law, custom, social practice or organisation that forms part of the social structure and influences the regular patterns of human behaviour.

The most obvious institutional need for social learning is the creation of some form of platform that enables different actors to come together and which gives legitimacy to a process of interactive learning. For transboundary water resources management, this typically involves establishing some form of organisation with an established mandate from involved governments. Who constitutes such an organisation, the powers it has, the resources it controls, the legitimacy it has in the eyes of stakeholders all greatly influence the capacity for social learning.

However, the institutional dimension does not end here. A social learning approach requires support from government policies and programmes. Government agencies need to change their culture to take on a more facilitative (as opposed to command and control) role, that is, learning to develop a more communicative style. Social learning also depends on a constructive and balanced engagement between government, business and civil society, which in turn requires attention to building social capital. Media institutions play a critical role in shaping societal perceptions – they can work for or against processes of social learning. Education systems are also critical, from the messages school children bring home to their parents through to the way graduates are trained. All these issues become embedded as cultural norms and attitudes. Therefore, transboundary water resources management needs to understand the importance of a supportive institutional setting – in all the ways described above – for effective communication and social learning.

It needs to be recognised, of course, that institutions are by definition what gives society stability over time and are consequently not easy to change. However, the rapid pace of technological, economic and industrial development and the emerging consequences and risks of this development have created a situation where society's capacity for institutional reform often lags behind what is needed to respond effectively to rapid changes.

4.4.4 Developing facilitation and leadership capacity

Effective social learning requires a high level of facilitation skills and enlightened leadership from within stakeholder groups. Although facilitation capacities are improving, there are too few professional facilitators to deal with the demand. It remains disappointing how few professionals entering the natural resource management sector have received training in facilitation.

Facilitation capacity needs to be seen not just as the skills to facilitate a stakeholder workshop but as the ability to understand the culture and politics of a situation and to design and manage a long-term social learning process. A facilitator needs a good grasp of the theoretical, methodological and

institutional aspects of social learning outlined earlier in this chapter. They also need to be knowledgeable about the subject area with which they are dealing.

This calls for a new type of facilitation professional. Such a person needs a multi-disciplinary training, alongside a high level of personal awareness about the role they are playing. Unfortunately, many facilitators are simply given a bag of participatory methods, but their lack of understanding leads to a mechanical application of methods in inappropriate and ineffective ways.

Facilitation capacity needs to be viewed not just in terms of individuals but also in terms of organisations. Increasingly, government agencies, for example, find themselves taking on more of a facilitation role, particularly as agencies move from providing technical pre-packaged answers to developing innovative solutions in dialogue with stakeholders. This often requires a significant internal cultural change, employment of different types of staff and the development of new training programmes. Critical is that incentive structures in organisations match the new way of working.

Social learning, however, cannot rely just on the skills of facilitators. The leadership qualities and behaviours of different stakeholder groups are also critical. While a facilitator may be working towards a participatory and inclusive process, there is no guarantee that community, government or business leaders share this outlook, understanding or capacity. Developing an understanding of what a communicative strategy for problem-solving entails may require careful negotiation and leadership capacity building.

4.5 CONCLUSIONS

Approaching transboundary water resources management from a social learning perspective challenges many established assumptions and practices in the water resources sector. The focus shifts from short-term and partial technical, economic or policy solutions to establishing learning systems that will engage key stakeholders in an ongoing process of adaptive management. This means viewing water resources management not as a technical problem to be ‘solved’ but rather as a social and political process that requires facilitating effective communication and innovation.

Scientific understanding, technical solutions, policy innovations and the development of appropriate incentive mechanisms will remain necessary in such social learning processes. However, starting from the question of ‘how will we involve key stakeholders in an ongoing process of learning how to manage a river system sustainably?’ is fundamentally different from starting by asking ‘what solutions can be found to current water resource problems?’

Stakeholder participation, dialogue and social learning are sometimes erroneously seen as only involving local communities or the general public. The

idea of social learning presented in this paper is a much broader concept. Certainly the engagement of local resource users and the wider public is important to a social learning process. But equally important is the way scientists, politicians, policy-makers and business leaders interact. This does not mean trying to involve all stakeholders in all forums and decisions – this would be socially naïve and inefficient as critics of participatory processes have pointed out. Adopting a social learning perspective means analysing and improving existing processes and institutions to ensure (representative) stakeholder interaction at multiple scales and across sectors.

Conceptual advances and practical experiences across diverse disciplines have provided a solid foundation for articulating a more coherent framework of social learning – what might be considered a meta-discipline. This chapter has outlined this framework, which includes theories, methodologies and institutional considerations that those facilitating improved transboundary water resources management might usefully consider.

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5

Legal aspects of information in transboundary river basin management

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5.1 INTRODUCTION

Information is one of the vital tools of human interaction, be it in written, visual, aural, electronic or other form. And law is an important means for regulating human interaction – apart from its also being a source of information. Without information, there would be no law, and public authorities could not act. Law gives power over information. Already principle 10 of the Rio Declaration (1992) stresses the need for access to information on the environment held by public authorities.

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We can recognise three ways in which law may influence information:

(1) the human rights issue: the way in which it protects freedom of thoughts and access to essential data;
(2) the property rights issue: the way in which it empowers the author/inventor to capitalise the know-how, built up by him or his company (authors' rights, industrial and commercial secrets);
(3) the security issue: the way in which it protects information vital to national security, strategic national interests and international relations.

Each of these benefits has its reverse side:

(1) the human rights issue: how does this relate to that other human right issue of privacy of personal data? And do public authorities have the duty to protect citizens against misinformation?
(2) the property rights issue: do public authorities have the right to profit from the data they own under the umbrella of authors' rights and industrial and commercial secrecy? And could the fact of information being withheld lead to an impediment for the authorities to make well-balanced decisions?
(3) the security issue: can public authorities withhold information which is vital for assessing sustainable development? And can dissemination of information also enhance security?

Not only do all three issues have a significant impact on the way we deal with information; in practice, they interfere substantially.

This chapter will firstly outline the legal framework set up or under construction within the United Nations Economic Commission for Europe (UNECE) and the European Union (EU) in the field of environmental information in general and of transboundary river basin management in particular, and which may be seen as implementing the UN and Council of Europe Human Rights codex. Subsequently, these instruments will be discussed in the light of the three issues outlined above and, finally, we shall briefly touch upon the question whether the transboundary dimension of international river basins gives rise to any particular observations in this context.

In order to prevent this contribution's scope from diverging too far, thereby risking complication of the discussion, the public participation issue will only lightly be touched upon. Public participation is nevertheless not only recognised as a tool for public authorities to ensure public commitment to its acts, but also an important means for the public to get information. The government will never monopolise all information sources, and can therefore considerably benefit from information possessed by other stakeholders. This is explicitly

stressed in the Aarhus Convention, which deals with public participation as well with access to information.

5.2 INTERNATIONAL LEGAL FRAMEWORK

Article 19 of the Universal Declaration of Human Rights entails everybody's right to freedom of opinion and of expression; this right includes the freedom to search for, receive and transmit information by all means available and without having to respect boundaries. The Council of Europe's Convention on the protection of Human Rights and Fundamental Freedoms acknowledges the same right in its Art. 10, but stresses that, as the exercise of these freedoms entails obligations and responsibilities, it can be made subject to specific formalities, conditions, limitations and sanctions provided for by law and necessary in the interest of essential matters such as national security, territorial integrity or public safety, the prevention of disorder and penal offences, the protection of health or good morals, the protection of others' good fame or rights, and the prevention of dissemination of confidential communications.

Recently, a set of important generic international law instruments has been created in the environmental field for dealing with information: the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, the EU Directive 90/313/EEC of 7 June 1990 on the Freedom of Access to Information on the Environment and the EU Council's common position on a new Directive on Public Access to Environmental Information. In addition, specific relevant provisions are to be found in international water law: the UNECE Water Convention, its Protocol on Water and Health and the EU Water Framework Directive.

5.3 THE AARHUS CONVENTION

The *Aarhus Convention* (UNECE 1998) was concluded on 25 June 1998 in Aarhus, Denmark, at the Fourth Ministerial Conference in the 'Environment for Europe' process, and signed on that same date on behalf of 35 countries as well as the European Community. Four other countries signed later that same year. It has now been ratified by 22 countries, the overwhelming majority of which are situated in Central and Eastern Europe and Central Asia; five of those countries had not even been among the signatories. The Aarhus Convention entered into force on 30 October 2001, and its first Meeting of the Parties was held in Lucca, Italy, 21–23 October 2002. If it is true that the Aarhus Convention has not yet been ratified by all European countries, the fact that 44 countries and the EU have committed themselves by signing and/or ratifying it gives it a particular

significance all over Europe, even if Russia has not yet signed or ratified it, and three EU Member States have as yet only ratified it.

The Convention's preamble stresses every person's right to 'live in an environment adequate to his or her health and well-being, and the duty, both individually and in association with others, to protect and improve the environment for the benefit of present and future generations'. In order 'to be able to assert this right and observe this duty, citizens must have access to information' and 'may need assistance in order to exercise their rights'. It recognises that in the environmental field 'improved access to information and public participation in decision-making enhance the quality and the implementation of decisions, contribute to public awareness of environmental issues, give the public the opportunity to express its concerns and enable public authorities to take due account of such concerns'. It aims thereby to 'further the accountability of and transparency in decision-making'. It recognises the 'desirability of transparency in all branches of government'. It notes, also in the context of public support for and commitment to environmental decision-making and of public environmental education, the importance of 'making use of the media and of electronic or other, future forms of communication'. It recognises the need for public authorities themselves 'to be in possession of accurate, comprehensive and up-to-date environmental information' and it acknowledges that they hold such information in the public interest. And it notes the importance of 'adequate information being provided to consumers to enable them to make informed environmental choices'.

In this perspective, the Convention's objectives include guaranteeing the right of access to information in environmental matters (Art. 1). Environmental information (Art. 2§3) means 'any information in written, visual, aural, electronic or any other material form' on:

(a) the state of elements of the environment and their interaction;
(b) factors affecting or likely to affect these elements, including administrative measures, environmental agreements, policies, legislation, plans and programmes; as well as cost-benefit analyses and 'other economic analyses and assumptions' used in environmental decision-making;
(c) the state of human health and safety, conditions of human life, cultural sites and built structures, inasmuch as they are or may be affected by the state of the elements under (a) or by factors under (b).

According to Art. 4, States have to ensure that *public authorities* (defined in Art. 2§2 as any level of government, including EU institutions; natural or legal persons performing public administrative functions under national law; or natural or legal persons with responsibilities or functions, or providing public services, in relation to the environment, under the control by the former

categories – judicial and legislative bodies being excepted) *make environmental information available to the public* (including associations, organisations and groups: Art. 2§4*) upon request*. The public is not required to state an interest. The documentation is to be given in the form requested unless it is already publicly available in another form, or unless it is reasonable to hand it over in a different form, and the reasons for this are given. The information must be given within a month unless the volume or complexity justifies a month's extension.

The request may, however, be refused if :

- the authority does not hold the information requested; in this case it must promptly either inform the applicant about the public authority which it believes is able to transmit the information, or transfer the request to that authority and inform the applicant accordingly;
- the request is manifestly unreasonable or formulated in too general a manner;
- the requested material is still in the course of completion or concerns internal communications (but in such cases, the public interest served by disclosure must be taken into account);
- disclosure would adversely affect:
    - confidentiality of public proceedings according to law
    - international relations, national defence or public security
    - the course of justice, fair trial or an authority's ability to conduct a criminal or disciplinary enquiry;
    - confidentiality of commercial and industrial information where this lawfully protects a legitimate economic interest; but information on emissions relevant for environmental protection must be disclosed in this context;
    - intellectual property rights;
    - confidentiality of personal data or files of a natural person who has not consented to their disclosure;
    - confidentiality of material supplied voluntarily by a third person;
    - the environment itself (such as breeding sites of rare species).

These grounds for refusal, however, have to be interpreted restrictively, taking into account the public interest served by disclosure and the requested information's relation to emissions. If an information file is confidential, but the information requested or part of it can be separated from it, the authority must do so in order to make the remainder available to the applicant.

In case of refusal, this must take place within a month, unless the information's complexity justifies a month's extension; it has to be made in writing if the request was made in written form, or if the applicant requests so. It must be duly motivated, and has to indicate modalities of the review procedure

applicable before a court of law or another independent and impartial body established by law. (According to Art. 9, such a procedure must be foreseen and binding; if a court of law is provided, an expeditious procedure for reconsideration or review must be foreseen which is free of charge or inexpensive.)

Charges for issuing information are allowed, but they must be based on a transparent schedule which has to be transmitted in advance to the applicant, and their amount must be reasonable.

According to Art. 5, parties must, in addition, *ensure that public authorities possess information relevant to their functions*, and that they get a mandatory and adequate flow of information on proposed and ongoing activities significantly affecting the environment. In case of imminent threats to human health of the environment, all public information must be disseminated to the public who may be affected, so that they can take preventive or mitigating measures. Information to be transmitted must be transparent and effectively accessible. The public must be informed on the type and scope of information available, on the terms and conditions of making it accessible and on the process to obtain it. Practical arrangements must be made, such as

- publicly accessible lists, registers or files with information which is free of charge;
- requiring officials to support the public in making information available;
- identifying contact points.

Easily accessible electronic databases must be made publicly available, including (insofar as electronically available) reports on the state of the environment, relevant legislation and, as appropriate, agreements, policies, plans and programmes, and other information which may facilitate the Convention's application. Reports on the state of the environment, its quality and the pressures it is exposed to, must be published and disseminated by the parties every 3–4 years. Legislation must provide for dissemination of the relevant legislation, policy documents, international agreements and other international documents. Operators whose activities have a significant impact on the environment have to be made subject to the obligation to regularly inform the public on this impact (e.g. by eco-labelling or eco-auditing). Parties must publish relevant and important (analyses of) facts for framing environmental policy proposals; make accessible available explanatory material on dealing with the public under the Convention's scope; and provide information on the way the government at all levels functions and performs in matters related to the environment. Further, sufficient product information must be made available to enable the public to make informed environmental choices.

More generally, Parties must establish and maintain a clear, transparent and consistent framework for implementing the Convention; ensure that officials and authorities assist and provide guidance to the public; promote environmental education and awareness among the public; and provide for appropriate means to recognise and support environmental NGO's. They must ensure that persons legally exercising their rights are not being penalised, persecuted and harassed for this, and that the Convention is applied without discrimination. Furthermore, they must promote the application of its principles in international decision-making processes and within the framework of international organisations. Finally, they may take stricter measures than provided for by the Convention (Art. 3).

Recently, a protocol has been drafted under the Aarhus Convention on the issue of Pollutant Release and Transfer Registers; this draft Protocol, which requires each Party to establish a publicly accessible and user-friendly register containing information on the 86 substances considered to pose the most significant threat to environment or health, will be submitted for adoption at the Ministerial Conference 'Environment for Europe' scheduled to take place in May 2003 in Kiev.

5.4 GENERIC EU LEGISLATION

Already in 1990, the Council of the European Communities had agreed upon *Directive 90/313/EEC on the freedom of access to information on the environment* (European Communities 1990). In the preamble, the Directive is justified by stressing that 'access to information on the environment held by public authorities will improve environmental protection'; that disparities between Member States' laws concerning access to information on the environment held by public authorities 'can create inequality within the Community as regards access to information and/or as regards conditions of competition'; and that 'it is necessary to guarantee to any natural or legal person throughout the Community free access to available information on the environment in written, visual, aural or data-base form held by public authorities, concerning the state of the environment, activities or measures adversely affecting, or likely so to affect the environment, and those designed to protect it'. In addition to environmental needs and basic rights of citizens, the Directive therefore also pursues economic goals.

The objective of the Directive is to 'ensure freedom of access to, and dissemination of, information on the environment held by public authorities and to set out the basic terms and conditions on which such information should be made available' (Art. 1); in this context, the term 'information on the environment' is defined in the same way – albeit slightly more precisely – as in the Aarhus Convention; the definition of

'public authorities' is identical to that of the Convention, except that no specific mention is made of EU institutions (Art. 2 and 6).

The right to access of information and the grounds for refusal, stressed in Art. 3, are similar to, but less elaborated than those of the Convention; but the Directive allows a 2-month term for transmitting or refusing the information.

Refusals, inadequate answers and ignoring of the request must be open to judicial or administrative review (Art. 4). Charges for supplying the information may not exceed a reasonable cost (Art. 5). Like the Aarhus Convention, the Directive foresees that general information is provided to the public on the state of environment 'by such means as the periodic publication of descriptive reports'.

In spite of its having been adopted 8 years before the Aarhus Convention, the Directive's text is strikingly similar to it; it has apparently substantially influenced the Aarhus negotiating process. Even so, the Convention's broader scope necessitated an update of the Directive for the EU to be able to ratify the Convention. Therefore, on 28 January 2003, the European Parliament and the EU Council adopted a new *Directive 2003/4/EC on public access to environmental information* (European Union 2003), which entered into force on 14 February 2003, and will have to be implemented in Member States' legislation on 14 February 2005.

This Directive generally follows the Aarhus Convention's provisions, and thereby extends the scope foreseen by Directive 90/313, which it intends to replace. It splits the *objective* as formulated in the former Directive into two parts: the right of access to environmental information, and the promotion, 'as a matter of course', of the widest possible systematic availability and dissemination to the public of such information (Art. 1). Art. 2§1 defines 'environmental information' along the same lines as the Aarhus Convention, but explicitly includes wetlands, coastal and marine areas under the environment to be protected, and waste, emissions discharges and other releases under the factors which may effect the environment; furthermore, it separates 'measures' as well as 'economic analyses and assumptions' from 'factors' in order to make it clear that such measures may influence the factors themselves as much as the environment; and it also mentions 'activities' under these measures, analyses and assumptions. Reports on the implementation of environmental legislation are covered as well. Likewise, Art. 2§2 extends the definition of 'public authority': next to 'government' it mentions 'other public administration' (the Parliament proposes to add 'advisory bodies' as well; moreover, it would like to make the exception to judicial and legislative bodies an optional, and restrict this exception to the extent that these bodies act in these capacities). It is striking that – in contrast to the Aarhus Convention – the EU institutions are still not covered by this definition (an amendment made by the European Parliament in

the first reading was rejected by the Commission); the reason for this is that the Directive addresses itself to Member States and not to EU institutions.

Art. 3 sets out the general rules concerning requests for information. The *time-limits* for replying to the request as foreseen by the Aarhus Convention are taken over, with the addition that the applicant must be informed in a timely manner of an extension of the time-limit. If the request is formulated in too general a manner, the public authorities must invite the applicant to specify the request and lend him assistance. The reasons for refusal must be provided within one month.

Public authorities also must make all reasonable efforts to maintain the information held by or for them 'in forms or formats … readily reproducible and accessible by computer telecommunications or by other electronic means'. The following examples of *practical arrangements* under which the information is to be made available are specified: information officers; facilities for examining the information; publicly accessible lists of authorities and registers or lists of information held by them or by information points. These registers or lists must be provided 'with transparent and clear indications of where the information can be found'. Officials are required to support the public in seeking access. Public authorities must inform the public adequately of their rights and to an appropriate extent provide information, guidance and advice to this end.

As to the *exceptions* (Art. 4), in addition to the list taken over from the Convention, the following precisions are made:

- it is made explicit that under 'material in the course of completion' also 'unfinished documents and data' are being addressed. In such cases, the statement of refusal must state the name of the person or authority preparing the material and the estimated time needed for completion;
- the confidentiality of the proceedings of public authorities is restricted to cases where such confidentiality is required by law;
- under the confidentiality of commercial information, legitimate economic interests also include 'the public interest to maintain statistical confidentiality and tax secrecy';
- the restrictive interpretation of the exceptions is to be applied on a case-by-case basis by weighing the public interest against the interest served by refusal;
- requests relating to information on emissions, discharges or other releases into the environment may not be refused on the basis of confidentiality of public proceedings and of personal data or files, commercial and industrial confidentiality, third-party material or environmental protection;
- Member States must draw up a publicly accessible list of criteria for deciding upon requests.

As far as *charges* are concerned (Art. 5), no charge shall be made for consulting the requested information *in situ*. Moreover, access to public registers or lists must be free of charge.

Art. 6 prescribes an expeditious and inexpensive administrative *reconsideration or review* procedure against refusals, ignoring requests, inadequate answers and procedural failures, as well as an *appeal* procedure before a court of law or other independent and impartial body established by law. The final decision of the latter body must be binding on the public authority. Member States may provide for access to legal recourse of third parties incriminated by the disclosure of information.

Art. 7 provides for public authorities organising and updating the relevant information relating to the environment held by or for them, with a view to its active and systematic *dissemination*, in particular by means of computer telecommunication and/or electronic technology, including links to Internet sites. The information must progressively become available in electronic databases which are easily accessible to the public through public telecommunication networks. The information to be disseminated includes texts of international agreements and national legislation at all government levels; policies, plans and programmes; progress reports on the implementation of these, prepared by authorities; reports on the state of the environment; and (summaries of) data derived from monitoring of activities that (are likely to) affect the environment. National, and where practicable also regional and local, reports on the state of the environment must be made available regularly, and at least every 4 years. The exceptions formulated in Art. 4 may apply in relation to these duties.

Art. 8, which was introduced at the request of the European Parliament, deals with the quality of environmental information. It requires any information made available upon request or disseminated, to be up-to-date, accurate and comparable, so far as is within the Member States' power. Upon request and where available, reference shall be made to the measurement procedures used in compiling the information, including methods of analysis, sampling, and pre-treatment of samples.

5.5 SPECIFIC PROVISIONS ON INFORMATION IN RIVER BASIN MANAGEMENT

The *UNECE Water Convention* (UNECE 1992) states in Art. 6 that Parties must provide for 'the widest exchange of information, as early as possible, on issues covered by the Convention's provisions'. This is further worked out in Art. 13,

which obliges parties to a river basin agreement to exchange reasonably available data on, *inter alia*:

- environmental conditions;
- R&D results and experience, including Best Available Technology;
- emission and monitoring data;
- measures to prevent, control and reduce transboundary impact;
- permits or regulations for waste-water.
- information in order to harmonise emission limits.

If information that is not available is requested by a riparian party, the party requested to do so must make efforts to comply, but may charge the requesting party with reasonable costs for collecting and processing the data.

Art. 8 provides for an exception to protect 'information related to industrial and commercial secrecy, including intellectual property, or national security'.

Art. 14 requires riparian parties to inform each other without delay about critical situations, in particular through co-ordinated or joint communication, warning and alarm systems operating on the basis of compatible data transmission, treatment procedures and facilities. Parties must exchange to this end the names of competent authorities or points of contact.

Finally, Art. 16 deals with public information. It requires that information on the conditions of transboundary waters, measures (planned to be) taken to prevent, control and reduce transboundary impact, and the effectiveness of those measures, is made available to the public. This includes water quality objectives, permits issued and conditions required to be met, results of water effluent sampling for monitoring and assessment purposes, and results of checking compliance with quality objectives and permit conditions. This information must be available to the public at all reasonable times for inspection free of charge, and reasonable facilities must be provided for obtaining copies on payment of reasonable charges.

The *Protocol on Water and Health* (UNECE/WHO 1999) in its Art. 7 obliges Parties to collect and evaluate data on progress towards achieving their targets, and on the indicators for evaluating progress; to publish periodically the results; and that the results of water and effluent sampling carried out for the purpose of this collection of data are available to the public. Periodically, progress reviews and target assessments must be published, and summary reports thereof must be circulated to all Parties. The summary reports will serve as a basis for evaluating progress in implementing the Protocol.

Art. 8 requires Parties to ensure:

- operational surveillance and early-warning systems which:
    - identify (significant threats of) water-related disease outbreaks or incidents;

    - promptly and clearly notify public authorities;
    - in case of imminent threat to public health, disseminate to the public affected all relevant public information for preventing or mitigating harm;
    - make recommendations to the public authorities and, where appropriate, to the public about preventive and remedial actions;
- comprehensive national and local contingency plans for responses to outbreaks, incidents and risks;
- the capacity for authorities to respond in accordance with the contingency plan.

Art. 9 requires Parties to encourage the development of integrated information systems to handle information about long-term trends, current concerns and past problems and successful solutions to them in the field of water and health, and provision of such information to competent authorities.

Art. 10 asks Parties to make available to the public the necessary public information on:

- establishment of targets and dates for achieving them and for developing water-management plans;
- establishment, improvement or maintenance of surveillance and early-warning systems and contingency plans;
- promotion of public awareness, education, training, research, development and information.

This information, as well as the progress assessment reports, must be available to the public at reasonable times for inspection free of charge, and members of the public must get reasonable facilities for obtaining copies, on payment of reasonable charges.

Public authorities must, in response to a request for other relevant information, make this available within a reasonable time to the public. The exceptions to this rule are drawn from the Aarhus Convention.

The *EU Water Framework Directive* (European Union 2000) requires member states to publish their river basin management plans (Art. 13§6). In the plan's preparatory period must be published:

- 3 years before the planning period starts, the timetable and work programme together with a statement of the consultations to be taken;
- 2 years before the same date, an interim overview of the significant water management issues identified;
- 1 year before that date, draft copies of the plan.

On request, the background documents and information used for developing the draft plan must be made accessible (Art. 14)

According to Art. 15, the plans must be sent to the Commission and other concerned states; Member States must also report on the economic analyses made and the monitoring programmes designed on behalf of the plan. Three years after publishing the plan, they must submit an interim report on implementation progress of the programme of measures.

5.6 DISCUSSION

Apparently, quite a number of legal instruments on the issue of information and environmental law are available. Pages and pages can be filled on how to interpret and implement the provisions contained in these legal texts, especially where the texts slightly differ among each other. For instance, a manual for implementing the Aarhus Convention can be found on the UNECE website; additionally, draft guidelines on public participation in water management including the issue of access to environmental information have been drawn up for consideration by the UNECE Water Convention's second Meeting of the Parties in The Hague, March 2000, by an expert group under the aegis of UNECE and UNEP/Regional Office for Europe. However, the context of this chapter will be restricted to the three issues described in the introduction, including their reverse sides: the human rights issue, the property rights issue and the security issue; and on the transboundary aspects of these issues.

5.6.1 The human rights issue

It is apparent from reading the Aarhus Convention that the way it deals with the right of access to environmental information is closely linked to the formulation of human rights, such as freedom of expression. Even the exceptions formulated can be easily ranked under those already admitted for freedom of expression. We therefore might detect a human right in the course of development.

Neither freedom of expression nor free access to environmental information are absolute rights. The number of exceptions admitted is rather extensive. The grounds for exception are certainly serious, being linked to matters like the functioning of public institutions, the primacy of politics, and even other human rights like the protection of others' privacy and of human integrity. But if exceptions are formulated in a generic way, they have to be applied on a case-by-case basis. This may, in particular cases, lead to the interest of the applicant for confidential information being considered so much greater than that of the state in keeping its information secret, that its release is ordered by court.

At least as important is the requirement that grounds for refusal of information can only be admitted insofar as they serve the goal they are intended to serve, and must be interpreted in a restricted way. This implies that authorities will have to act consistently and in a non-discriminatory way when releasing documents, and to refrain from arbitrariness; and that they will have to apply the proportionality principle, which means that they should apply the exceptions in such a way that an optimal balance is achieved between the authority's interests and those of the applicant. In addition, they will have to act transparently, and to refrain from keeping the applicant in the dark: they must reply within the time-limits set, and help the applicant further if he went to the wrong desk. Anyhow, decisions on these matters are subject to review and appeal procedures, not just after partial or total refusal, but also in case a request has been ignored. If the information asked for is linked to confidential files, it will have to be separated from them where possible. Also, in some cases, grounds for refusal are subject to exceptions themselves, as in the case of emission data, which will be discussed below. Finally, the public authorities' use of grounds for refusal is, in principle, optional.

Especially important in this respect is the tendency in legal texts to increase the number of matters on which data must be actively disseminated by authorities, especially through electronic media. In particular, this applies to legal texts, reports, policy plans, public registers and imminent threats, as well as procedures and contact points at the administration for getting information.

As for the question as to whether public authorities have the duty to protect citizens against misinformation, this should be treated with the utmost reticence. Different opinions may occur about what is misinformation. For example, the precautionary principle already deals with uncertainties and matters not yet scientifically clarified. Putting a brake on the dissemination of such matters may lead to prohibiting the publication of official documents on climate change. This is not just a theoretical case: a newly enacted US law requires the government to set standards for the quality of scientific information and statistics used and disseminated by federal agencies. If the standards are not followed by an authority and complaints are made, the authority would have to expunge the data from government websites and publications (Revkin 2002).

5.6.2 The property rights issue

As indicated above, property rights (including intellectual property and commercial and industrial information) can be called upon by way of exception to the obligation to release information. However, this right is not absolute; for instance, the exception will not be granted where the data concerned should be

known to the public for reasons of public health and safety. Emission data have to be made accessible, at least in such cases where the importance of their accessibility in relation to impacts on the environment is considered much greater than the polluter's right to protect the confidentiality of his industrial information. This is an important step away from the claim often made by representatives of industry that matters released by them into the environment (and thereby out of their own control, within the public sphere!) should still remain secret.

This issue has even been raised where public data are concerned, absurd as this may appear. Indeed, public data are there for the sake of the public and may be considered to be public property. Therefore, the fact that an agency holds such information does not give this agency the right to keep it as though it were its own private property. The agency will therefore have to abide by the rules of the citizen's right of access to environmental information, and release the data concerned; except, of course, in cases where other grounds for refusal are valid, such as where public security is at stake, or if the data concerned are owned by private parties and have been confidentially put at the authority's disposal, e.g. in the course of a licensing procedure.

It is true that transmitting information can be a costly business; therefore the public authorities are allowed to charge costs to applicants for transmitting information. But these charges are in no way linked to the information's ownership; instead, they can depend only on the stewardship exercised by the authorities over public information. This is reflected in the conditions to which such charges are subject. They must be reasonable as to their amount and based on a transparent schedule. Again, the principles of consistency, non-arbitrariness, non-discrimination and proportionality can be considered to apply. The EU decided to declare free of charge consulting documents *in situ* and access to public registers or lists; the European Parliament even unsuccessfully requested the charges not to exceed reproduction costs.

Even then, it should be kept in mind that there can be a danger lurking if the authorities get hold of material they cannot use externally because of its confidentiality. It may be difficult to account for their decisions in such cases. Anyhow, they will at least have to be open to those who are deciding on review or appeal cases. And if private parties refuse to transmit data essential for licensing purposes to public authorities because of their confidentiality, they risk not getting their licence.

5.6.3 The security issue

The security issue can be discussed briefly. Information is often considered as dangerous. Public security (weapon sites!) and public health may be admitted as

exceptions to releasing environmental information but, in general, the public will have more to gain by exposure of data than by being kept in the dark (although, in case of calamities, it may be important to prevent panic among the public, and it may be important to keep silence on breeding sites of rare species). In case of emergency, public security or public health may, in fact, be a reason for authorities to release or even actively disseminate material which is, for example, subject to confidentiality of some kind, or which may adversely affect international relations. In the first case, this may lead to claims for indemnification, which the authority will then have to cope with; in the second case, the risks of damaged relations will have to be put in the balance against those of protecting citizens.

In other words, even security is a relative issue. Information may, in fact, also promote security: it may enhance public awareness; it may convince citizens to take precautions against, and to be responsive to, risks; it can be an important weapon against prejudices; and it can increase understanding among different disciplines, such as water management and public health.

5.6.4 The transboundary dimension

Up till now, this chapter has focused on the role of information in the relationship between public authorities and the citizen. But information also plays a substantial role in relationships among states. Especially where we are dealing with the management of transboundary river basins, some attention will have to be paid to such relationships. Several international agreements on the management of joint river basins contain provisions to this effect, which happen to get pretty close to those addressing public-private information issues.

As it appears above from the UNECE Water Convention's provisions, the *human rights issue*, translated into the right of access to environmental information conferred by the legislator upon citizens finds a corollary in the right of river basin states to be informed about status, impacts and response measures by other states in the same basin. This obligation is further worked out in provisions on warning and alarm systems, joint monitoring schemes and river basin planning.

With regard to the *property rights issue*, there does not appear to be much difference between the public-private relationship and that between States. Documents freely available to citizens are, as a matter of fact, equally accessible to foreign powers; what has been said about reasonable charges is equally valid here. Embassies usually keep themselves very well informed on matters of importance to their capitals. In fact, among the reasons why documents may be kept secret from private citizens, matters like defence and international relations

make it clear that lack of openness may be due to international relations rather than the mere relationship between State and citizen. Indeed, matters may be disclosed to a foreign power which are not, or not yet, accessible to citizens; this may occur, *inter alia*, in the context of negotiations on conflict prevention.

And here, we finally also touch upon the *security dimension.* It is nowadays commonly acknowledged – and this is supported by numerous international agreements - that strategic water management can best be handled at river basin scale; this will often mean at international river basin scale. Information is a powerful weapon for international river basin management, and thereby helps to increase security for all people living within the catchment – as well as by enhancing common understanding among riparian people. That is why the UNECE Water Convention, the Water and Health Protocol and the EU Water Framework Directive foresee joint information tools such as:

- warning and alarm systems;
- joint monitoring networks;
- transboundary notification of plans or activities with a possible transboundary impact;
- joint targets, emission standards and BAT;
- joint river basin plans.

Such information will be shared by all authorities and citizens within the catchment, with the consequence that boundaries in the field of river basin information will gradually disappear. In this way, the three issues of information discussed above will play a role not only in the national public-private and the State-State relationships, but also in the relationship between river basin states' authorities and each other's citizens!

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6

Environmental information, the legal context and a Scottish case study

Sarah Hendry

6.1 INTRODUCTION

Law is a significant driver and regulator of behaviour, whether of institutions, organisations or individuals. This chapter will examine legal issues arising with regard to environmental information. Legislation may require governments or public bodies to provide information, and may set out the form in which it is to be provided. Particularly important in this regard for EU Member States (MS) and accession countries is the EU Directive on Access to Environmental Information and proposals for its amendment, and also the Water Framework Directive (WFD), which makes very particular provision for information collection and exchange. Different legal issues arise dependent on whether legislation addresses exchanges between public bodies and experts, or the provision of information to the general public.

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The chapter will also look at Scotland as a case study. Scotland is not a state but a small nation within the UK. A new devolved Parliament has responsibility for, amongst other things, water, the environment and the implementation of relevant EU law. This is enabling review of the law in areas where the Westminster (UK) Parliament did not have time to legislate – principally, in areas where the law in Scotland is not the same as that in England and Wales. One such area is water law, and the young Scottish Parliament has undertaken a major review, both of the water services industry and also of water pollution control, as part of our transposition of the WFD. The transposing legislation must make provision to ensure compliance with the UK's obligations in Scotland for information provision and exchange, and this chapter will consider how effectively this is achieved.

The conclusions will consider the optimum approaches that legislators can adopt in providing for information exchange, and the necessity for multidisciplinary research activity in this area. Whilst the chapter and its conclusions deal with legal aspects at a sub-state level, we feel that many of the issues raised are also valid at transboundary level, not least because Scotland is well ahead of other MS in already having enacted implementing legislation for the Water Framework Directive.

6.2 LEGISLATIVE PROVISION FOR ACCESS TO ENVIRONMENTAL INFORMATION

Directive 1990/313 on Access to Environmental Information (Commission, 1990) makes provision throughout the EU for access to environmental information. This Directive requires that 'Member States shall ensure that public authorities are required to make available information relating to the environment to any natural or legal person at his request and without his having to prove an interest' (Art. 3); this information is to be provided 'as soon as possible, and at the latest within two months'. The Directive also specifies a list of exemptions, including confidentiality of proceedings of public bodies, commercially confidential information, information which is *sub judice*, confidential personal data and material supplied by a third party who was under no obligation to do so. Member States may make a 'reasonable charge'.

This has been implemented in the UK by the Environmental Information Regulations 1992 (HMSO 1992). The Regulations require disclosure of information by 'relevant persons' who are further defined as including (a) Government Ministers and departments, local authorities and 'other persons carrying out functions of public administration', and (b) 'any body with public

responsibilities for the environment which … is under control of a person falling within [para. (a)].'

This definition immediately identifies two basic problems. Firstly, where states are implementing EU (or international) law, the terminology used in both sets of rules must be the same. Secondly, the terms themselves must be clearly defined. For who in law is a public authority, or indeed a body with public responsibilities? Particularly, is a privatised water company, carrying out statutory functions in the provision of a public service, a body within this definition who must therefore provide such information? In case law pertaining to EU directives on employment law, water companies have been held to be 'emanations of the state' (Griffin 1995) and a parallel argument could be used for a duty to disclose environmental information. Water companies in England and Wales are under the control of a public administrative body, the Office of Water Services (the economic regulator).

Both the Directive, and the UK Regulations, create problems for those with responsibilities under them, and both have been under review, partly due to a recognition of these problems and partly because the EU and the UK have now ratified the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (UNECE 1998) (Aarhus). Aarhus makes provision for the collection and disclosure of environmental information which is in excess of that provided for under Directive 1990/313, and has a wider definition of environmental information and a more detailed definition of 'public authority' (which will also now include the institutions of the EU). The Aarhus Convention is discussed in more detail by Villeneuve (Chapter 5 in this volume).

Sixteen countries were required to ratify Aarhus to bring it into force, and this goal was achieved in October 2001. Implementing legislation in the EU is taking the form of a revised Directive, which will require transposition in Member States. The Commission produced a proposal (Commission 2000a), and now a new Directive has been adopted (Commission 2003). Here the definition of authority will specifically include privatised utilities whose work impacts on the environment. In Scotland, an early consultation on the Commission proposal (Scottish Executive 2000) is now being followed by a further consultation on Aarhus (Scottish Executive 2002a) in order to bring forward implementing legislation. These regulations will be made under the Freedom of Information (Scotland) Act (HMSO 2002a) (FOISA). FOISA makes general provision for an enforceable right of access to information across the public sector. Environmental information is exempt from this regime but instead will be covered by the new regulations, and there is an enabling power for these, specifically to implement Aarhus. The Executive envisages close parallels between the two regimes and is suggesting that the Scottish Information Commissioner should supervise the new regulations as well as the FOISA provisions.

6.3 PUBLIC REGISTERS AND INVENTORIES – LEGISLATIVE PROVISION, PURPOSE, ACCESS AND USEABILITY

In Scotland as in many other jurisdictions, national (as well as EU) legislation requires the maintenance of statutory registers containing prescribed information with regard to the major environmental licensing regimes – waste management licensing, consents for discharges to controlled waters, integrated pollution control (IPC) along with its replacement, integrated pollution prevention and control (IPPC), and trade effluent consents – as well as some regulated activities which are not licensing regimes, e.g. contaminated land. It should be noted that the Environmental Information Regulations described above do not apply where there is separate statutory provision such as these registers; in the same way as the FOISA regime does not apply where the Regulations do. Where there is such a multiplicity of rules, there is potential for confusion, which is never desirable in the law.

Although the content of each set of statutory registers differs in the detail, there is broad similarity as to what must be provided. Thus, for water discharges the registers contain information as to the applicant and the application, the consent and conditions attached to it, any appeals, details of samples taken by the environmental regulator (in Scotland, the Scottish Environment Protection Agency, SEPA) as well as samples taken by any other party (e.g. results of self-monitoring by the operator), any enforcement notices or other statutory notices served by SEPA, any variations to or revocation of the consent and any convictions.

In addition to these national registers, some of which are required by EU law, a new EU-wide European Pollutant Emission Register (EPER) is being established under the IPPC regime, for installations releasing specified quantities of certain substances (Commission 2000b). Unlike statutory registers in Scotland and indeed England and Wales, the EPER will be available electronically, which will be of benefit to many prospective users. However, in other respects it is possible that the EPER will share some of the problems and shortfalls of our national provision.

Whilst the benefits of providing registers are clear, in terms of information provision there remain problems with such registers and the way they are used. These problems are twofold. Firstly, there are issues of physical access, and secondly, useability. In terms of access, individuals need to be able to locate documentation, which may be held in the offices of relevant authorities. In rural areas with dispersed populations, this may involve considerable travelling distances. Once located, the information itself may be read on site, and facilities

must be provided for this, but it is also likely that users will wish to make copies. Legislation should make provision for access during office hours, and for reasonable charges for copying. In the UK statutory registers are not yet available electronically, although this may happen in the future. When it does, such dissemination provides an excellent tool for those with internet access, but may be disenfranchising for those without. The second issue is useability and this is harder to manage. Much information provided in these registers is of a technical nature, and may be difficult for the layperson to interpret and use. Even if it is comprehensible it will normally need to be compared, e.g. to other similar operators or processes, or with mandatory quality standards or guideline standards for high quality waters of that type, to be truly informative. Technical information is likely to be much more useful to NGOs, who will have some specialist knowledge and expertise, than to the general public, and a question remains as to whom legislators envisage actually using the registers. In 1998 in England and Wales, only some 1000 visits were made to the combined statutory registers held by the Environment Agency (EA), although another 10,000 enquiries were received pertaining to the registers which the EA then answered (Hughes et al. 2002). An early study in the UK (Burton 1989) suggested that in the first 4 years of the water pollution register, very little use was made by the general public, although rather more by environmental NGOs. This lack of uptake was mainly due to lack of awareness, physical access, cost and useability of the data. A more recent study of these registers generally suggested that the same problems remain and they are most widely used by consultants and researchers (Rowan-Robinson et al. 1996). This should not be interpreted as a suggestion that registers are ineffective or unnecessary but rather that continued efforts are required, especially where information is intended to benefit the general public.

6.4 ENVIRONMENTAL INFORMATION UNDER THE WATER FRAMEWORK DIRECTIVE

The Water Framework Directive (Commission 2000c) (WFD) is a major piece of environmental legislation that will radically reform the management of water resources in the EU and, potentially, neighbouring states with transboundary waters. The WFD is a Fifth Framework Directive (Commission 1993), incorporating concepts of sustainable management of water resources. It addresses water resources, water supply and pollution control, taking a combined approach to the latter (i.e. using both emission limit values and water quality standards) and will require the production of River Basin Management Plans (RBMPs) for all river basins within the EU. The RBMPs will be the

principal management tool and also the principal source of information on water quality within each MS. The WFD will require each MS to draw up a programme of measures, containing basic measures, which are required by Community law, and supplementary measures, which may be required by national law, or be non-law tools such as economic incentives or educational programmes. These programmes of measures will be the means by which MS will seek to improve their waterbodies up to 'good' quality as defined in Annex V.

This section will address two aspects of the information required by the Directive: firstly, the requirements as to information gathering and exchange between authorities, government bodies and the Commission and, secondly, information to be provided to the public both within the RBMPs themselves but also as part of the consultations on preparing the Plans. Other issues are addressed in a later chapter in this book.

The WFD and especially the Annexes legislate for significant flows of information. Once a MS has identified river basins and allocated these to districts, it (or its competent authority) must undertake an analysis of the RBD, a review of human activity on the status of waters and an economic analysis of water use, according to the technical specifications in Annexes II and III (Art. 5). Extensive monitoring programmes must then be put in place to establish the status of waters (high, good, moderate, poor or bad) and this monitoring will be in accordance with Annex V (Art. 8). Under Art. 15, not only must MS send to the Commission copies of the RBMPs within three months of publication, they must also send summary reports of the analyses and monitoring programmes, within 3 months of their completion. (The Art. 5 analyses must be undertaken by December 2004 and the monitoring programme established by December 2006, with the first Plans published by December 2009.) Three years after each Plan or update is published, MS must make an interim report on their progress.

The Commission itself must make a report to the Parliament and the Council, 12 years after entry into force of the Directive and thereafter every 6 years, reviewing progress with regard to implementation and water quality in the Community, with 3-yearly interim reports (Art. 18). In addition, the Commission will be assisted by a Regulatory Committee (Art. 21) and shall present to it on an annual basis plans for further related water legislation (Art. 19).

Annex I requires information on the competent authority, and also the mapping of the river basins, to be provided to the Commission, as well as coordinating information on institutional arrangements (which may be within a MS, or across state boundaries). Whilst Annex III on economic analysis is brief and contains little detail to guide competent authorities, Annexes II and V, the technical annexes, are complex and detailed. The primary focus of the WFD for

surface waters is on ecological quality, i.e. the capacity of a waterbody to support life. Annex II requires the categorisation of waterbodies into ecotypes, and two systems are provided whereby this may be done. System A specifies typology based firstly on ecoregions, and then on altitude, size and geology. System B, which must provide the same degree of differentiation as A, provides a series of physical and chemical factors, some obligatory and some optional. Annex V then enables values to be set for high-quality water bodies of each type. Still under Annex II, MS must gather information on the anthropogenic pressures, point and diffuse pollution, water abstractions, flow regulation and relevant land use, and assess their impact on the waterbodies. It should then be possible to identify bodies at risk of failing water quality objectives. Annex V sets out, for each type of surface waterbody (e.g. rivers, lakes) those biological, hydromorphological, chemical and physico-chemical elements that will determine the classification of that waterbody (as high, good etc). Annex V provides for both surveillance monitoring and operational monitoring. The former is designed to provide sufficient information to assess the overall surface water status within a catchment, and also, thereby, determine future monitoring requirements. The latter will be used for waterbodies that are at risk of failing to meet their environmental objectives (i.e. generally, good water status under Art. 4) and to assess changes resulting from the programme of measures. Investigative monitoring may also be required, eg where reasons for failure to meet quality standards are unknown. There is provision with regard to monitoring sites and frequency. Once this exercise has been completed, colour-coded maps will be drawn up which will form part of the RBMP.

The purpose of the above material is not to explain the technical annexes. Rather, it is included to demonstrate the complexity and detail of the information-gathering exercise under the WFD. Most of the detail in Annex V is of such a nature that most legislatures would make it subject to secondary legislation, and at one stage the Commission had intended to produce it separately – but given its importance to the whole regime, the Parliament and Council insisted that Annex V be produced in full before the Directive was agreed (Commission 1998). There will be a wealth of detailed information, and much of it will be highly specialised, of use principally to water professionals. Summaries of all of this will be required for the RBMPs, but the detail itself will not always be in the Plan. It may (and indeed should) be made available to the general public, but the question remains as to how useful it will be to anyone without an appropriate technical background.

Again, this is not to suggest that this work should not be undertaken (or indeed published in full). Without these detailed surveys, it would not be possible to indicate by a simple map the quality of surface waterbodies within a region, a state or the Community as a whole, any more than it would be possible

to determine the steps necessary to improve the quality of each of those stretches of water. Each of these are valuable activities. The first portrays information concisely in a way easily understood by any interested party without requiring any specialist knowledge on their part. The second is the core purpose of the Directive as a whole. In terms of information exchange, what can we learn from this process even as we begin to carry it out? Firstly perhaps, that it is vital to take the technical detail and turn it into user-friendly information for the public whilst still making the detail available for those who wish to know. Secondly, that the professionals concerned must learn enough of each other's language to facilitate working together in areas such as the environment, which require multidisciplinary activity.

One final point can be made on Annex V. Section 1.4.1 makes detailed provision for an intercalibration exercise, to ensure comparability of biological monitoring results across MS. This is an area in which the EC has some experience, having established, for example, a common procedure for the exchange of information on the quality of surface fresh water (Council 1977) and also a very complex system for the sampling and monitoring of surface water for drinking (Commission 1979). However, even within the EU, which as a supranational body can enforce its rules judicially against the MSs, returns of information to the Commission have not always been complete or timeous. For states outside the EU or a similar regional organisation, or where the transboundary waters cross the boundary of the EU, such provision may be more difficult to agree and enforce.

6.4.1 The Water Framework Directive and provision of information for the public

As mentioned above, the WFD requires summaries of technical data to be included in the RBMPs. The purpose of this is to facilitate public participation, again in line with the Directive's focus on sustainable resource management and again in line with the requirements of the Aarhus Convention. Art. 14 of the WFD requires MSs to 'encourage the active involvement of all interested parties' and also to ensure the publication for comment, of the timetable and work programme, overview of significant water management issues, and draft river basin plans (respectively, 3, 2 and 1 years before the publication of the relevant plan) with a minimum of 6 months for responses at each stage. Citizen participation is a key principle of environmental law, inextricably bound up with sustainable development. However, it may be the hardest principle of all to put into effect, depending as it does on an educated and informed general public, willing to engage in debate and contemplate difficult choices. Art. 14 raises two

immediate questions. Firstly, who are 'interested parties' and how do they differ from the general public as a whole. Secondly, what is 'active involvement' and how does it differ from a paper consultation exercise. The remainder of this chapter will address these questions by examining the approach taken to implementing the Directive in Scotland, a nation within a MS.

6.5 THE SCOTTISH EXPERIENCE

Scotland, with a population of 5 million and population density of 57/km^2, has approximately 100,000 km of rivers, 150 lochs with a surface area of over 1 km and nearly 12,000 km of coastline (SEPA 1999). Annual rainfall averages 1431 mm/annum (Wright 1995) and exploitable surface water resources are equivalent to 16,000 m^3 per person per year (Scottish Office 1998), well in excess of the European average of 4600 m^3 (Eurostat 1995). Although the population distribution and coastal variations may mean water shortages in some areas at some times, Scotland is blessed with an abundant resource.

This very abundance brings its own problems. In particular, the public tends toward the view that as water is free and plentiful, so too should water services. Government activity at any level that is related to water, and is likely to increase costs, whether individuals' water bills or environmental charges to industry, will be met with opposition. This attitude may cause problems as decision-makers attempt to increase effective participation in water management.

In addition, Scotland is currently adjusting to life as a devolved administration. Whilst the UK is and remains a state for the purposes of international law and membership of the European Union, there is now a devolved Scottish Parliament and Scottish Executive sitting in Edinburgh and responsible for most areas of domestic law and policy, including the environment, water and implementation of relevant EU law. This is a major change. Before devolution, the Westminster Parliament struggled to find time to legislate effectively on Scottish matters. This meant that Scots law was often amended piecemeal, through other statutes that otherwise might only apply in England and Wales; in turn this made the law hard to find and use. It was therefore reasonable to hope that the new Parliament would have time to legislate on a range of issues where reform and consolidation were overdue. Water law was one such area, and along with the Executive and other regulatory bodies, the legislature has devoted considerable time to various aspects of this topic in the last year. The result has been twofold. The Water Industry (Scotland) Act (HMSO 2002b) established Scottish Water (SW) as a new national provider of water and sewerage services. (In Scotland, unlike England and Wales, water services are still provided through the public sector). The Water Environment and Water Services Act, which has just completed its

Parliamentary progress, will transpose the WFD and it is this Act which the current chapter will address.

Section 11 (s.11) of the Act makes provision for consultation. It sets out a list of statutory consultees whom SEPA must consult, including Scottish Natural Heritage (a public body with nature conservation functions), SW, local authorities, District Salmon Fisheries Boards, National Park authorities, business interests, persons 'as appear to SEPA to have an interest in the protection of the water environment' and 'such other persons as SEPA thinks fit'. In addition the various materials must be publicised to allow comment by the wider public but no specific provision is made as to how that will be done; again, it is to be in 'such manner as SEPA thinks fit'. Any views expressed must be taken into account as SEPA proceeds to the next stage of the planning process. Once a RBMP is finalised, SEPA must submit it to the Ministers, who may approve the plan or require its amendment and resubmission – but there will be no further consultation on any such amendments. Each RBD will have a River Basin District Advisory Group to advise SEPA on the production of the plan. SEPA will determine the membership of the advisory group, but it must ensure 'appropriate representation' from the groups mentioned in s.11. However, the list in s.11 does not include public representation as such, but rather public authorities and interest groups.

In addition, SEPA may (but has no such duty) prepare a sub-basin plan which may relate to any smaller area, water type, sector or issue, within a District. Consultation on such sub-basin plans will be with whomever the authority sees fit, from those mentioned in s.11 – which will not necessarily, under the Bill, include the general public. There is no requirement for an advisory group for sub-basin plans.

In its first consultation exercise on implementing the WFD, the Executive recognised the importance of wide public participation and suggested the establishment of consultative fora in each RBD. This was widely supported. In its second consultation, by which time the Executive was considering establishing only one strategic RBD, the proposal was for a network of fora, perhaps based on major river catchments. There was also recognition of the desirability of working with existing initiatives such as local catchment management bodies where these exist, and community planning initiatives. In the Bill itself however, although there is provision for consultation with the bodies specified above, there is no express provision for such a network.

Over the last 2 years both the Executive and SEPA have engaged in a series of meetings, including a National Stakeholders' Conference, and have also supported such initiatives by other bodies. These activities have enabled links to develop between government, the competent authority and other stakeholders,

including SNH and SW, as well as local authority development control staff, those engaged in Local Biodiversity Action Plans (LBAPs), groups representing rural land use interests, fishery interests, industry and environmental NGOs. A workshop on participation was co-hosted by the Executive with the WWF. Some of these meetings were sectoral, some issue-based, and they took place at local as well as national level.

Where local catchment planning already exists, it is generally an inclusive process, and there are a number of bodies carrying out activities related to the WFD, such as the Scottish Coastal Forum, an umbrella organisation coordinating the work of bodies including the Clyde Forum, Solway Partnership and Moray Firth Partnership, or the Flood Defence Groups. These could be utilised and their work will be built upon to provide the local input needed for meaningful participation in the RBMP process. Some of these initiatives will be addressed further below.

However, the question remains whether the provision made in the Act itself for 'active involvement' is sufficient with regard to the general public. There seems to be no requirement to do more than publish these documents and thereby make them available for those who are aware of the process and already keen to engage in it. SEPA intends that a key means of providing access to RBM planning will be via interactive web-based display of monitoring results and programmes, environmental objectives, programmes of measures etc. This will provide access to supporting information as required by the Directive and could be developed further to provide further opportunities for consultation. As discussed above, electronic publication of consultative documentation is highly effective for those with internet access, but disenfranchising for those without. Paper copies require access to SEPA offices, time to read and funds for copying.

Of course, the Directive's requirements for 'active involvement' extend only to 'interested parties', and these will be expressly consulted under s.11. And it is difficult to extend such parties beyond those who make some particular use (business or recreational) of the resource and those who are already involved in some form of environmental activism. This is a general problem with all sustainable development and indeed all social inclusion issues, and there are no easy solutions. The Executive also identified the opposite problem, the need to ensure that expectations were not raised that could not subsequently be met, and this too is a well-established risk. Nonetheless, it is important that every opportunity is taken to reach out to the wider community, and there is evidence of attempts to establish good practice in this regard.

Two formal WFD projects are underway to take forward the RBMP process. The Executive has initiated a pilot scheme in SEPA's South West area, which has led to the production of a 'shadow River Basin Management Plan'. This work was undertaken by Babtie Group, a leading consultancy firm, and

supported by an advisory group, which was SEPA chaired, and a steering group led by the Executive. The former had representatives from local authorities, Forestry Authority, SNH, Fishery Boards and others, including environmental NGOs. One of the results of this project was the development of a GIS demonstrator, capable of portraying information at every level from the strategic planning scale to the smallest waterbody (Scottish Executive 2002b, 2002c). SEPA has also undertaken three case studies on the application of Heavily Modified Water Bodies, which formed a contribution to the EU's Common Implementation Strategy for the WFD. This work also involved a collaborative advisory group including SEPA, the Executive, SNH along with representatives of the hydropower sector, Scottish Water, port authorities and relevant NGOs. The reports on the case studies are due for publication in the near future and should be available on the Scottish Executive's website.

In addition, a number of local catchment planning initiatives are underway, for example in the Annan catchment in Dumfries and Galloway region in South West Scotland, on the River Tweed, on Loch Lomond (which has National Park status) and undertaken by the various firth fora. These may also represent exemplar approaches for WFD implementation. The sub-basin plans provided for under the Bill may operate at catchment level, or they may relate to particular activities within a RBD. As new regulatory regimes and new monitoring networks develop, the improvements and information gained will in turn feed into initiatives such as these. For Scotland, where there is no history of statutory catchment planning, such good practice will be vital to achieve the spirit, as well as the letter, of the Directive.

6.6 CONCLUSIONS

From a lawyer's perspective, provision of environmental information raises several critical and related issues. Firstly, what does the law require to be provided and by whom? Linked to this are issues of terminology and definitions: what is environmental information? who is a public authority? Any legislative provision which is vague or ambiguous will be bogged down in controversy, possibly court actions – it will certainly not contribute to achieving the aims of the legislation. Secondly, how must the information be provided, and what structures are in place to ensure meaningful access? Will there be electronic publication, or paper-based, or both; and for paper sources, how distant will they be from those who may wish to consult them? Thirdly, what level of detail should be made available? This will in part depend on the intended users. Ideally all the detailed background and technical data should be in the public domain, with only the most stringently managed exemptions – but,

in addition, there must be simplified analysis and non-technical summaries to ensure that the public at large, as well as the involved professionals, can make meaningful use of the information. All of these questions must be addressed and answered when legislation is being drafted, taking account of best practice. As well as the provision of data and the establishment of consultation processes, it is essential that all the professionals concerned seek the most imaginative and forward-looking ways to engage with each other and the public. Multidisciplinary activity, particularly in information exchange, breaks down professional barriers and leads to more effective solutions more quickly. Better mechanisms for public participation increase knowledge and active involvement in environmental decision-making, which must be in everyone's interests and of course of benefit to the environment as a whole.

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7

The EU Water Framework Directive and public participation in transboundary river basin management

Ana Barreira and Giorgos Kallis

7.1 INTRODUCTION

Water is the sector with the most comprehensive coverage in EU environmental regulation. Adopted in September 2000, the Water Framework Directive (WFD) (CEC 2000) aims to provide an umbrella for the implementation of the various instruments of EU water policy as well as to introduce new standards and tools for the protection of the ecological quality of waters. The WFD sets common approaches and goals for the management of water in 27 countries (15 Member State (MS) countries and 12 pre-accession countries which should conform in

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the long-term with Community law). The implications of the WFD are far-reaching and beyond the limits of Europe. The directive sets out a new legal and institutional approach to water management that may be useful and adopted in other parts of the world.

The objective of this chapter is to present the main measures of the WFD and trace its requirements and implications for public participation in a transboundary river basin management context. Section 7.2 presents the WFD following the drivers behind its formulation, the institutions put forward, goals and measures foreseen. Section 7.3 focuses on the requirements of the directive on environmental information and public participation emphasising the transboundary river basin management context. We conclude with section 7.4 discussing some of the broader lessons and implications of the WFD.

7.2 THE WATER FRAMEWORK DIRECTIVE

7.2.1 The EU water policy context

EU water policy pre-WFD was developed in two phases. The first phase (1973–1980) was characterised by an emphasis on public health protection. A number of directives were formulated aiming to regulate standards for critical water uses or to control the discharges of dangerous substances to surface and ground waters (Somsen 1990). The 'water use directives' were based on 'quality objectives' specified into 'imperative' standards (that should be respected in all cases) and/or 'guidance' standards (more stringent, that MS should 'endeavour' to respect). Uses covered by these directives included water for drinking, bathing and for fish and shellfish harvesting. 'Water pollutant directives' on the other hand regulated the permissible levels of discharges of dangerous pollutants. Two lists of harmful substances were set: for 'List I' substances, emission limit or quality standards were to be agreed by EC Ministers in subsequent substance-specific 'daughter' directives. For 'List II' substances, MS were asked to come up with integrated programmes for their reduction. For groundwater, rules were more stringent and all list I substances were prohibited from reaching aquifers (STOA 1995).

In the second period (1987–1992), the emphasis shifted to the control of pollution at the source. Legislation included uniform requirements for the installation of waste-water treatment plants (specified according to size of settlements) and integrated programmes for the protection of vulnerable zones from agriculture-related nitrate pollution. A number of broader environmental pollution control directives for products (detergents and pesticides) and processes (integrated pollution prevention and control of industries' emissions)

had also positive implications for water quality (Kallis and Nijkamp 1999; STOA 1995).

Although EU water legislation has its detractors, the consensus view is that 'the operation of the Community's aquatic policy provided a momentous advance over previous legislation under the various national laws' (Howarth 1992). The drinking, bathing and wastewater directives were relatively more successful as they provided EU-wide reference standards that generated public attention and led to considerable public investment in the improvement of water and wastewater treatment facilities (Ward *et al.* 1997). On the other hand, less successful were policies that targeted economic activities directly. Various MS blocked progress in the Council for the adoption of 'daughter' directives for dangerous substances that would affect national industries, whereas very little progress has been seen in the nitrates directive, especially in southern MS, farmers being reluctant to take over the high costs of the integrated programmes (Kallis and Nijkamp 2000).

The pressure for a drastic reform of EU water policy came from various, often contradictory, forces (see detailed discussion in Kallis and Nijkamp 2000). These included:

- reports on the deteriorating status of water quality in Europe (EEA 1995);
- the high costs of compliance with standards (Karl and Ranne 1997);
- calls against the centralised approach of uniform EU standards, in terms of economic inefficiency in comparison to a decentralised approach (Karl and Ranne 1997) and in terms of inflexibility for local-specific conditions (Ward *et al*. 1997);
- unwarranted overlaps or gaps between the various directives as these were developed disjointed, for specific purposes;
- recognition that water quantity and quality could not be treated separately;
- the need to update standards and account for the implementation deficits of certain directives (especially on the control of dangerous substances).

The broadly perceived failure of a strict standard-based approach, given the diversity of local conditions and cost-effective options, led to the replacement of a planned new (standards-based) directive for ecological quality, with a wider reformulation of the framework of water policy (see Barreira and Sanchez-Ulloa 2000 for the policy process that led to the WFD from the first proposal in 1997 to the final adopted text in 2000). The new 'framework', instead of a standards-based approach, means that goals and processes are set at a European level but Member States are given relative freedom in specifying these standards upon local circumstances and for choosing the best mix of options for achieving them.

The objectives of the new EU water policy can be summarised by the following (Barreira and Sanchez-Ulloa 2000):

- integration of all aspects of water management in a unified system, organised within the hydrological/geographical boundaries of the river basin;
- co-ordination of the various aspects of water use and kinds of water (drinking, bathing and ecological, surface and groundwater);
- effective co-ordination of the alternative available tools (measures) for the achievement of common goals;
- a combined approach in the control of pollution with both emission limit values and best available technologies (or practices);
- enhancement of public participation and transparency in the formulation and implementation of water policy;
- sustainable use of water in quantitative terms;
- cost-effectiveness in designing the appropriate implementation measures.

7.2.2 Goals: good water status

The overriding goal of the directive is the achievement of a 'good' and non-deteriorating 'status' for all waters (surface, groundwater and coastal). There are three basic classes of quality status: high (referring to undisturbed conditions or only very minor evidence of distortion), good and moderate. For surface waters the objective is that of a 'good' ecological and chemical quality status. A surface water is defined as of good ecological quality if there is only slight deviation from the biological community that would be expected in conditions of minimal anthropogenic impact; a standard process is provided in the WFD for defining local standards accordingly. Quality elements for assessment are divided into biological, hydromorphological and supporting chemical and physico-chemical elements for rivers, lakes, transitional and 'artificial/modified' waters (those created or resulting from a human physical modification and serving economic activities) (CEC 2000). The directive defines a specific process for defining harmonised, yet river basin-specific parameters and standards for status (see below).

Chemical status is classified only in two categories: 'good' and 'failing to achieve good'. A 'good' water body fulfils all the standards set by EU legislation for the concentration of chemicals in it. Critical has been the provision for a process to define an additional list of chemical substances to be regulated (a 'deadlocked' process due to MS disputes on agreeing to standards for 'daughter' directives). The Commission has come up with a first priority list

of substances which will be renewed every 4 years. If MS fail to agree on standards for these substances at a Community level, they are obliged to set their own standards within 6 years and accordingly monitor with respect to the chemical quality of water. From this list, a number of *priority* hazardous substances will be identified whose emission should cease altogether in 20 years time (CEC 2000).

For groundwater the goal is a 'good' status defined in terms of chemical and quantitative properties. A groundwater body can be either of a 'good' or a 'poor' status. A chemically 'good' groundwater should comply with all existing legislative standards, should not exhibit effects of saline or other intrusions and, in general, should not result in failure to achieve the goals for surface waters or in significant damage to terrestrial ecosystems. Several parameters to be monitored are provided (see below). In terms of a 'good' quantitative status, the criterion is that the level of groundwater is such that the available resource is not exceeded by the long-term average rate of abstraction and result in failure to achieve the objectives for surface waters, any significant diminution in the status of surface waters or damage to terrestrial ecosystems and permanent alterations to flow direction.

An important goal is that of 'no-deterioration' for all waters upon implementation of the measures or, more specifically, no deterioration from a higher to a lower status (Lanz and Scheuer 2001). A principle of 'no direct discharges' to groundwater is also established, though a number of exemptions are maintained for some common direct discharging activities (mining-related).

The 'good' and non-deteriorating status is the minimum goal for all waters; in addition where more stringent requirements are needed for particular uses, 'protected zones' should be established and higher objectives set within them. These should include at least areas already protected by Community legislation, i.e. drinking waters, bathing waters, nutrient (nitrate and urban w/w) sensitive designated areas and areas designated for the protection of habitats or species. In addition other zones may be designated for the protection of economically significant aquatic species and for recreational activities.

The goal of non-deterioration has been in force since the entry into force of the WFD, that is from 22 December 2000, good status should be achieved within 15 years. A 12-year extension may be granted from the Commission after request from the MS. The wording of the text raises concerns whether MS will be held legally liable if they fail to achieve the standards. In a loose interpretation, MS are obliged only to do their best, i.e. set up the river basin authorities, produce plans and implement the measures foreseen (see below), but they cannot be held responsible if the measures fail to achieve the goals (Kallis and Butler 2001; Lanz and Scheuer 2001).

7.2.3 Institutional structure: the river basin authorities and plans

In the new EU water policy the level at which goals and measures will be set is that of the decentralised, hydro-political unit of the river basin. The establishment and operation of the river basin authorities is the cornerstone of the implementation of the WFD. MS are required to designate river basins and competent authorities within their territory, or in co-ordination with other states for international waters. River basin agencies may be based on existing authorities but should not be based on other than hydrological administrative barriers. River basin districts correspond to large catchment basins as composites of multiple catchments (CEC 2000).

Each authority will be responsible for preparing and implementing in 6-year periods a River Basin Management Plan (CEC 2000), which will include description and mapping of the basin and the monitoring network and a summary of significant pressures and the measures taken to achieve the goals of the directive.

Monitoring is central to the directive as it will determine the classification of the waters' status and the necessity for additional measures in order to achieve goals in the directive. Specific details are given for the monitoring requirements for different types of water and assessment (i.e. ecological, chemical or quantitative) and monitoring performance quality standards should be respected (national or international, CEN/ISO when developed, etc) (CEC 2000).

7.2.4 Tools

Each river basin plan should be complemented with a programme of measures including a number of mandatory 'basic' measures. These include those required at a minimum to comply with the requirements of the directive. First and foremost these include the implementation of all other relevant Community legislation for the protection of water (i.e. IPPC, urban w/w, nitrates, drinking and bathing water directives). If application of the existing legislation does not suffice to achieve 'good' status objectives further measures may be necessary. These should include pollution control measures based on a combination of emission limit values and recipient quality standards where the more stringent will apply (the 'combined approach'), requirements for prior authorisations of point source emissions not covered by the IPPC directive (which regulates integrated licenses for emissions from industries) and, where necessary, prohibitions. For diffuse sources of pollution, best environmental practices and controls are foreseen, as well as prior authorisations or registrations based on

binding rules. Measures should also account for the direct prohibition of all groundwater discharges (unless derogated), conformance with standards for the future regulated chemical substances and elimination of pollution of the priority hazardous substances' list. Protective and pollution-control measures should also be taken, if necessary, to ensure that the quality of drinking water sources conforms to the level of treatment at that place. The implementation of 'supplementary measures' to complement the basic measures rests on the discretion of the authorities. A list of indicative options is given in the WFD including, among others, demand management measures, additional legal and/or economic instruments, rehabilitation projects, desalination plants, artificial recharge and education programmes. Additional controls are foreseen for the abstraction or impoundment of freshwater including a register of abstractions and a requirement for prior authorisation. Moreover, MS are asked to 'take account' of the principle of recovery of costs (operational, capital and environmental/resource) of water services in accordance with the polluter pays principle. This includes ensuring that 'water pricing policies' are in place which 'provide adequate incentives' for efficient use of water, and that different users provide an 'adequate contribution' to the full cost of water (CEC 2000). Progress on the implementation of each of these measures should be reported on the river basin plans.

7.2.5 The WFD and environmental information demands

It has been argued that the success of past EU water directives has not been so much a case of a tight enforcement of regulatory standards as much as the outcome of a 'self-reinforcing' mechanism of regulation, information gathering and reporting, public attention, public pressure and finally local action for compliance (Kallis and Nijkamp 1999). Hassan (1995) looked at the case of the UK, the most reluctant MS to accept initially the EU water directives and confirmed the above analysis. He argues that the contribution of EU directives has been momentous in opening up British administrative structures, establishing 'open' monitoring and reporting schemes and consequently raising new issues and creating more public pressure for action. In turn, this effect has made governments more sensitive to environmental issues and more willing to comply with their formal obligations. Gathering and reporting of data has been instrumental in drawing the attention of the public to water quality issues. In turn, it has provided a driver for new research leading to new policies and standards (Kallis and Nijkamp 2000).

Collection of environmental data is central to the process of assessment of the status of waters in the WFD. Past EU water quality directives were criticised for their inflexible approach, i.e. setting specific, universal parameters and

standards often unrealistic or very expensive in terms of sampling requirements. At the local level, this has unwarrantly elevated costs that could be saved by focusing sampling on more indicative-aggregative parameters. On the other hand, environmental proponents saw, with a reason, in this argument a pretext for a relaxation of standards. In the WFD a more flexible approach is adopted whereby the general categories and classes of parameters are provided, but river basin authorities are free to pick up and monitor the indicative parameters that best fit the peculiarities of their locales. MS will first set type-specific reference conditions for high, good and moderate status for the above elements under the descriptive criteria provided in the directive. Then they will express the results of their assessment systems in terms of ecological quality ratios (i.e. measured value per reference value of undisturbed conditions). An intercalibration network will take care to harmonise the class boundaries across the various river basins. A monitoring operation of selected sites will be set. Out of each qualitative element indicative parameters will be chosen which will then be regularly monitored and compared with the relevant reference condition. Several open questions, remaining to be settled in practice, will determine the success of the process (Lanz and Scheuer 2001).

How will the reference conditions (i.e. 'undisturbed' bodies) be determined? What will be the class boundary between high and good and, more importantly, good and moderate, and at what level of precision/uncertainty? How will aggregation of the different values of the biological and physico-chemical quality be undertaken? Must all samples over a year show a good status or only some percentage? Is the status good when all or some percent of the parameters of each quality element reach values which are at or above the status level? Which parameters will be sampled, at what locations and at what frequency?

These are not simple, practical questions that can be easily resolved but touch the core of the profession of environmental information. They relate to questions of the handling of uncertainty, to methods of aggregation and the use of indicators. On the positive side, one cannot but welcome the scientific activity that will be triggered by the implementation of the WFD which will foster co-ordination and harmonisation of approaches. On the other hand, there remain doubts about whether governments will try to use the high uncertainty entailed to water down the requirements of the directive. The only safeguard to ensure a proper use of information and handling of uncertainty is accountability and the openness of decisions to the public and to the scientific community. This raises the question of 'participation', which is dealt with separately in the next section.

This Directive establishes a framework that leaves many answers opened. This framework needs to be developed. With this purpose in mind the EU Member States, Norway and the European Commission approved the WFD Common Implementation Strategy (CIS) in May 2001 for supporting the

implementation of this Directive. The main aim of this strategy is to allow coherent and harmonious implementation of the Directive. Focus is on methodological questions related to a common understanding of the technical and scientific implications of the WFD. Key principles in this common strategy include sharing information and experiences, developing common methodologies and approaches, involving experts from candidate countries and involving stakeholders from the water community.

7.3 PUBLIC PARTICIPATION IN TRANSBOUNDARY RIVER BASIN MANAGEMENT

The central feature of the WFD, around which all its other elements are arranged, is the use of river basin district as the main unit for management of river basins. A 'River Basin District' is the area of land and sea, made up of one or more neighbouring river basins together with their associated groundwaters and coastal waters (Art. 2 (15); see also Article 3). This recognises that water respects physical and hydrological boundaries, but not political and administrative limits (WWF 2001).

The WFD introduces the concept of international River Basin District. This establishes that Member States shall ensure that a river basin covering the territory of more than one Member State is assigned to an international River Basin District. Therefore, Member States that share river basins should coordinate their actions to achieve the objectives of the directive. If the River Basin District extends beyond the territory of the Community, MSs should try to coordinate with non-Member States and must ensure the application of the WFD within their territory.

The environmental objectives are achieved through the development and implementation of river basin management plans and programme of measures. The Directive establishes specific requirements for public participation not only in the development of the river basin management plans but also in the whole implementation of the Directive (Art. 14).

From the text of the Directive we can say that there are two basic obligations for MS sharing a river basin district: to establish an international river basin district by 2003 and to coordinate the programme of measures. In the case of river basin management plans, the WFD only advises to elaborate a joint plan in the case of international river basin districts. The directive is silent on the issue of public participation in the scope of international river basins. How will the public participate in the whole implementation process and, in particular, in the elaboration of a single management plan? Should this participation be channelled through each country's institutions or through common institutions?

In the context of the Common Implementation Strategy, a series of working groups and joint activities have been launched for the development and testing of non-legally binding guidance. The outcomes of the work packages under Working Group 2.9 on Guidance on best practice in River Basin Planning of the WFD Common Implementation Strategy will provide us some answers to the issue of public participation. Working group 2.9 is led by Spain and focuses its activity on:

- Work Package 1. Guidance on the identification of river basin districts;
- Work Package 2. Guidance on the planning process;
- Work Package 3. Guidance on public participation;
- Work Package 4. Manual on integrated river basin management planning.

At the end of 2001 a Drafting Group was established to develop technical guidance on public participation under the leadership of the Netherlands. This draft was submitted to consultation and it has been finalised at the end of the year 2002. The guidance will be tested for improvement and updated accordingly in the pilot river basins (Guidance on Public Participation in Relation to the Water Framework Directive).

Public participation will contribute to the establishment of the river basin management plans and to the programme of measures and will, therefore, contribute to the achievement of the general and environmental objectives of the WFD. Information and public participation also contribute to foster cooperation in transboundary river basins.

7.3.1 Guidance on public participation

The guidance intends to provide general principles and a general approach to public participation. However, these principles and approach will have to be tailored according to the political, organisational, cultural and physical contexts of each Member State. This document addresses:

- Member States and Accession countries;
- competent authorities of river basin districts;
- public and stakeholders.

The main purpose of public participation is to improve decision-making, by ensuring that decisions are soundly based on evidence, that decisions are influenced by the views and experience of those affected by them, that innovative and creative options are considered and that new arrangements are workable, and acceptable to the public.

Table 7.1 WFD provisions on public participation

Preamble 14

(14) The success of this Directive relies on close cooperation and coherent action at Community, Member State and local level as well as on information, consultation and involvement of the public, including users.

Preamble 46

(46) To ensure the participation of the general public including users of water in the establishment and updating of river basin management plans, it is necessary to provide proper information of planned measures and to report on progress with their implementation with a view to the involvement of the general public before final decisions on the necessary measures are adopted.

Article 14

Public information and consultation

1. 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 plans. Member States shall ensure that, for each river basin district, they publish and make available for comments to the public, including users:

(a) a timetable and work programme for the production of the plan, including a statement of the consultation measures to be taken, at least three years before the beginning of the period to which the plan refers;

(b) an interim overview of the significant water management issues identified in the river basin, at least two years before the beginning of the period to which the plan refers;

(c) draft copies of the river basin management plan, at least one year before the beginning of the period to which the plan refers.

On request, access shall be given to background documents and information used for the development of the draft river basin management plan.

2. Member States shall allow at least six months to comment in writing on those documents in order to allow active involvement and consultation.

3. Paragraphs 1 and 2 shall apply equally to updated river basin management plans.

Annex VII

RIVER BASIN MANAGEMENT PLANS

A. River basin management plans shall cover the following elements:

…

9. a summary of the public information and consultation measures taken, their results and the changes to the plan made as a consequence;

11. the contact points and procedures for obtaining the background documentation and information referred to in Article 14(1), and in particular details of the control measures adopted in accordance with Article 11(3)(g) and 11(3)(i) and of the actual monitoring data gathered in accordance with Article 8 and Annex V.

Table 7.1 gives the text of the WFD where it includes provisions on public participation in its preamble, articles and annexes. From this table it becomes clear that the WFD includes three forms of public participation:

(1) active involvement in all aspects of the implementation of the Directive, especially, but not limited to, the planning process. More intensive forms of public participation (shared decision-making to self-determination) are not required by the WFD but are up to the MS to practice;
(2) consultation that allows learning from comments, perceptions, experiences and ideas of stakeholders information supply;
(3) access to background information.

Though the WFD includes an article devoted to definitions, it does not include a definition of what is understood by 'public' or 'interested parties'. We must go to other pieces of EC legislation to find an answer. The Strategic Environmental Impact Assessment Directive (Directive 2001/42/EC) (CEC 2001) defines 'public' as 'one or more natural or legal persons, and, in accordance with national legislation or practice, their associations, organisations or groups'. NGOs promoting environmental protection and meeting the requirements under national law shall be deemed to have an interest. The Aarhus Convention on access to environmental information, public participation in environmental decision-making processes and access to justice in environmental matters that has been signed by the European Community defines public in the same way as the SEIA Directive. In addition, this Convention defines 'interested parties' as 'any person, group or organisation with an interest or "stake" in an issue either because they will be affected or may have some influence on its outcome'.

The guidance refers to public participation at different levels: river basin district, river basin and sub-basin/local. For our purpose, we will concentrate on those aspects of this draft that are related to international river basin districts.

7.3.2.1 Active involvement

This involvement has to be organised in the different phases of and tasks for the implementation of the WFD.

(a) Analysis and mapping: characterisation and description. In this phase the public will have to participate in diverse tasks: designation of river basin districts (article 3); description of water bodies, analysis of pressures and impacts, economic analysis (article 5); listing of protected areas (article 6); identification of water bodies used for the abstraction of drinking water.

(b) Active involvement in the assessment of the shortfalls between RBD status and requirements of the WFD, monitoring programmes and setting the objectives that can be reached by 2015. The WFD information demands as described in the previous section are essential for this task
(c) RBD Planning and establishment of a programme of measures. Active involvement in this phase will help determine stakeholders' views on the potential options, and to elicit other possibilities to be screened which in turn would help determine the final measures selected. For international river basins where it is decided to elaborate a unique river basin management plan, who should organise the active involvement process? It seems logical that in those basins having an International Commission, this Commission should organise such a process.
(d) Implementation, RBD plan application and updating process. In international river basins it might be appropriate to coordinate active involvement in the above-mentioned phases with the stakeholders of other Member States. This has to be considered and decided earlier. The involvement of these stakeholders will make coordination, which is at least necessary on international level (international river commissions), easier.

7.3.2.2 Consultation (in transboundary RBDs)

The WFD establishes a consultation process in the elaboration of river basin management plans. This process includes the obligation for Member States to publish and make available for comment to the public, including users: a time-table, a work programme including a statement of consultation measures to be taken, of an interim overview of the significant water issues identified, and draft copies of the river basin management plan.

MS shall include in the RBM plan a summary of the public information and consultation measures taken, their results and the changes to the plan made as a consequence (annex VII.9)

The consultation could be collected not only through written comments but also through an oral or active procedure (interviews, workshops or conferences).

How should comments regarding international management plans be collected? According to the guidance, these can be collected on a national basis, at defined locations. After being analysed, the relevant results of those well-founded comments should be forwarded to the international agency that prepares the international management plan. However, where an International Commission assisted by a Secretariat exists, why should this Secretariat not collect the comments?

7.3.2.3 Information Supply (in international RBDs)

This form of public participation, that should be understood as the first and previous pillar to make active involvement possible, covers two aspects:

(a) Sufficient 'information supply' in different WFD implementation steps. Sufficient refers to the different public and stakeholders, to the different kind of information and to the way information is provided. To avoid misinformation situations, it should be very useful to use at the EU level guidelines like the US Guidelines for ensuring and maximising the quality, objectivity, utility and integrity of information (EPA 2002). These guidelines aim at securing accurate information sufficient for effective participation in managing human health and environmental risks. EPA must rely upon information of appropriate quality for each decision they make.

(b) Access to background documents and information on request. This refers to an additional right to information on the documents used for the development of the draft river basin management plan that must be exercised via special application. The WFD does not specify to whom such application should be made. In the case of an international river basin district this information could be requested from the international commission if an international river basin management plan has been developed.

7.4 CONCLUSIONS

The WFD introduces new standards, criteria, institutions and processes for managing Europe's waters under an integrating ecosystem-based approach. It provides an exemplary legal document that binds together fragmented environmental legislation (as is the case in many policy fields and countries of the world) under common ecosystem-based criteria and planning processes. In terms of European water policy it introduces:

- *A new logic*. Water is to be treated as a whole and on the basis of its natural borders. Quantity and quality are integrated in a goal-based approach.
- *New goals.* The environmental (ecological and chemical) quality of water is regulated for the first time beyond its strict public health or economic importance. Maintaining or achieving a satisfactory environmental quality of water across the EU becomes a prime policy goal and, to an extent, a reference for other sectoral policies.

- *New institutions.* For the first time, institutions are set up on a bioregional scale. River basin authorities and the new planning processes can potentially provide their own impetus for changes in water management.

On the other hand, given its ambitious goal, the directive raises considerable demands. Scientific information on environmental parameters is one of these and is critical for the success of the implementation process. The directive marks a shift away from the traditional approach, based on clearly defined parameters and standards, and towards a more flexible, river basin-tailored approach on the basis of selected indicators. This change is dictated by the diversity of aquatic conditions across Europe that could not be 'boxed' into universal EU-wide standards. Yet coupling the decentralised approach with a harmonised, level-playing field will not be an easy task. Questions of scientific uncertainty, aggregation and data reliability that have been central in the literature on environmental information and indicators will be at the core of a 'thorny' political process of implementation.

The river basin approach implemented by the WFD is particularly fitted to the management of shared, transboundary waters. In fact, it was the success of the international river Rhine basin programme that inspired much of the process that led to the WFD. The Directive offers basic tools for transboundary management. However, there is room for a diversity of experiences on transboundary management depending on the similarity of working institutions and tradition on cooperation. Its provisions on public participation might serve as an incentive to produce clear and understandable information. Expert commissions will have to disseminate information and perhaps to produce information that can be understandable by different stakeholders and users.

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8

Incorporating user needs into environmental information systems

Jos G. Timmerman

8.1 INTRODUCTION

For transboundary river basins, the establishment of a joint understanding of the environmental status and trends, as well as their spatial variability, is more crucial than for national river basins, since the potential cost for intervention activities has to be shared in an equitable manner between two or more countries. Doubts and controversies about facts can under these conditions frustrate international cooperation and the fundamental problem of agreeing upon whom is to blame for a transboundary water quality or quantity problem is politically sensitive. In the meantime, the problem may get worse as measures are often postponed. This is particularly troublesome for many transboundary water regions on the Eastern European fringe, given major political and economic differences between countries,

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as well as variations in data availability, accessibility and quality. A joint monitoring network can be a first step in solving this problem.

Monitoring networks data and information activities constitute the larger part of the management activities of the various European transboundary water commissions (Enderlein 1999). But in the life water management situations, a gap exists between the assessed needs for environmental information and the information obtained within monitoring activities (see e.g. Adriaanse and Broseliske 1998; Bradshaw and Borchers 2000; MacDonald 1994; Pentreath 1998). As Pentreath (1998) stated: 'At present some of the systems for monitoring and gathering information about the environment in European countries are inefficient and wasteful. They generate excessive amounts of data on subjects which do not need it; and they fail to provide timely and relevant information on other subjects where there is an urgent policy need for better focused and consistent environmental assessment and reporting.'

One of the major reasons for this problem is the existing gap in communication and information exchange between policy- and decision-makers, stakeholders and scientists. On the one hand, monitoring is often considered an issue that should be dealt with by scientists, and it is often thought that monitoring information is much too technical and scientific for policy-makers and stakeholders. Policy-makers, on the other hand, are often accused of posing questions that are too broad for scientists to be able to provide adequate responses. Finally, local stakeholders who often have to implement or pay for adopted decisions and policies are often considered to lack expertise to be consulted in the decision-making process.

This chapter will address the issue of producing adequate information. The information cycle will be presented as a framework for information production in river basin management; the chapter will focus especially on the importance of knowing how information is used in river basin management and, based on this, assess the information needs of policy-makers with emphasis on transboundary river basin management. Special emphasis will be given to how information is perceived and appreciated in a water management decision-making situation in order to improve information production, and subsequently the usefulness of information in the decision-making process.

8.2 TRANSBOUNDARY WATER MANAGEMENT

The classical temple of sharing international water resources as described in Chapter 1 includes three pillars: politics, technical cooperation and institutions, based on a foundation of integrated water resources management. In this model, transboundary water management has to deal with a number of critical issues that will be further addressed in this chapter (Savenije and Van der Zaag 2000):

- River basins are not limited to administrative boundaries. Management of these basins can only be effective if this is at least coordinated between the responsible administrations.
- National interests may differ. Countries have a tendency to concentrate on their own interests and disregard the interests of other riparian countries, especially downstream.
- There often exist inconsistencies between policies, plans and practices which are often developed at different administrative levels.
- Developments in water-related issues and changing perceptions of issues require changes in water management, procedures, information, etc.

As stated, inconsistencies often exist between policies, plans and practices. Milich and Varady (1999) distinguish four conceptual paradigms in international environmental accords that may explain some of the inconsistencies:

(1) the technical/scientific paradigm where concrete goals are established, but management is mostly delegated to organisations dominated by scientists and engineers;
(2) the regulatory/standard-driven paradigm where international environmental quality accords are moved towards numerical standards and strict regulation of pollution;
(3) the closed paradigm where the process of negotiating international agreements has been restricted to high-level professional diplomats; and
(4) the top-down paradigm where ratified international agreements supersede domestic laws and arrangements.

These paradigms deal with different dimensions and may be present at the same time at different levels of treating the issue. In each of the paradigms we see an imbalance of the three pillars where one pillar is over-emphasised and the other two are neglected. The first two paradigms over-emphasise the technical cooperation pillar, the third paradigm focuses on institutions while the fourth puts all attention on politics. Each paradigm represents a certain bias, which, according to Milich and Varady (1999), may lead to the following setbacks:

- Too little attention is paid to the specific regional situation of the river basin.
- Political and economical imbalances are reflected in the water management situation.
- Implementation of accords is left to the discretion of the parties.
- Little or no public participation results in internal friction.
- The accords may be too much focused on one or a few issues, such as navigation or ‘development’.

These paradigms and their disadvantages can be counteracted through the inclusion of non-technical perspectives like social and economic consequences into the process to abate the technical/scientific paradigm, promotion of capacity-building, bringing in a better understanding of the natural processes in the regulatory/standard-driven paradigm, transparency through open meetings in a closed paradigm situation, and a bottom-up design through public participation when the top-down paradigm is dominant. This must go hand in hand with the balancing of the three pillars.

8.3 CHARACTERISTICS OF INFORMATION

A wide range of definitions of information has been included in literature, but basically it is the receiver of information that determines if information is understandable and useful, and if it will be used. For the purpose of this chapter, six characteristics of information are identified. The first characteristic describes information as directly related to the information user. The other characteristics can be seen as part of a hierarchy in which information as useful data is the most basic, and information as a constitutive force is most encompassing. In all characteristics of this hierarchy the implicit basic assumption is that information has a fixed meaning for the specific user (after Braman 1989; Rowley 1998).

(1) Information as subjective knowledge. In this characteristic, information has a variable meaning dependent upon the user's perceptions or values, and the nature of the task at hand. Information can in this characteristic be seen as potential knowledge. To convert information into knowledge, it must be integrated into an existing knowledge structure.

(2) Information as useful data or as a 'thing'. In this characteristic, data is processed for a purpose and is presented in a form that is meaningful to the recipient. Information is seen as processed and presented data. In order to communicate knowledge, information is expressed or represented in some physical way as a signal, text or communication.

(3) Information as a resource. In this characteristic, information is an objective resource, which is attainable and useable and which accordingly can be managed like other factors of production. The value of information is not readily quantifiable as its value depends on the content and use. Furthermore, information is not lost when it is given to others. This characteristic emphasises the uses people make of information rather than its effects upon people and society. Information as a resource links the use of information to the characteristic of information as a thing.

(4) Information as a commodity. In this characteristic, the notion of information as a resource is complemented by a right to use it. This right contains a certain value that is subject to trade. The commodity notion also requires a concept of an information production chain including creation, processing, storage, transportation, distribution, etc. of information. Information gains in economic value as it passes through each stage of the chain. As compared to information as a resource, information is granted at least economic power.
(5) Information as perception of pattern. This characteristic adds context to information as a commodity. Information in this perspective has a past and a future, is affected by various factors, and itself has effects. Reduction of uncertainty is one major capacity of information in this characteristic. Reduction of uncertainty increases the productivity of decision-making. Not only the possession of information but information itself is granted power.
(6) Information as a constitutive force in society. In this characteristic, information is a dynamic force for change in the systems within which it operates. Its environment does not only affect information, it is itself an actor affecting other elements in the environment. As such, information is a power in itself. The view of information as public infrastructure as promoted in the Aarhus convention (UNECE 1998) and recent European legislation (European Commission 2003) can be regarded as included in this view (also see de Villeneuve, Chapter 5 in this volume).

Differences in these views can be highlighted with the following; at the first International Conference on Management of Transboundary Waters, Olson (1998) stated: 'Environmental monitoring is not a goal in itself. Its primary function is to provide a database for the formulation of environmental objectives. A second function relates to evaluating the effects of corrective measures.' This statement reflects a view of information as a thing, as data, or possibly as a resource to be used to formulate objectives or evaluate measures. At this same conference, Huisman *et al*. (1998) stated that commonly elaborated monitoring infrastructures could contribute to mutual trust and eventual real cooperation, thus implicitly recognising the potentials of information as a constitutive force.

8.4 THE PURPOSES OF INFORMATION IN TRANSBOUNDARY RIVER BASIN MANAGEMENT

Information can serve many purposes in decision-making for water management. Especially in transboundary water management situations, the role and use of information becomes apparent as conflicts become more visible. Several roles can be distinguished that are partly related to the perception of information and partly related to the stakes involved. Some roles and uses of information in decision-making are:

- Information as a legal obligation. In laws and regulations related to environmental management, monitoring obligations are usually included. This information has to be collected and reported without consideration of its actual applicability. Information is in this sense a thing that has to be produced. This approach is often found in a regulatory or top-down paradigm situation.
- Information as hideout or safeguard. Assigning this role to information results in a situation where water management activities are directed towards monitoring. It provides a sense of doing much useful work without actually having to take measures. Information is in this way a resource that may prove to be useful in future and this approach can be found in a technical/scientific paradigm situation.
- Information to postpone decisions. In a situation where information is available but may give rise to discussion, stating that more information is needed will give the opportunity to postpone decisions. Information is in this situation perceived as having a pattern, but the uncertainty is grasped to diminish the power of the information. This approach is similar to the safeguard approach but is more likely to be found in a closed paradigm situation.
- Information as a 'weapon'. Information can be used to direct blame at other parties and to validate claims that it is the other party who is polluting the water or causing floodings. The power of information is generally recognised but particularly in a closed paradigm situation it can be used to hinder cooperation.
- Information as a trading good. This is clearly the situation in which information is regarded a commodity that can be traded for something else. This viewpoint can be the start of cooperation when in a transboundary context the riparian countries agree to exchange information.
- Information to direct decision-making. The available information is in this situation split into useful and useless information. Information

that supports the desired outcomes will be put to the fore, while information that counters the desired outcomes will be discarded. There is a perception of pattern in this use of information, but the power of the information is locked up.

- Information to support decision-making. This is more or less the ideal situation from the viewpoint of monitoring, in which the available information is the basis for the decision taken, it guides and supports the decisions. The information cycle builds on this role of information. In this notion, information can be a constitutive force.

As information is subjective, the difference between the two latter roles will be hard to distinguish. But only if this last role is applied to information can technical cooperation as described in the classical temple framework for transboundary water management (Savenije and Van der Zaag 2000) take place. Merely assigning a role to information, however, does not facilitate cooperation between riparian countries. A framework that can provide such support is the information cycle.

8.5 THE INFORMATION CYCLE

Research in monitoring as an essential source of environmental information has had a focus on the process of data collection ranging from monitoring network design and sample collection to data storage and data processing. The introduction of the monitoring cycle in the UNECE Guidelines on Water-Quality Monitoring and Assessment of Transboundary Rivers (UNECE TFMA 1996) and the information cycle as a more generic framework (Timmerman and Ottens 1997) introduced the concept of monitoring as an essential part of water management. The information cycle (Figure 8.1) is presented here as a general framework that describes the essential steps in the process of information collection and utilisation.

Unlike many other frameworks to develop information or monitoring networks, the information cycle advocates specification of information needs, which are closely linked to water management and water policy, as a first step in monitoring network design. In addition, the monitoring process does not end after processing of the data, but only after the resulting information is transferred to water policy and water management. The model of monitoring has been expanded through this concept.

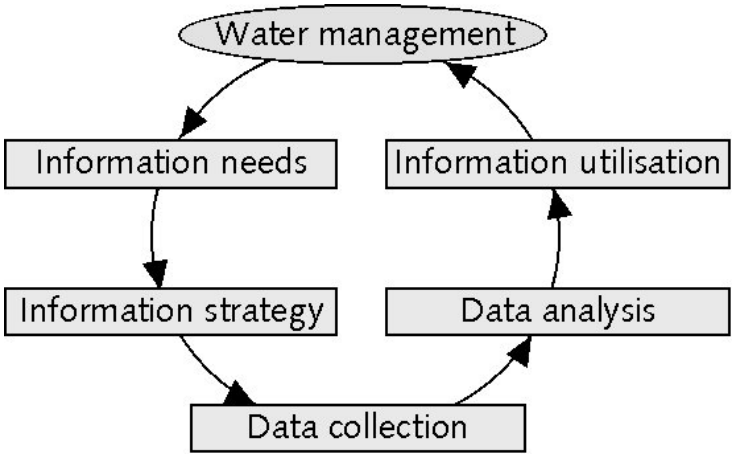

Figure 8.1 The information cycle

In going from information required to information obtained, the following steps can be distinguished (Timmerman *et al.* 2000).

(1) Information users, as part of the information cycle, should, in cooperation with information producers, decide upon the characteristics of the information that is needed.
(2) Information producers will, in cooperation with information users, decide upon the best way (i.e. strategy) to collect information with a specified (required) quality for the lowest possible cost.
(3) A monitoring plan can be the outcome of the information strategy, but this is not inevitable. Thus, the information cycle may be used as a generic framework for designing information collecting systems.
(4) The actual collection of data is the next step in the information cycle. As stated in the previous step, this may be through a monitoring network, but other sources of information are available, like literature or databases of other organisations.
(5) The collected data are analysed and the results interpreted relative to the information sought; information statements are made. The type of data-analysis is aimed at having the information users utilise the information.
(6) The resulting information is presented and transferred to the information users in a proactive manner.

Each step in the information cycle puts requirements on the previous step of the cycle and limits the following steps. By theoretically going through the

information cycle both clockwise and counter-clockwise, formulating the prerequisites and restrictions of every step, these requirements and limitations may be made explicit. In this way, the information cycle facilitates identification of 'where we want to go, and then work backwards' as Brett (2000) describes the first step of a methodology to assess environmental information needs for decision-making groups.

8.6 THE USE OF ENVIRONMENTAL INFORMATION IN DECISION-MAKING

To determine the type and nature of environmental information that is considered important to the policy-maker, and also to analyse the way such information is used in decision-making, an experimental study was performed (Timmerman *et al.* 2002). In the study, a constructed and theoretical water management situation was provided to a group of selected Estonian officials and representatives of the Estonian-Russian Joint Commission on Transboundary Waters. Participants were given a role either as member of the Estonian delegation or as Russian delegation member. The water management situation was constructed with the Lake Peipsi situation as an example. Available data were used, complemented with constructed but plausible data. The case was to focus on the nutrients in the case area and its effects on the ecosystem, fisheries, agriculture, etc. The participants were given the task of taking measures in order to overcome the problems as introduced by the case.

To determine the type of information that should be presented, it was considered that cause-effect relationships should be made clear. For this purpose, the DPSIR-framework (EEA 1998) was used. This framework describes the cause-effect chain as starting off with a Driving force (any human or human-related activity) that causes a Pressure (e.g. through emissions) on a water body, in turn changing the State of the water body. This changing state has an Impact on the functioning of the water ecosystem and/or on the human uses of the water. This results in a societal Response directed at any of the four elements mentioned to minimise the negative impacts. In the study, information was provided on each of these elements. As this information was considered to be insufficient for efficient and correct decision-making, additional general economic and social information was also included.

The case description was made from the viewpoint of the Estonian situation. Estonia, being an EU accession country, has an interest in complying with the goals of the EU Water Framework Directive; Russia a non-EU accession country is not committed to it. Also the socio-economic situation in both countries differs. As a consequence of these differences, the participants playing

the Estonian delegation role adopted the problem description (a clear perception of the patterns) and were able to define appropriate measures. The participants playing the Russian delegation role could not adopt the information and as a result started to dispute the information.

From the analysis of the use of the different types of information it was found that information on the state of the lake was not referred to in the discussions. Similarly, information on pressures and impacts was mostly referred to in a qualitative way. Only information on driving forces and responses was regularly used in a quantitative way to support possible measures. This implies that much of the information from physico-chemical and ecological monitoring was not used in decision-making. However, it is clear from the discussions that this information is used as a reference.

8.7 SPECIFICATION OF INFORMATION NEEDS

The significance of linking information to policy-making is widely acknowledged in literature and the specification of information needs is promoted as a means to achieve this (among others Adriaanse *et al.* 1995; Brett 2000; Timmerman and Cofino 2001; Van Luin and Ottens 1997; WCMC 1998). This notion is however rarely put into practice. One approach to assessing information needs is by focusing the attention of information users on the decisions they have to take sooner or later, based on available information. Normally, everybody anticipates to some extent having to make decisions, however, usually not very systematically. By working systematically, with the use of a few simple questions and schemes a person can give an extensive view of his/her information needs.

This idea has been worked out in a methodology that allows the process of specifying information needs to be managed and that provides the questions and schemes needed (Timmerman *et al.* 2001; Timmerman and Mulder 1999). Essentially, this methodology focuses on the fundamental objectives for the water body. Keeney (1992) distinguishes between fundamental objectives and means objectives. The objective indicates what is considered to be important and those are generally matters that should be maximised (for instance safety) or minimised (for instance costs). The methodology for specification of information needs builds on the fundamental objectives by formulating the basis on which it can be judged if the objectives are achieved. To find these criteria, it is useful to separate the important aspects from a general objective and then work out what measurable or easily perceptible criteria can be derived from this. As a next step, the positive and negative factors that promote or hinder achieving the objective and the information needed to be able to account for

them are identified. Also, the effectiveness of measures that have to be taken if a negative influence occurs and the information needed for this is also identified. Finally, the results of this exercise are taken in a feedback loop through the question: 'If I have this information, do I know enough to be able to take a decision?' (Timmerman *et al.* 2001).

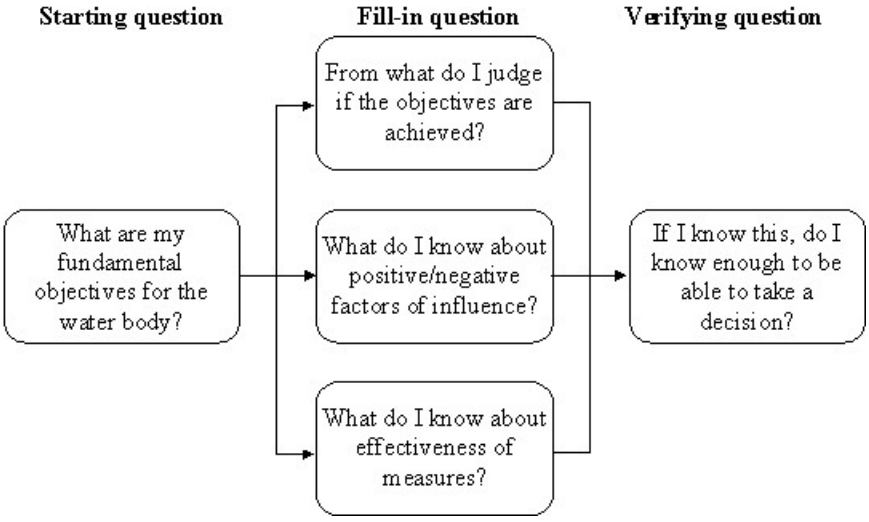

Figure 8.2. Essential questions in the mind-model for the specification of information needs.

8.8 APPLICATION OF THE INFORMATION CYCLE IN A TRANSBOUNDARY CONTEXT

How does this theory feed into practice? In the early 1990s, in European countries a shared interest was growing in working together to prevent deterioration of water quality in transboundary waters and to ensure reasonable and equitable use and joint conservation of transboundary waters. This concern is expressed in the Helsinki 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (UNECE 1992). Under this convention, Guidelines for water-quality monitoring and assessment of transboundary rivers were developed. To start the preparation of the implementation of the guidelines and to test these guidelines, a pilot project programme was started in 1997. The pilots in this programme followed the guidelines, using the monitoring cycle as a basis while specific aspects were further elaborated in a reference report (UNECE TFMA 1999).

An important activity in the pilot projects was the analysis of water management issues, based on several studies and inventories. This analysis of water management issues was done as a joint activity of the riparian countries and was the basis for the specification of information needs. The results of this part of the programme are laid down in separate reports for each river basin (Adamková and Bernardová 2002; Landsberg-Uczciwek 2002; László and Sandu 2002). In their analysis, the riparian countries included their priorities and water management issues. The joint reports show that differences exist between the countries, and these have to be accounted for when taking water management measures. As an example, in Table 8.1 the relation between the water uses in the basin and the occurring problems for the river Bug as concluded from the study are shown. The issues that are not important or are moderately important as a common concern are clearly indicated.

Table 8.1. Relations between the functions of the river Bug basin, the utilisation of the water and the problems occurring in the basin (adapted from Landsberg-Uczciwek 2002)

	Uses/functions							
Problems	Ecolog-ical function	Supply of drinking water	Agri-culture	Fish-farms	Recreat-ion and angling	Supplies for the industry	Transport medium including sewage	Impact on lake
Pollution by nutrients and eutrophication	+++	+++		+	+++	+	+	+++
Microbiological pollution	+	++	+	+	+++		+	+++
Organic pollution	+++	++		+	+		+	+++
Accidental pollution	+	+	+	+	+		+	+
High variability of flows	+				+		+	
Flood hazard	+	+		+	+	+	+	+
River regulation, damming and draining	++				+		+	
Pollution by toxic substances	+	+	+		+		+	+

accordingly +++ high; moderately ++ medium; not important as common concern + moderate stress

Evaluation of the pilot project showed that the projects resulted in strengthening of the cooperation between the countries through the work done in

joint working groups. It also supported the exchange of experience and provided insight into the ideas of people from neighbouring countries. This helped to overcome certain paradigms and helped to take on a higher level of perception of information, thus changing the role of information. In addition, it was felt that the approaches to monitoring and assessment were brought onto a higher level. On the other hand it was felt that political and legislative changes in the countries interrupted the progress of the pilots, while there was the danger of coming loose from the international river basin commissions (Adriaanse 2003).

8.9 DISCUSSION

Steps towards cooperation between riparian countries can be taken when patterns in information become clear. In a transboundary water situation, one country may have reasons to place emphasis on certain (types of) information, usually because it may help that country to deal with a specific problem or resource use, while this information may not be too relevant for the other country. Only when the other country learns about the reasons behind the information can it appreciate the need to collect such information. Such understanding can lead to mutual trust and eventual real cooperation as Huisman *et al*. (1998) emphasise.

Based on common appreciation of problems and the information from the monitoring networks, countries can take measures that are mutually beneficial. In terms of the classical temple framework we see technical cooperation, the central support for transboundary water management, develop. Information and, next to that, access to information, especially to enable public participation and a bottom-up approach (see Milich and Varady 1999), are indispensable in this process. Building on this, real cooperation is established and information has become a constitutive force.

However, differences in appreciation of information between the parties, the public, scientists and decision-makers, may still exist. The manner in which information is used in decision-making depends on the ways in which the problem is perceived, and is consequently highly subjective. Moving through the characteristics provided in this chapter of information as moving from data to constitutive force, the subjectivity of the information increases. If information is to have an impact on policy, it has to form awareness and opinions, and has to change attitudes among decision-makers (Denisov and Christoffersen 2001)(see also Chapter 10).

Transboundary water management faces the challenge of working towards close cooperation between riparian countries. An integrated approach, including social and economic aspects of water management, is needed as well as transparency and involvement of local stakeholders. Proper information is

essential in this. The work on the basis of the information cycle shows that this framework provides a good basis for the required cooperation. The information cycle focuses on processes in the central pillar of technical cooperation, but aims at including the politics and institutions. If the three pillars are insufficiently connected they may build their own structures, thus leading to imbalance in the shared water resources management.

Much of the presently available environmental information is little appreciated by policymakers. In decision-making there is little attention paid to the exact figures, especially the physico-chemical and biological data. On the other hand, if such data is not present, it will be asked for. Next to this, if the information presented, especially information concerning the problem description, lies not within the expectation scope of the decision-maker, the decision-maker will dispute the information and ask for additional information. The information cycle promotes the stage of specification of information needs prior to the production of information as a solution to this problem. Recognition of the potential of information as a constitutive force can increase the attention of policy-makers for improved information production. Involvement of policy-makers is a prerequisite for effective cooperation in applying the information cycle and for effective specification of information needs.

The process of specification of information needs itself, on the basis of the methodology used in the pilot projects, provides a good basis for the required integrated approach. The methodology promotes transparency and supports capacity-building. It also provides for inclusion of public participation in the process. As information production is based on the expectations of the information user, the resulting information is likely to fall within the scope of expectations of the decision-makers and be reliable in the perception of the decision-maker. In a transboundary water management situation the information should reflect the concerns of the countries involved. Furthermore, this information should also allow for different solutions in different countries.

In conclusion, specification of information needs to support transboundary water management should be carried out in a participatory process that is based on close cooperation between the riparian countries. Involvement of policy-makers in this process is imperative. Also, an integrated approach is needed that stretches out over a wide range of disciplines. Only in such a way can information be really supportive of water management.

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9

Addressing environmental information efforts: the impact-of-information chain

Nickolai Denisov, Ieva Rucevska, Brian Lucas, Otto Simonett, Claudia Heberlein and Hugo Ahlenius

9.1 INTRODUCTION

This paper discusses common practices and failures of public environmental information services and suggests as an alternative a shift towards supply- rather than demand-driven environmental communication.

The discussion is put into a framework of the impact-of-information chain which is described in much more detail, with numerous examples and arguments, in UNEP/GRID-Arendal (2001a).

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The paper draws in particular from the authors' long-term capacity-building experience in Central and Eastern Europe and the Newly Independent States (http://www.grida.no/enrin/) as well as their work in the context of Baltic environmental cooperation. To better relate the issues to a water basin management context, references are made to transboundary water management of the international water basins of the Baltic, Caspian and Aral Seas.

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9.2 IMPACT-OF-INFORMATION CHAIN

An 'impact chain' is a simplified graphical model of how information propagates through different stages of interaction between the producers of information, the audience of its users, and the environment.

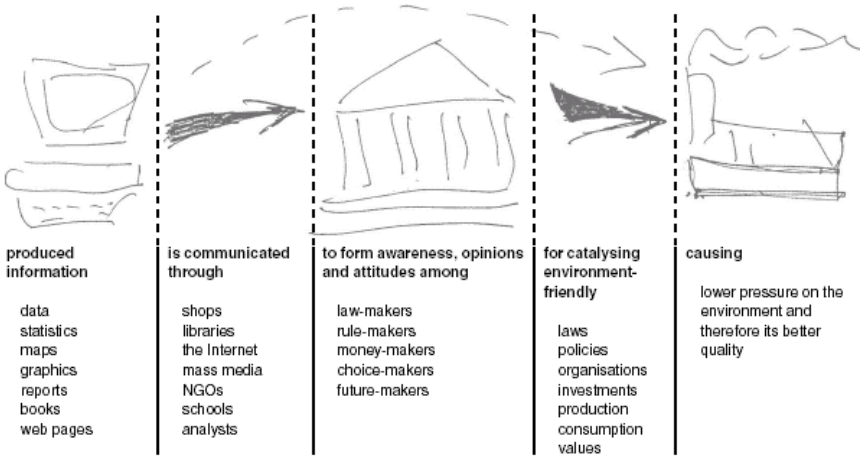

Figure 9.1 Impact-of-information chain (UNEP/GRID-Arendal 2001)

The left part of the chain represents the supply of information, while the right part represents the demand for information determined by its users and the context of use. The 'impact chain' represents only a linear part of the process, there are also feedback loops. The different stages of the 'impact chain' are described in Box 9.1.

Box 9.1 Elements of the impact chain

Production of information includes everything from data collection to interpretation to the publication of an 'information product' in the form of a report, a book, a graphic, a map, etc. At this stage, the producer of information can choose the content and the format of the product to be released.

Communication is the stage where information leaves its place of origin and is communicated to the outside world. Information may reach its target audience directly: people buy a report in a bookstore, borrow a book at a library, receive a briefing note in mail, or download a map from the Internet. The same information can also reach its audience through such intermediaries or 'brokers' as the media, special interest groups (NGOs, clubs, parties), analysts, schools. These channels of communication are able to 'filter' and refocus information according to the specific needs and interests of their own target audiences.

Awareness, opinions, attitudes: groups such as the media or NGOs are sometimes perceived as end users of environmental information. Instead, they should be considered effective intermediaries of environmental knowledge to those in a position to make decisions. What actually happens when people become aware of an issue is however difficult to understand fully, sociological and psychological studies suggest that relations are not at all simple between private opinions of individuals, public opinion that often relates to that of private individuals only indirectly, and the build-up of an attitude.

Decisions: information can either directly encourage actions if a solution is already within practical reach (to buy or not to buy; to vote or not to vote; to drive or not to drive), or it can help promote, develop and establish more comprehensive and effective frameworks (e.g. legal, institutional, fiscal etc.) intended to modify the behaviour of people or organisations in the desired direction. In the latter case information plays a role both before a framework is introduced (to raise awareness about its importance and provide supporting arguments) and after it has been implemented (to maintain awareness about the issue, to explain a new mechanism, opportunities it offers and practicalities of implementation).

Impact: the final stage in the chain is where we may be lucky to observe a positive change in the environment. Examples exist where such a change has been quite clear and where information has obviously played a decisive role (UNEP/GRID-Arendal 2001a). On the other hand difficulties with systematically collecting such evidence are also quite apparent (Frank Thevissen in UNEP/GRID-Arendal 2001b).

The concept of the chain, obviously based on a good deal of common sense, is not new. A similar model 'Who - Says What - In Which Channel - To Whom - To What Effect' was already outlined by Harold Lasswell in 1948 (Lasswell 1948). This model was then developed further by a number of media and communications researchers who added extra dimensions, feedback mechanisms and other complementary elements. Thus the impact-of-information chain as presented here can be seen as a specific variation of Lasswell's model (although it was originally developed independently of it). Its pragmatic value is that it provides a framework specifically applied as a coherent analysis of development, communication and use of environmental information processes, which are otherwise often seen as separate and unrelated in the practice of public environmental management.

3 LIFE IN A PUBLIC ENVIRONMENTAL ADMINISTRATION OFFICE

In the everyday life of public environmental management, activities related to environmental information are often under-prioritised. This has to do with the fact that neither environmental administrators nor providers of public environmental information see the entire chain as one process which should be managed as such. This results in environmental monitoring and data processing being quite detached from, for example, media and public relations of environmental administrations and, furthermore, the everyday life of those who should be the final consumers of public environmental data (politicians, general administrators, consumers, citizens). Such users of environmental information, too, have only limited understanding of what information they would need and what is feasible to expect, and limited possibilities to influence the whole process.

Some common faults of public environmental administrations in addressing the environmental information delivery process in its entirety are summarised, in a somewhat exaggerated manner, in Box 9.2.

These statements are characteristic of many environmental administrations and institutions on various levels, from the local to the regional and even global. To better relate this to the context of water basin management, Box 9.3 illustrates the authors' impression of how these statements apply to the management of three transboundary marine basins in Eurasia, namely the Baltic, the Caspian and the Aral Sea.

Box 9.2 Common faults in managing public environmental information

PRODUCTION
A Monitoring is self-centred and self-driven. Data holders do not want to be understood and have no appreciation of end users of information (particularly outside administrations). Maintenance of data cemeteries rather than user-targeted production wastes energy of public environmental information offices.

B Competition rather than cooperation prevails among data providers, there is little appreciation of common goals not related to securing funding for sustaining on-going activities.

COMMUNICATION
C When public environmental communication does happen, it is often not based on data, or at least data available within the same administration are grossly under-utilised by public relations offices.

D Power of attractive user-targeted formats of information products and user-specific channels for their dissemination is under-appreciated; publications are supply and expert-driven (what is commonplace in the world of commerce, high politics and NGOs is yet to be understood by public environmental offices).

E The most efficient communications channels such as mass media and NGOs are often not considered allies by public administrations (and vice versa).

DECISIONS – IMPACT
F Data are never really used or understood by administrators and policy-makers. Hence there is no systematic 'social order' to information providers and disseminators from the policy-making side (rather ad-hoc requests).

G The general public, being an equally major user of information (cf. the Aarhus Convention), is altogether not part of decision-making when it comes to establishing and maintaining public environmental information systems.

H Environmental administrations entertain no overall concept/idea and vision/management of environmental information and communication activities, different bits and pieces are managed separately in an unrelated way. External target audiences are unknown and not taken seriously. Nobody really cares about the end impact of public environmental information, no assessment of efficiency and effectiveness of public environmental information is carried out.

Box 9.3 Information management issues in some transboundary water basins as encountered by UNEP/GRID-Arendal's experience

	Baltic Sea Basin http://www.helcom.fi/ http://www.ee/baltic21/	**Caspian Sea Basin** http://www.caspianenvironment.org/	**Aral Sea Basin**
A	HELCOM monitoring programme is rather technical with a long time-frame, Baltic Agenda 21 sectoral monitoring is driven by policy goals	Transboundary Diagnostic Analysis (TDA) made as a technical exercise, Topic Centres are not user-focused	Monitoring and databases are technically driven, severe problems with access to existing data
B	Strong competition at least in the Eastern part, and high resistance to change	Poor coordination of national and thematic data holdings	Insufficient capacities, thus little real competition
C	Currently very good combination at HECLOM, good but not frequent at Baltic Agenda 21	Little communication of assessment data	
D	Improving, good examples exist, ongoing process of creating more targeted reporting	Some ongoing work	May be improving under the revised Aral Sea Basin Programme
E	Good, active media approach at HELCOM	Little work with NGOs and media	
F	Data generally reach political agendas	No obvious own drive, though TDA is part of a policy process	No own drive, weak linkages to agenda-setting although formal links exist, low capacities
G	Unclear/no public influence on design of information flow	Marginal, at best ad hoc consultations with end users and NGOs	
H	Improving, good examples exist	No systematic approach, CaspSIS is data-driven	Largely data driven although the need is recognised

10.4 INVERTING THE CHAIN

Probably the most important element that will increase the potential impact of information is trivial: to always think about it when designing and implementing the information process. Amazingly many information systems and publications, at least in the public domain, seem to be designed with no usage perspective in mind, on a completely supply-driven basis. If information is released not just because it is incidentally available and in whatever form turned out convenient for publication, but

because its producer has at least a slight idea of who can use the information, and how and why it is useful, then there is a better chance of success. An objective-driven approach to developing, disseminating and using information has for a long time been widely accepted in the world of commercial marketing and advertising, public relations and similar fields. It has been also successfully used by major environmental NGOs.

Two examples below illustrate how 'reverse-engineering' thinking can be applied to gain a holistic and objective-driven perspective of environmental information flow. Box 9.4 shows a hypothetical case study from Communication of Environmental Information workshop in Arendal, Norway in 2001 (UNEP/GRID-Arendal 2001b) aimed at developing a top-down communication strategy for protecting biodiversity in South-East Asia, taking into account different needs and roles of various 'players'. (In real life, UNEP's and ICRI's 2002 global communication campaign for protecting coral reefs did include many similar elements, see UNEP 2002). The other example (Figure 9.2) is a conceptual framework supporting the development of an overall communication strategy for UNEP/GRID-Arendal. Details of this and other GRID-Arendal's activities related to the impact of environmental information can be seen at htpp://www.grida.no/impact/. Yet, apart from the overall philosophical value, the practical application of such techniques for a specific life situation always remains a challenge: a matter of art rather than hard science.

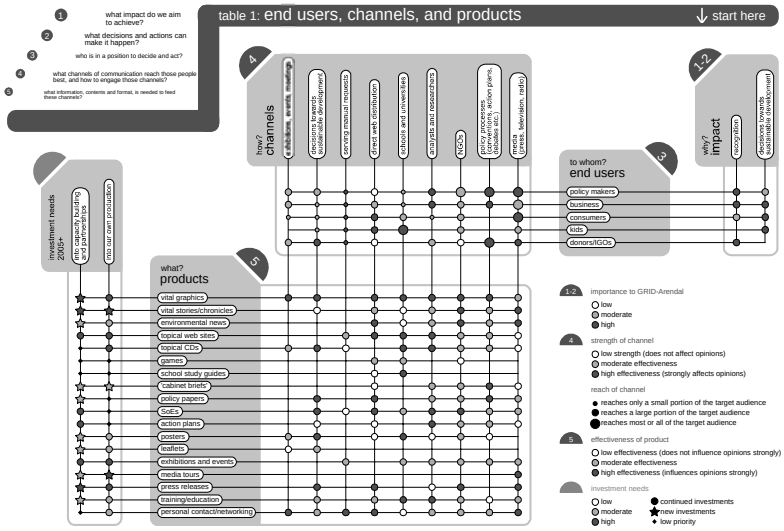

Figure 9.2 Conceptual framework for GRID-Arendal communications strategy.

1. Overall objective: create awareness on the issue in South-East Asia and improve status of biodiversity in region. Time frame for tangible effects is 3–5 years **2. Specific objectives:** Public awareness, species and area protection should go up, biodiversity-unfriendly development down			
3. Who are our audiences?	**4. What are their needs?**	**5. What should we tell them?**	**6. … and how?**
National Government National Parliament Local Politicians	Stay in office National prosperity Attract foreign investment Re-election Regional/local prosperity	Biodiversity is a 'Hot Topic', popular, good national image, resource	HARD FACTS: business opportunities are associated with bio-friendliness (also see Industry) MEDIA: plant a story to illustrate popularity of the issue, demand for biodiversity LOBBYING: alliance with environment groups – support by feeding info.
Farmers	Good life Income Continue farming	It is possible to sustain your lifestyle without devastating your local environment Alternative economic uses for protected areas (e.g. medicinal plants)	Teach alternative farming techniques Demonstration farms Community leaders (political, religious)
Tourists	Fun, exotic experience	Eco-tourism = fun, exotic experience Exclusive Be friend of nature and your host	PROMOTION: video, print materials (newspapers, magazines) to show how wonderful nature tourism is. Practical information: how to go there, what to do. Media (e.g. National Geographic), travel agents IN-COUNTRY: instruction how to behave eco-friendly, airlines, hotels
Land developers Other industries Resource extraction Industries Tourism industry	Business as usual (or better!) More money More tourists, better image Attractive destinations	Economic opportunities Invest in eco-tourism and protection or lose competitive advantage Competitive advantage for 'eco-friendly' resources	HARD FACTS STRATEGY: Future development of the markets MEDIA STRATEGY: You're bad and we are better! You will lose! Publicise biodiversity 'hot spots' Changing markets best business practices (tours, direct interaction with other companies) ECO-LABELS (Western market sensitivity)
Children	Do something good Natural spaces Kids love animals	Take care of animals Talk to your parent about it	MEDIA/TOYS/BOOKS/SONGS: What fun it is to have lots of animals ORGANISATIONS (scouts/guides/schools): field trips, camps, events, educational support materials for school
Consumers	Status symbols Price/quality	There are high-quality, inexpensive, and environment-friendly alternatives – choose green! Endangered species products are not sexy	MEDIA: celebrity anti-endorsements Horror-campaigns (Activist groups in the West) Show companies' activities, good and bad

Box 9.4. Communication strategy for protecting biodiversity in South-East Asia (a workshop case study, UNEP/GRID-Arendal 2001b).

9.5 CONCLUSIONS

Environmental information is an indispensable resource readily at the disposal of usually under-funded and under-appreciated public environmental administration. It has high value for direct assistance to environmental decision-making, mobilisation of public support to public environmental policies, and supporting environmental arguments in resolving inter-sectoral conflicts. Its power, however, as well as ways to effectively release it, are often not adequately understood by public environmental management bodies who also have little capacity to work beyond their traditional information fields (monitoring, publications, serving explicit requests).

On the other hand, the impact-of-information chain model being a representation of the flow of environmental information as a continuous process from its origin to a real-life impact clearly demonstrates that information is best managed in a holistic manner. This means that all essential elements of the chain, from monitoring to packaging and disseminating information to its interaction with decision-making processes need to be taken into account. Successful long-term planning should be objective- rather than supply-driven, starting on the side of communication strategies rather than production. Unfortunately this is more often not the case than it is.

To improve the use of environmental information in public environmental management, there is an apparent need for awareness raising and capacity building among environmental administrators (information as a policy instrument), public/media relations professionals within environmental administrations, and data/information producers and providers. Relations should also be strengthened with both the end users of environmental information (decision-makers of all kinds) and intermediaries such as mass media and the NGOs, who may also be in a position to provide support with some tasks for which public administrations lack experience, capacities or a mandate (e.g. re-packaging of environmental information into popular formats, active campaigning and involving broad civil society).

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10

Towards GIS- and Internet-based information systems for transboundary river basins

Sindre Langaas, Hugo Ahlenius, Fredrik Hannerz and Susanna Nilsson

10.1 INTRODUCTION

The prevailing water resources management paradigm is currently moving away from a quite strict focus upon the water objects themselves, such as rivers, lakes, lagoons and groundwater bodies, and their environmental qualities or water resource quantities. The direction of this shift is towards the entire river basin including the water objects but giving much more emphasis to the human activities affecting water quality and quantity. Popularly speaking, it can be described as a move from H_2O towards H_UMANS as the primary management unit. The logic for this change of emphasis is quite obvious, although not

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uncontroversial in a professional area dominated by a technical/scientific paradigm and water professionals. As water-related policy and management increasingly deal with environmental problem solving, or efficient and equitable water resources sharing, the human activities and their distribution within the river basin have to be considered in order to find the politically acceptable and most cost-effective solutions to the problems identified. Furthermore, it is increasingly becoming recognised that the actors and stakeholders affecting water quality and quantity are diverse and operating on many different geographical levels. Thus, participatory management and planning requires a substantive and easily accessible open information base to be able to support actors and stakeholders on all these levels in their decision-making. Ideally, what is needed is an open and non-restricted information system featuring information both on water quality and quantity aspects, and the human activities and factors in the river basin that influence these aspects.

The Water Framework Directive (WFD) is a most tangible and influential legal instrument partially reflecting this change of paradigm. With the changed paradigm, new needs for information focusing upon humans and their activities influencing water quality and quantity from within the entire river basin and information tools to handle such information have emerged. From an information-technology point of view two obvious candidate tools for meeting this new information challenge are Geographical Information Systems (GIS) and the Internet. The WFD is in a European context paving the way for the use of GIS in river basin management by explicitly demanding Member States (MS) to report various 'GIS maps' to the European Commission. As concerns the use of the Internet as the 'systems solution' for providing open and non-restricted access the WFD does not demand this to be used, yet there are strong indications that the Internet will become a key tool for many MS in their public outreach efforts.

This chapter starts by providing an account of how the WFD demands GIS to be used for reporting purposes, and through legally non-binding guidance documents tries to stimulate wider use of GIS in IWRM. Such wider usage includes analysis of the environmental pressures in the river basin that may threaten the goal of achieving good ecological status of the water bodies and the likely impacts upon water quality caused by the pressures. Further, the guidance document on public participation (PP) promotes the use of interactive WebGIS as a PP tool.

Second, based upon experiences from the Baltic Sea region in developing, using and disseminating transboundary sea, lake and river basin GIS data and information, we want to highlight some key challenges related to the establishment of the transboundary river basin GIS databases, but also exemplify how GIS and the Internet have been used to provide free and

non-restricted access to transboundary river (and sea) basin information and systems.

Third, based upon the previous sections we outline a concept for a transboundary river basin information system (RBIS) that technologically may simply be looked upon as a marriage of GIS and the Internet, with a multi-thematic GIS database as the 'heart' and a legal (and politically defined) status as a public good. The RBIS concept contains the traditional definition of GIS expanded with these additional features.

Finally, we discuss some of the main challenges in the development of such a RBIS. This discussion will focus upon the development of the GIS database. While the technical part of developing a transboundary GIS database is far from trivial, the most problematic parts are related to (1) the development of a RBIS that can become a public good, given the legal status of most GIS data developed by the public sector actors, and (2) the organisational aspects related to which actors should develop and maintain such a RBIS. While traditional transboundary river basin regimes have been able to develop joint water monitoring activities and databases, the development of an RBIS will mean a new undertaking that requires new competence and focus as well as resources, as demanded by the changed paradigm.

10.2 THE WATER FRAMEWORK DIRECTIVE AND GIS

For European countries being EU Member States, Candidate Countries and associated EFTA countries, there is an increasing number of EU Directives that will have a positive impact upon the introduction and diffusion of GIS into the area of national and transboundary integrated river basin management (IRBM). Most of these directives, of which some have entered into force and some are in the process of being developed, proactively try to improve access to, use and re-use of GIS (and other types of) data and information that have been developed by public authorities. Two existing Directives with these aims are:

- the Water Framework Directive (22 December 2000);
- Directive 2003/4/EC on public access to environmental information (28 January 2003).

Additionally, a proposed directive on the re-use and commercial exploitation of public sector information, and another possible future directive that will address the specific key issues related to data access and the creation and maintenance of spatial data should be mentioned.

Among these, in the short and medium term, the most influential legal instrument on the EU level that will influence the use of GIS in integrated river basin management is indisputably the WFD. As the WFD has just started to be

implemented across Europe, any analysis at this stage of the impact of the WFD upon GIS usage in IRBM will primarily be based upon review of the WFD text itself, its annexes and the recently developed guidance documents. The latter are legally non-binding documents that have been developed under the common implementation strategy of the European Water Directors. The main aim of this strategy is to allow a coherent and harmonious implementation of this Directive. Focus is on methodological questions related to a common understanding of the technical and scientific implications of the Water Framework Directive. These guidance documents are targeted to those experts who are directly or indirectly implementing the Water Framework Directive in river basins.

The WFD is currently putting strong pressure upon the EU member states and candidate countries in introducing GIS in the implementation of the WFD. The guidance document on implementing the GIS Elements of the WFD (Vogt 2002) is tailored towards those preparing the geographic datasets for the preparation of maps required by the Directive, those preparing the final maps as requested under the WFD, and those reporting the maps and GIS layers to the European Commission as required by the WFD. The document focuses upon the thematic content and technical specifications for the GIS layers to be prepared for reporting to the European Commission. It does not, however, address how to use GIS in the analysis of pressures upon freshwater bodies and their likely impacts, neither does it cover how to use GIS in the preparation of river basin management plans nor how to use GIS for public consultation.

Historically, georeferenced data have been reported to the European Commission in the form of analogue maps. With the introduction of GIS, these maps or the underlying GIS layers can now be reported in digital form. In the European context experience with digital reporting is limited. The GIS guidance document, therefore, additionally suggests best practices for the immediate reporting needs of the WFD and at the same time formulates strategies for long-term needs. The recommendations will have to be tested and further developed over the next few years.

Following a detailed analysis of the WFD and its annexes, the GIS Working Group (WG) arrived at a list of 12 maps based upon 15 primary GIS layers that should be developed and reported to the European Commission at different occasions until 2009 during the implementation of WFD. The 12 ‘GIS maps’ to be reported to the European Commission are:

- River Basin District Overview:
- Competent Authorities
- Surface Water Bodies (SWB) – categories
- Surface Water Bodies (SWB) – types
- Groundwater Bodies
- Monitoring Network for Surface Water Bodies

- Ecological Status and Ecological Potential of Surface Water Bodies
- Chemical Status of Surface Water Bodies
- Groundwater Status
- Groundwater Monitoring Network
- Protected Areas
- Status of Protected Areas.

The GIS WG in its guidance document does not address how to use GIS in the analysis of pressures and impacts. This aspect, however, has been dealt with by the WG established to provide guidance on how to carry out pressure and impact analysis, an important aspect in the development of the River Basin Management Plans (IMPRESS WG 2003). On this aspect, however, the WFD is much weaker when it concerns the use of GIS. While the WG IMPRESS has given strong emphasis in their guidance document to the benefits of using GIS-based tools and models in carrying out river basin-based pressure and impact analysis, and also provides a number of best practice examples on how this can be carried out, there are no mandatory obligations upon Member States (MS) to use GIS tools for such purposes. Thus, the possible use of GIS for such analytical purposes will be left to current and forthcoming MS to decide upon.

It is also clear that any MS implementing the WFD could well improve public participation in the elaboration of the River Basin Management Plan by providing open Internet access to the primary GIS data, derived geographic information products, such as ready-made digital maps and statistical tables, and interactive WebGIS. The guidance document on public participation explicitly describes this interactive WebGIS as a useful technique in public participation, in particular with respect to public consultation and outreach purposes, but also in conjunction with possibilities for establishing interactive dialogues (Public Participation WG 2002).

A quite substantial fraction of the River Basin Districts (RBD) currently being designated by the current and forthcoming MS will be of transboundary nature. In these cases the requirements upon WFD implementation are relaxed relative to the pure national RBDs. This also concerns the use of GIS even for the mandatory reporting requirements. Still, the larger European transboundary rivers with mature International River Commissions – Oder, Elbe, Rhine and Danube – have strong ambitions to develop transboundary multi-thematic GIS databases to meet the demands of the WFD and have already started work in this direction (European Commission 2002). In the case of most other transboundary river basin districts without existing or with feeble formal regimes and management structures, the implementation of GIS has weaker prospects. This is in particular the case for transboundary river basins districts with one or more

riparian states being neither current nor forthcoming MS and thus without strong incentives to comply with the requirements of the WFD.

10.3 EXPERIENCES IN DEVELOPING TRANSBOUNDARY GIS DATABASES IN THE BALTIC SEA REGION

The heart of a GIS, whether stand-alone or in combination with the Internet, is the database. Past European experiences have shown that the development of GIS database aimed for use in transboundary water research or management is a non-trivial task (see Langaas 1998, Kwadijk 1998, Hannerz et al. 2002). This concerns the development of multi-thematic GIS databases for single purpose, single institutional use, but even more so if the ambition is to make the resulting database freely available for any potential third party concerned with the region covered. As seen in the previous section, the WFD has now become a legal stick on the national level and carrot on the international level, and is 'demanding' the development of multi-thematic GIS databases. Certain past experiences in the Baltic Sea region may point to some key challenges and solutions for such efforts on the international level, in particular if the ambition is to acknowledge the principle that open and free access to environmental information is a right and precondition for IRBM. In Europe, the Baltic Sea region has become a sort of model region for the development, use and dissemination of GIS data for transboundary water regions. We will here summarise some key features of two GIS database development efforts, both with transboundary scope and with the intention of providing non-restricted access to the resulting data, derived information and information services:

(1) the Baltic Drainage Basin GIS, Maps and Statistical Database, hereafter named Baltic Drainage GIS (Sweitzer et al. 1997, Langaas 1998);
(2) the Lake Peipsi/Narva River Catchment GIS database (Hannerz et al. 2002).

The primary aims of both these efforts have concerned the development of harmonised transboundary GIS databases for initial use within specific RTD projects, and with the subsequent non-restricted distribution of the databases and derived geographical information products, such as digital cartographics and statistics, to any third-party users.

10.3.1 The Baltic Drainage Basin GIS, Maps and Statistical Database

The purpose of this database development effort was twofold. First, it took place within the Baltic Drainage Basin Project (BDBP), an EU 3rd Framework RTD project, and was initially developed to address some specific scientific questions related to the spatial distribution of sources and sinks of nutrients, primarily nitrogen and phosphorous within the entire Baltic Sea drainage basin. Second, as one partner involved in the work, UNEP/GRID-Arendal, has an institutional objective of increasing access to environmental information, it was also developed with the aim to support other potential users and beneficiaries concerned with and involved in large-scale environmental research and management of this region. The GIS database development effort took place in 1993–94, while the automated Internet distribution of GIS data, derived statistics and maps, both static and interactive, as well as associated documentation, started in 1995 and is still going on.

The initial database compilation efforts were conducted as a joint effort between the Beijer Institute of Ecological Economics, Department of Systems Ecology – Stockholm University and GRID-Arendal. Given the resource and time constraint of the project, the primary approach used in the development of the GIS database was a top-down approach. This approach is essentially based upon the use of GIS layers with complete coverage of the entire region, such as the Digital Chart of the World. However, for some key layers such as Administrative Units, there were no freely available GIS data sets with seamless coverage of the entire region. Thus in this case the GIS data had to be compiled from a wide variety of data sources (Langaas 1998). Additionally, for some thematic variables such as arable land and wetlands, derived 'probabilistic' layers were prepared based upon modelling using a combination of land cover GIS data and land cover statistics for administrative units (Sweitzer 1996). The final database contained the layers listed in Table 10.1.

The resulting GIS database was used within the BDBP to assess, for example, the cost and benefits of different nutrient reductions to the Baltic Sea and to quantify the nitrogen retention capacity of wetlands in the drainage basin.

Table 10.1 Layers used in the GIS database for the Baltic Basin Drainage Project

Layer	Scale	Comments
Administrative Units	1:500k – 3mill	Based upon multiple sources
Land Cover	1 km	6 classes: Open land, Forest, Urban areas, Water, Glaciers, Unknown land. Based upon ESA remote sensing forest map of Europe and Digital Chart of the World
Arable lands	10 km	Arable land is probability modelled using combination of Open Land class in the Land Cover layer and Arable land statistics for administrative units
Pasture lands	10 km	Pasture land is probability modelled using combination of Open Land class in the Land Cover layer and Arable land statistics for administrative units
Coastline	1:1mill	Digital Chart of the World (DCW) coastline
Population density	10 km	Modelled using combination of Land Cover layer and rural and urban population statistics for Arable land statistics for administrative units
Wetlands	50 km	Modelled using combination of wetland layer from DCW and wetland statistics for county level administrative units
Meso-scale Catchments	1:3mill	Digitised from existing HELCOM paper maps

A quite wide diversity of users of the information was anticipated when the dissemination strategy was elaborated. This strategy relied heavily on the use of automated Internet dissemination and recognised that the capability to use raw GIS data was limited among many potential users. Thus, a small array of different geographic information products (GIP) was developed and offered online alongside with the GIS data. The number of GIPs has gradually increased over time as new user needs have been expressed or new data formats have become de facto standards, such as PDF format. Currently, the suite of GIPs includes raw GIS data in four different formats, cartographics in four different graphics formats, statistical tables in two formats and some scientific documents describing or using the database in PDF format. With the advent of the Internet Map Server (IMS) technology, an interactive WebGIS server named the Baltic Environmental Atlas (BEA) was developed in 2000 (Ahlenius 2000) so that non-GIS users could interactively create customised cartographic GIPs (Figure 10.1).

The main user categories that have downloaded various GIPs and used the BEA have essentially matched the initial anticipation (Langaas and Ahlenius 2000). They primarily represent the following broad user categories:

- environmental administrations (policy- and decision-makers)
- university and academics (scientists)
- educational sector (pupils, students, teachers).

The two primary ways of identifying the beneficiaries (or users) have been through frequent but irregular examinations of web statistics, and e-mail and oral communication with users.

The representatives of the environmental administrations have primarily used the GIPs as background information in reports, notably the cartographics or the statistics. In some cases there have been reports on the use of GIS data for this user category. For example, the Swedish Environmental Protection Agency in a government commissioned study on the loads of nutrients to the Baltic Sea from Southern Sweden used the Land Cover GIS layer to model the nutrient fluxes. The Helsinki Commission (HELCOM) in their most recent environmental assessment report base their drainage basin characterisation upon the statistics from the Baltic Drainage basin GIS, Maps and Statistical Database (HELCOM 2003).

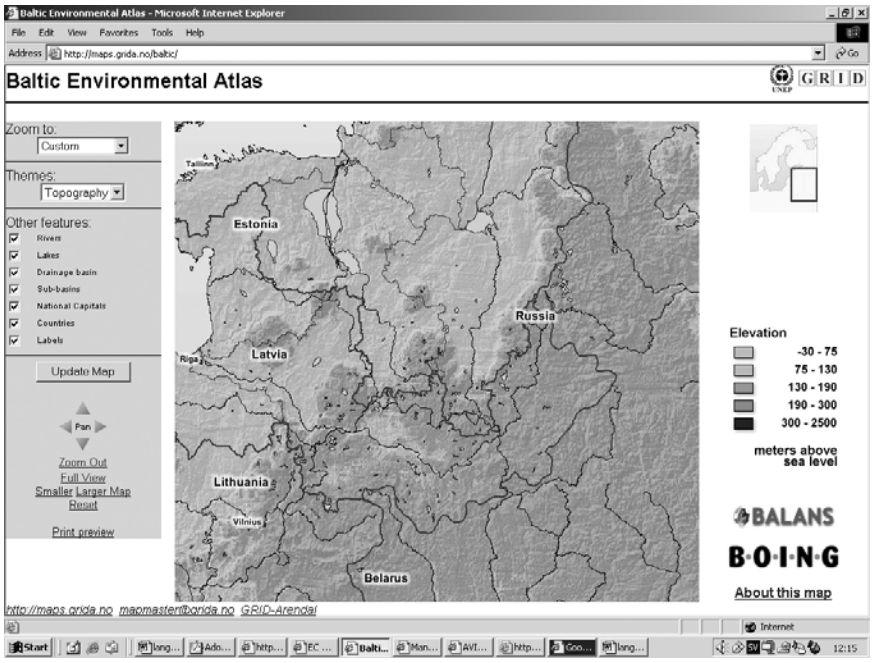

Figure 10.1 The Baltic Environmental Atlas zoomed in at the Daugava River basin.

The academic sector is the one that has most frequently communicated with the publishers of the database. This is probably because academics have used the database for quite specific and demanding scientific applications with high-quality data requirements. Thus, these contacts have been made to obtain additional meta-data beyond what is offered online. Many of the applications have been connected to the analysis of terrestrial (land cover-based) sources of nutrient load. A most interesting scientific undertaking with a strong decision-support aim is currently taking place in the major Swedish MARE program. The overall goal of the MARE research program is to develop a generally accepted and open user-friendly decision-support system (DSS) as a tool to develop and test cost-effective strategies to reduce eutrophication in the Baltic Sea. The MARE DSS will build on a series of models linking information about ecosystem properties, biogeochemical processes, physical transports, nutrient inputs and costs for nutrient reductions. The Baltic Drainage basin GIS, Maps and Statistical Database is one of the input data sources for this DSS.

The last category, the educational sector, has mainly been interested in the less demanding GIPs such as cartographics, and statistics.

Doubtless, the openness to data and information and the ambitious dissemination strategies in the project have led to wide use of the derived products, and thereby to an improved information base and management of the Baltic Sea Drainage basin, than would otherwise have been achieved with a restricted data distribution philosophy. How much better, and the value of corresponding improvement of environmental parameters, is of course difficult to estimate.

10.3.2 The Lake Peipsi/Narva River Catchment GIS database

The development of the Lake Peipsi/Narva River Catchment GIS database took place within the MANTRA-East project, a RTD project under the EU 5th Framework Program. The overall objective of the creation the Lake Peipsi/Narva River Catchment GIS database was to create a multi-thematic GIS database boundary relevant for modelling, assessment, strategic decision-making by partners within the MANTRA-East project, existing management structures and the general public concerned with the tri-lateral region shared between Estonia, Russia and Latvia.

Initially, the GIS database was intended to serve the needs for spatial data for the modellers within the project. Additionally, the GIS database was aimed at serving as many GIS data requirements as possible of those specified in the WFD, and thereby becoming an important input to the work of the Estonian-Russian Transboundary Water Commission in their ambitions to implement the WFD. A recent experimental study on the use and valuing of environmental

information carried out with a group of selected Estonian officials and representatives of the Estonian-Russian Transboundary Water Commission showed that the officials specified river basin information in the form of maps as essential to describe the environmental situation and locate specifics and as superior to textual descriptions (Timmerman et al. 2002). Based on this conclusion and the experiences with the Baltic Drainage Basin GIS, Maps and Statistical Database demonstrating the benefits of free and easy access to various GIPs, the provision of the GIS database and derived information free of charge, easily accessible online and without explicit copy-right restrictions was considered of utmost importance.

While most of these objectives for developing the GIS database overlap, they also put slightly different requirements on the data layers, including resolution, scale and information content. The aim of placing the GIS database and other GIPs in the public domain also imposes constraints on the content of the public GIS database.

In contrast to the BDBP, the approach used in compiling the Lake Peipsi GIS database was predominantly a bottom-up approach based upon national and sub-regional GIS data. This approach demanded considerable more efforts for data harmonisation. Data harmonisation is the process whereby data with different characteristics (thematic, geodetic or temporal) are brought together into a common system or modified in order to contain the same or at least comparable variables. In the case of transboundary GIS databases most often data originating from different countries have both varying thematic and temporal content, as well as geodetic reference systems. Concerning the latter issue, use of existing functions included in most GIS software solves such harmonisation problems. Some sources, such as the elevation model and land cover data, were in raster format. These were resampled to a common 100-metre spaced grid. After all data had been geodetically harmonised came the much more difficult part, the thematic harmonisation. Acquired data that were to be included in the database had several different national and international coding systems and definitions attached to them. The varying coding systems and definitions of the data sources reflected the varying approaches and instruments used in the national data preparation. Converting such data into a single system is challenging and requires both theoretical and technical skills. It was a very time consuming process, partly due to the severe lack of metadata attached to the acquired data. In some cases long hours of telephone conversation with responsible institutions, relevant researchers or people who had been in contact with the data in some other way gave good results but in other cases not. It was easier to assess data from the two EU accession countries, Latvia and Estonia, than similar data from Russia.

Noteworthy was that GIS data from National Mapping Agencies (NMA) in most cases could not be used due to prevailing restrictive copyright legislation they apply. As an example, the NMAs of the Baltic Sea region have recently developed a cartography oriented GIS database of the Baltic Sea region in the scale 1:1mill, named the MapBSR database. Some of the layers from this GIS database could well have been included in the Lake Peipsi GIS database based upon technical merits and characteristics. However, as the usage rights to this GIS database are being sold with a differentiated pricing scheme based upon the logic that the fewer users and beneficiaries there are, the lower the price, it was deemed an unacceptable option.

Through an extensive personal knowledge about available data sources among the project partners involved in the GIS work, a quite unique and harmonised database could be developed. The final multi-thematic GIS database is composed of 26 layers grouped into 7 themes: Hydrology – basic; Hydrology – analytic; Land cover; Pedology, hydrogeology and topography; Administration; Nature conservation areas; and Infrastructure. The basic qualities and characteristics of the database reflect those of the primary data. For example, the nominal scales of the primary data layers range from 1:200,000 to 1:3mill.

Based upon the positive experiences from the Baltic Drainage Basin GIS, Maps and Statistical Database, an interactive webGIS is currently being developed to meet some of the aspirations of the WFD when it concerns public consultation and outreach, in particular towards those concerned stakeholders without GIS competence but with Internet access.

10.4 FROM GIS TO RIVER BASIN INFORMATION SYSTEM (RBIS)

We will here try to develop a concept for what can be called a river basin information system (RBIS) with an emphasis upon transboundary river basin districts. Such a concept may be relevant to introduce at this particular time. Most European countries, enforced and stimulated by the WFD, are in the process of defining how GIS are to be implemented. The concept will build upon following two important starting points:

(1) Many of the River Basin Districts (RBD) to be established in 2003 will be of transboundary nature. The requirements upon WFD implementation are somewhat relaxed relative to national RBDs given that international competent authorities of international RBDs are not obliged to implement EU legislation. Still, several transboundary river commissions that have committed themselves to take on the task of

developing the transboundary river basin management plans, and accordingly to develop and use GIS database for this and other purposes. Examples of transboundary river basin commissions that currently aim to introduce GIS, however defined, are Elbe, Oder, Rhine and Danube (European Commission 2002).

(2) It is now widely known that effective river basin management requires participatory approaches (e.g. GWP 2000 and WFD 2002) Thus, a key ambition should be to develop the RBIS as a public good to meet the information needs of the multi-level actors that in various ways modify the biogeochemical cycles so that water quality or quantity changes. Information needs among stakeholders that influence water quality and quantity are diverse and different from those found in the commonly small and well-defined group of 'water or river basin managers'.

Kaul et al. (2002) explain public goods in the following manner: 'Goods with non-rival consumption and non-excludable benefits have a strong potential for publicness. For example, it generally costs little or nothing to give an additional person access to statistical data. Yet only some data are in the public domain and thus available for all people to use free of charge. Other data are private and must be purchased. Thus it is important to distinguish between a good's potential and de facto publicness. Only de facto public goods are actually available for all people to consume.'

Thus, our concept of a RBIS is a 'systems solution' defined as a public good that offers easy and unrestricted access to a wide variety of river basin information (environmental, socio-economic, hydrological) offered in various formats addressing the information needs of multiple stakeholders and actors at various levels, not only the needs of the forthcoming River Basin Authorities, and the capacities of the stakeholders and actors to handle different type of geographic river basin information.

The provision of public goods, such as a RBIS or its GIS database according to our concept, typically consists of two interrelated processes. The first is the political process, which involves making decisions about the public good to be produced, how to design it, and a good understanding of what net cost and with benefit to whom. The second is the production process. The second process involves bringing together relevant contributions from all concerned actor groups, sectors, and – in transboundary cases – countries.

Technologically, we weave together GIS and Internet in the RBIS concept. As for most other classical stand-alone information technologies, the potential links between GIS and the Internet were early discovered as the Internet boomed in the late 1990s (Plewe 1997). The key added benefit of linking up with the

Internet lies in the ability to provide distributed access to GIS derived data and information and allowing for simple interactive analytical and map-making services to anyone connected to the Internet and equipped with a web browser. By embracing the Internet as an extension to the classical GIS definition, it may appear as if we consider physical access to the Internet a non-issue. We admit that this techno-optimistic view does not reflect the realities of the world or even Europe in 2003. Still, the penetration rates of the Internet into most European countries are high. Thus, we believe that this view is at least partially justified. However, in each case where there are political ambitions to develop a RBIS, the percentage of Internet connected and their access speed among the main target groups should be evaluated and alternative dissemination channels considered.

A RBIS can thus be described in the following manner:

- Purpose-wise. It is a politically initiated non-rival and non-excludable information system that provides easy and non-restricted access to adequate river basin information appropriately packaged for meeting information needs of diverse stakeholder and actor groups participating in IWRM driven by the WFD. Beyond interactive webGIS it should also provide access to the 'hard' GIS data, ready-made maps (in commonly used graphics formats), relevant statistical tables, meta-data and relevant documentation.
- Technology-wise. The main components on the information system provider (server) side are computers equipped with adequate classical GIS software for compiling and handling the GIS database and performing analytical tasks, and Web and Map server software for enabling public access to the GIS data, related information and some basic analytical functionality. These servers should be configured and designed with the most important user groups in mind. On the user (client) side, an Internet connected computer with a standard web browser is required. Additionally, for the 'specialist' user segment, GIS software will be desirable.
- Data-wise. The heart of the transboundary RBIS should be a harmonised, multi-thematic GIS database with a thematic information content that is adequate from the perspective of awareness-raising and decision-making when it concerns factors with an impact upon water quality and quantity. The database should have technical characteristics that satisfy the widest possible user groups. The database should have a legal status that makes it possible to re-use and re-distribute the database in raw or slightly modified form. Such a database will most likely originate from a wide range of original data producers including national mapping agencies, hydro-meteorological agencies, statistical agencies, environmental protection agencies, universities and research institutes and other information producers generally found in the public sector.

- Institution-wise. Within the process of developing a sustainable RBIS the identification of an institutional solution is a most challenging part. As outlined by Kaul et al. (2002), it entails bringing together concerned actor groups, sectors, and in transboundary cases, countries, both from the information (system) producer and user need sides. As the GIS data and information itself is the core or heart of a RBIS, and the relevant data is found at many institutions, the issues related to costs and copyright of data are not easy to resolve. An acceptable financing solution needs to be found as it critically influences data producers' incentives to co-operate. A possible approach is to define the institutional solution for the development and maintenance of a RBIS as a part of the institutional solution proposed for the River Basin Authorities that have to be established according to the WFD. As an example, the International Commission for the Protection of the Danube River with the task to develop a River Basin Management Plan for the Danube river basin has established a River Basin Management Expert Group with a subordinated GIS Expert Sub-Group to ensure the establishment of a feasible GIS solution to meet the WFD GIS demands and its own needs.
- Competence-wise. Beyond the obvious technological competencies required, environmental and geographical information broker competence is required, ensuring that adequate data layers with the acceptable legal and technical characteristics are identified and obtained from a wide range of data providers. As information is widely disseminated the feedback in form of expert knowledge among the public needs to be taken care of in the organisation. Therefore communication strategies have to be prioritised.

10.5 DISCUSSION AND CONCLUSIONS

A concept for a River Basin System (RBIS) has been developed as a potential means for supporting WFD-driven IRBM, including the strict legal reporting requirements, river basin characterisation including pressure and impact analysis, and public consultation and outreach purposes. This concept defines that RBIS as a public good and defines the key aspects from the perspectives of purpose, data, technology, competence and institution.

A non-restricted multi-thematic GIS database will constitute the core and heart of a RBIS. Unfortunately, the European national realities surrounding the production and supply of GIS data in the public sector of today effectively impedes the development of RBIS as a public good. These political, financial and legal realities quite effectively prevent development,

use and re-use of multi-thematic GIS databases, e.g. for river basin management. Over time, and in particular during the last two decades, most public authorities, such as National Mapping Agencies, with a main public thrust to produce spatial information have evolved into what can be termed a monopolistic publicommercial sector. This sector is characterised by actors that have a government granted monopoly concerning the rights to produce and distribute specific types of spatial data on the national levels (Weiss 2002). At the same time they are indirectly enforced through so-called cost-recovery policies imposed by the Ministries of Finance to sell data licences to others for using the data in order to recuperate parts of their costs. The authorities have therefore implemented a combined cost- and copy-right regime to maximise their economic gains through the sales of licences, thus largely disregarding the possibility of offering at least some GIS data as public goods.

Still, as described for transboundary catchments in the Baltic Sea region, it *is* feasible to develop RBIS as a public good if the ambition exists and there are available GIS data resources without severe restrictions for re-use and dissemination. However, one may then have to accept GIS data of lower technical quality than those available in the 'publicommercial' GI sector for some thematic layers. When dealing with larger transboundary regions, often US-based global GIS databases are acceptable non-restricted alternatives.

There are several new and forthcoming EU Directives with key objectives to reduce and eliminate some of these legal hindrances and stimulate use, re-use and dissemination of public sector geographical (and other) information. The WFD is currently the most influential among those in the area of IRBM and will unquestionably lead to increased GIS use in this domain area. The minimum legal requirements of the WFD concern only the use of GIS for preparing digital GIS maps to report to the European Commission. Thus, how far into a RBIS implementation the present and forthcoming MS will aim for remains to be seen. With the relaxed requirements upon WFD implementation for transboundary RBDs and the increased difficulties in developing transboundary GIS databases compared to the national levels, one might anticipate lower ambitions in RBIS implementation for international RBDs. On the other hand, the lower ambitions may lead to higher acceptance for using GIS data with lower technical qualities, and less restrictive copyright rules.

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11

Environmental information for sustainability science and management

R. Kerry Turner

11.1 INTRODUCTION

Water quality and the integrity of water resource stocks are of critical importance for human well-being both now and in the future. Failure to conserve and protect renewable and quasi-renewable water sources will impose significant costs on the economy and society. There is the risk that under current global economic development conditions and trends, irreversible changes may be being imposed on environmental systems which threaten the transition to sustainable development. Further, the complexity of the relationships between

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renewable water sources means that effects can be radiated throughout an ecological system, and the speed and timing of such effects may be uncertain.

While there has to be some trade-off between additional economic development and water resource degradation and depletion, substantial socio-economic welfare improvement can be sustainably secured without the imposition of excessive cost. Striking a balance between the complementarity and the trade-off that exists between economic development and water resource degradation and depletion is the underlying context for future fundamental water resources planning and management questions and challenges.

What is commonly agreed is that in future a more sustainable water management strategy will need to be better integrated in the following ways:

- in systems ecology terms, i.e. in order to better understand how each component of the water system (across a catchment and watershed scale) influences other components;
- in hydrological, biogeochemical and physical terms, i.e. to focus on how water interacts with other natural systems; and
- in socio-economic, socio-cultural and political terms, i.e. to recognise and plan for the accommodation of links to relevant policy networks and economic and social systems with attendant culture and history, so that the chances of achieving a co-operative solution/mitigation strategy are maximised.

11.2 INTEGRATED ENVIRONMENTAL ASSESSMENT (IEA) FOR WATER RESOURCES

When water resources are seen as components of a wider set of interrelated systems encompassed within catchment and watershed boundaries, more efficient management of water and related measures to protect the wider supporting ecosystems are all vital components of a sustainable development strategy. Given the generic goal of sustainable development, management agencies should seek to maintain the resilience of systems, in terms of the ability to cope with stress and shock. System resilience maintenance and/or enhancement is linked to the ecological concept of functional diversity and the social science analogue, functional value diversity. In other words, managing water resources across at least the catchment scale is intimately connected with an appreciation of the full functioning of hydrological, ecological and other systems and the total range of valuable functions and functional outputs of goods and services that are provided. A sustainable approach to water management and pricing must therefore be based on a relatively wide spatial appreciation of the landscape ecological processes present, together with the relevant environmental and socio-economic driving forces. Such a

management strategy will need to be underpinned by a scientifically credible but also pragmatic environmental decision support system, i.e. a toolbox of evaluation methods and techniques, complemented by a set of environmental change indicators and an enabling analytical framework (see Figure 11.1).

Water catchment uses form the essential link between catchment functioning and ecosystem values. Non-use values will be independent of use but still dependent on the essential structure of the catchment or basin ecosystems. Economic value is contingent on ecosystems performing functions that are in one way or another perceived as valuable by society. Functions in themselves are therefore not necessarily of economic value, there needs to be a demand for these functions, or for the goods and services they provide. An 'effective market' needs to be recognised and assessed. The notion of intrinsic environmental value is not captured in the economic paradigm. Intrinsic natural value, i.e. the inherent worth of nature in its many manifestations, remains a contentious issue both ethically and on a more practical level when conservation versus development trade-offs emerge and require resolution. Further, since it is the case that the component parts of a system are contingent on the existence and continuing 'proper' functioning of the whole, putting even an aggregate economic value on ecosystems is a complicated problem.

The economic worth of catchment ecosystem structure (the plants, animals, soil, air and water stocks and flows) is generally more easily appreciated than that of ecosystem process. To evaluate processes such as nitrogen fixation, nutrient retention, pollution absorption and others from any given segment of catchment is a formidable challenge. A precautionary approach is therefore required in any catchment management strategy. It is also evident that there are strong linkages between the types of functions and the benefits provided. The need to insure against double counting in any economic valuation exercise cannot be overstated.

The support system should allow managers to identify a number of generic steps or 'decision rules' in order to operationalise the framework in a given catchment. The main steps are listed below.

- scoping and auditing stage – to scope the nature of the problem and the causes and consequences that are relevant to the so-called DP-S-I-R framework has proved useful at this stage (Turner *et al.* 2001);
- identification and selection of complementary analytical methods and techniques – such as GIS, coupled natural science models, economic analysis, institutional analysis, scenario analysis, etc;
- data collection and monitoring via indicators of change and forecasting of future possibilities via environmental change scenarios;
- evaluation of project, policy or programme options – using methods such as stakeholder analysis, cost effectiveness, cost benefit analysis and multi-criteria analysis (see Figure 11.1).

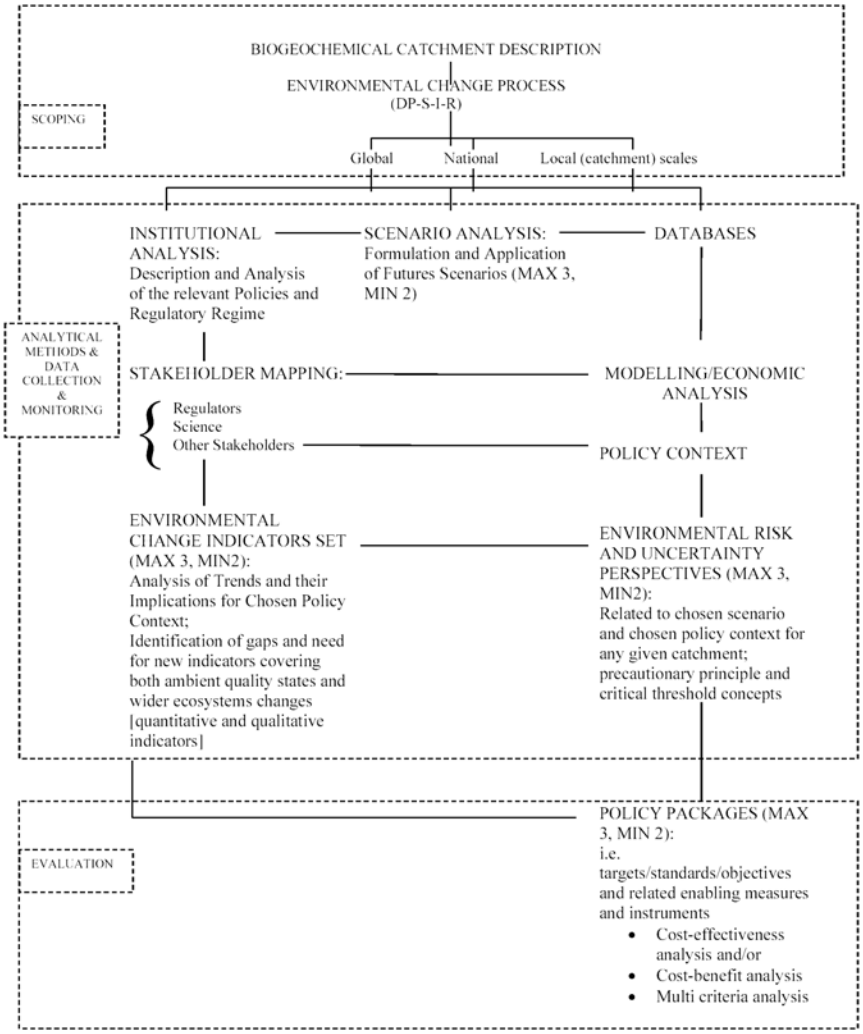

Figure 11.1 Conceptual framework.

11.3 THE NEED FOR AN EXTENSIVE SPATIAL SCALE OF ANALYSIS

Ground and surface water systems are of major socio-economic and environmental importance and their management should be based on an integrated framework in which water is seen as an integral component of a water catchment ecosystem, a natural resource, and a social and economic good, the quantity and quality of which determines the nature of its use. Much of the development and management of these water systems so far has been piecemeal, often without regard for the natural processes in the system as a whole, and in general ignorance of the long-term effects of human activities on the system. This situation has arisen partly as a result of the differing interest of users and local, regional and administrative bodies. But the importance of and need to protect water resources and people and assets in an integrated manner has more recently been recognised by policy-makers, for example at the European wide level of concern, and as laid down in the recent Framework Directive in the field of water policy (Directive 2000/60/EC).

A new management strategy based on the principle of sustainable water resource utilisation should have at its core the objective of catchment ecosystem integrity maintenance, i.e. the maintenance of systems components, interactions among them and the resultant behaviour or dynamic of the system. Integrity is best protected when efforts are made to secure a diverse range of water system functions and their asset values, i.e. functional value diversity. This latter concept encompasses the variety of spatial and temporal scales with which organisms react to each other and to the environment. The onus is then on analysts and managers to take a wider perspective and examine changes in large-scale hydrological and ecological processes, together with the relevant environmental and socio-economic driving forces. Ground and surface water resources management is thus considered at the wider perspective of the overall ecosystem rather than a more narrowly focused sectoral view. Protecting as diverse a range of functions as is practicable should contribute to overall systems resilience and the capacity to cope with stress and shock, allowing adaptation to both physical and social vulnerability. The policy objective of maximum diversity maintenance serves to ensure the maximum amount of functional value in terms of goods and services provision. Such a management strategy requires the practical coupling of economic, hydrological and ecological models within an integrated environmental assessment (see Figure 11.2).

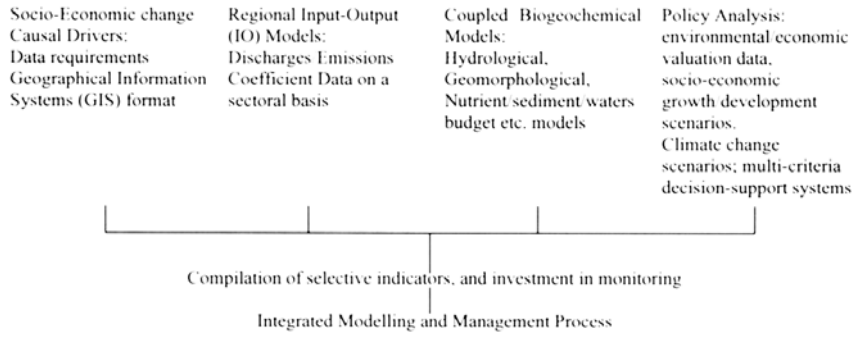

Figure 11.2 Towards integrated models and analysis.

Given the goal of holistic catchment management, one of the primary issues to be faced is whether the scale of administrative structures and appropriately refined scientific support equate with the scale of catchment processes. Management of water systems is all too often focused on a sectoral basis, and constrained by political and institutional considerations. The proprietorial interests shown by local people in 'their' section of the water catchment is an extremely powerful force and one which democratic systems often find difficult to accommodate. Yet water systems, both hydrological and ecological, are driven by processes that transcend the local scale and the short time period. In these linked hydrological-ecological systems, catchments provide a wide range of benefits and services that are often ignored or under-valued in water-use planning, leading to their long-term loss. Moreover, human intervention in these complex and large-scale systems can have results that we do not understand fully at present (Turner 2000).

11.4 IEA AS A CONTINUOUS PROCESS AND DIALOGUE

Various forms of IEA exist including technical, health, environmental, economic and social appraisals. In general, the need for these multidisciplinary appraisals results from the complexity of problems where decision-makers face a range of interrelated choices and conditioning policy networks. At a fundamental level, IEAs should yield value added over single disciplinary oriented assessment; and should provide policy-relevant information. A successful IEA should provide not only a conceptual and analytical framework, but also a 'team-based' interdisciplinary learning process, for experts, decision-makers and, in its most inclusionary form, all other relevant stakeholders (see Figure 11.3).

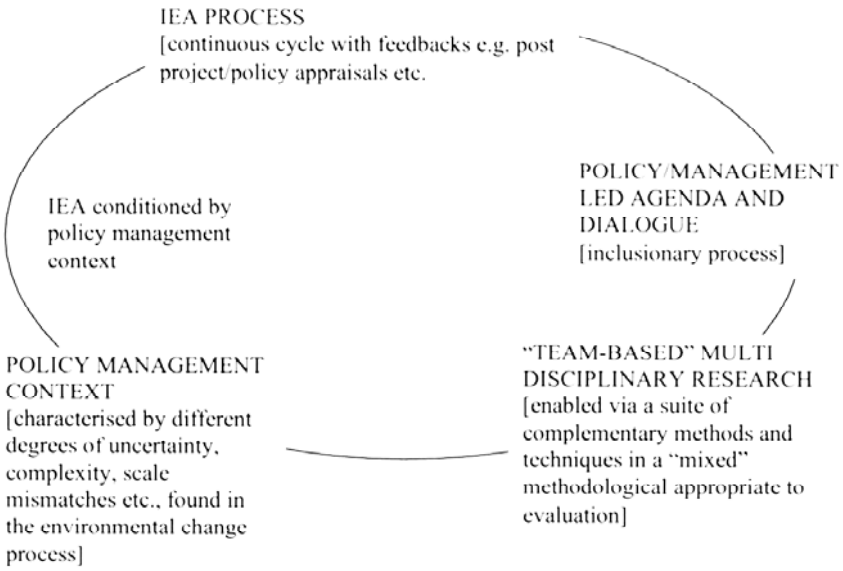

Figure 11.3 IEA as a continuous process and dialogue.

Setting up a collaborative framework between experts with different scientific backgrounds and experiences is often a time consuming procedure. Participants have to get used to and acquainted with each other, overcoming different uses of language, and their often fundamentally different ways of thinking, before their work can actually be put together in a meaningful and coherent way (Turner 2000).

In order for this collaborative process to be successful, effective communication is essential, i.e. communication between experts (scientists) and communication between experts and (lay) policy or decision-makers. Decision-makers should be continually involved in this process so that any assessment is appropriately scoped. Second, any assessment process involves some subjective judgements. If these judgements influence outcomes in a major way, they should be made transparent to the users of the evaluation. Third, most complex decision contexts are beset by inevitable scientific uncertainties and risks, and the involvement of decision-makers in discussions about these uncertainties and risks can help in the formation of coping strategies such as the Precautionary Principle, or the use of Safe Minimum Standards.

While it is important that the different contributing disciplines know something about each others' methodology and approaches to scientific

investigation, this is not the critical problem. What is more significant is that each contributor to IEA maximises their knowledge of the policy/management context at issue (Harremöes and Turner 2001). Each contributor should also be prepared to contribute consciously to the dialogues that must take place if IEA is to be socially relevant. If integration is to succeed in the real world it needs to be less a process of comprehensively including all possible parameters and more a focused process seeking to identify, quantify, evaluate and monitor key parameters (Harremöes and Turner 2001). It is also a process that puts a premium on the efficient collection, monitoring and analysis of relevant and appropriately scaled date.

11.5 SOCIO-ECONOMIC DATA COLLECTION

A full understanding of human activities requires an analysis of individual behaviour in a social setting. In contrast to the individualistic approach, methodological holism requires social theories to be grounded in the behaviour of irreducible groups of individuals. Links within groups and between groups are important. In addition to groups to which one belongs there are 'reference groups' from which an individual may derive standards for his/her behaviour. There is a need, therefore, for a social-cultural groups-based approach to human behaviour, including the valuation and use of environmental resources. One of the key tasks will be to elicit environmental values information for incorporation into the decision-making process.

A spectrum of more deliberative and inclusionary processes (DIPs) is beginning to find favour with resource managers and administrators trying to implement sustainable development. These approaches range from better information provision and consultation exercises to fully fledged participatory processes in which stakeholders are a component of the decision taking mechanisms (see Figure 11.4).

The shift from mere consultation of stakeholders towards participation in decisions, requires individuals to recognise and accept citizen values, responsibilities and obligations. Since multiple stakeholder interests and perspectives are commonplace, water resources management will involve trade-offs informed by a range of decision criteria, some of which will be competing. In these circumstances the search for 'optional' outcomes is misplaced (see Figure 11.4). Rather the idea is that more participatory processes allow individuals to 'learn' more about citizenship and collective responsibilities. Individuals may become immersed in a 'social learning process'. The facilitation of this process brings benefits in terms of 'better' decision-making in complex and uncertain contexts, better information dissemination and transparency, and a building of trust and accountability in contemporary society.

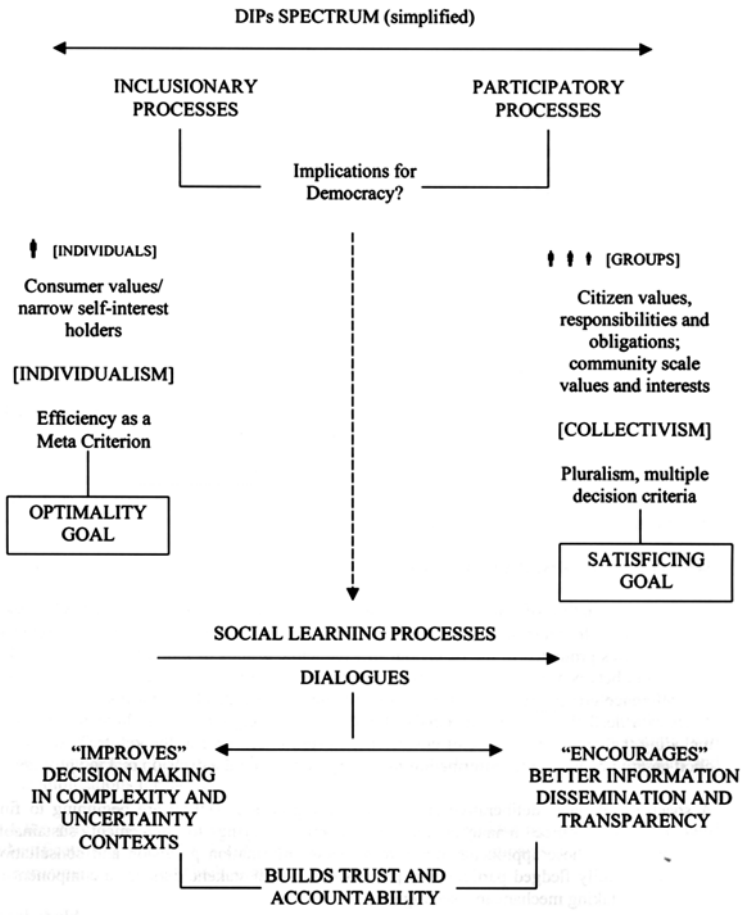

Figure 11.4 Social and deliberative approaches to support management and policy-making.

11.6 TOWARDS AN ENVIRONMENTAL DECISION SUPPORT SYSTEM

As we argued earlier, management actions need to be underpinned by a scientifically credible but also pragmatic environmental decision support system, i.e. a toolbox of evaluation methods and techniques, complemented by a set of

environmental change indicators and an enabling analytical framework. The support system should allow managers to identify a number of steps or 'decision rules' in order to operationalise the framework in a given catchment context.

The following steps and related information gathering and analysis procedures, outlined in Section 11.2, are recommended in the appraisal process.

11.6.1 Scoping problem auditing and analytical methods selection

The DP-S-I-R (driving pressures-state-impacts-response) framework, originally developed by the OECD, is a useful device for the scoping of complicated management issues and problems. It can make tractable the complexity of causes of water resources, habitat/species degradation or loss and the links to socio-economic activities, across the relevant spatial and temporal scales. It also provides the important conceptual connection between ecosystem change and the effects of that change (impacts) on people's economic and social well-being. Relevant indicators of environmental change can be derived (see below), and the loss of ecosystem function provision in terms of goods and services (direct and indirectly received) can be translated into human welfare loss and quantified in monetary and/or other more qualitative ways.

To operationalise the analysis an empirical description and explanation is also required covering the relevant policy context and regulatory regime that is to form the focal point of the research within any given catchment. The regulatory regime work, where necessary, will need to encompass both regional/national and international regulations and designations and their implications for the catchment.

At the core of the assessment is the requirement for stakeholder mapping and the related identification (via the DP-S-I-R approach) of the significant impacts and consequences of environmental change, which impinge on stakeholders.

Stakeholder mapping

For a given catchment it is necessary to identify the following:

- the different 'interest' groups within the catchment and outside (national and international) that are relevant to the policy issues and contexts being focused on;
- existing stakeholder networks (or the lack of networks);
- existing institutional arrangements and 'power' structures; and
- the aggregate 'policy networks' (or the lack of networks) that serve to influence policy choice outcomes.

This stakeholder-related information should then be set against the relevant drivers and pressures of environmental change in the catchment (from the DP-S-I-R data), e.g. population growth and density changes, pollutants and contaminants trends, climate change. The findings should help, among other things, to highlight any distributional equity concerns (i.e. who gains, who loses) and power relationships relevant to existing policies and future potential policy measures. The policy set should include any national, EC or other international regulations, designations and agreements. All this information will be relevant to the outputs from the futures scenarios and policy goals and measures research, to which we turn in the next sub-section.

Scenario analysis

The future will always be shrouded in uncertainty and therefore accurate prediction is not a feasible goal. However, it is possible to formulate scenarios which can shed light on and offer insights about possible future developments. It is these scenarios which can inform the policy targets, standards and measures packages relating to the policy issues chosen as the foci for the catchment-level research (see Figure 11.1). Three illustrative futures scenarios are, for example:

- Business As Usual – based on the assumption of the continuation of current trends into the future;
- Policy Targets – assuming that in the future all current regulatory standards and targets will be met and then 'over-complied with', because of social value changes more strongly in favour of environmental goals, and/or industrial reorientation in favour of eco-efficiency gains and green marketing gains;
- Deep Green – assuming that a fundamental shift in societal values over the long run encourages the pursuit of environmental conservation goals in preference to economic growth-related objectives.

Scenario formulation and development proceeds by way of narratives and storylines (see Figure 11.5). Once the basic narratives have been constructed, it is then possible to make the links to different policy standards/targets, objectives and measures and the policy issues which are deemed most important in the catchment. The idea is to set up sets of related policy targets etc. and measures (packages) which reflect the three (or two) scenarios and implicit perspectives (Ledoux *et al.* 2002).

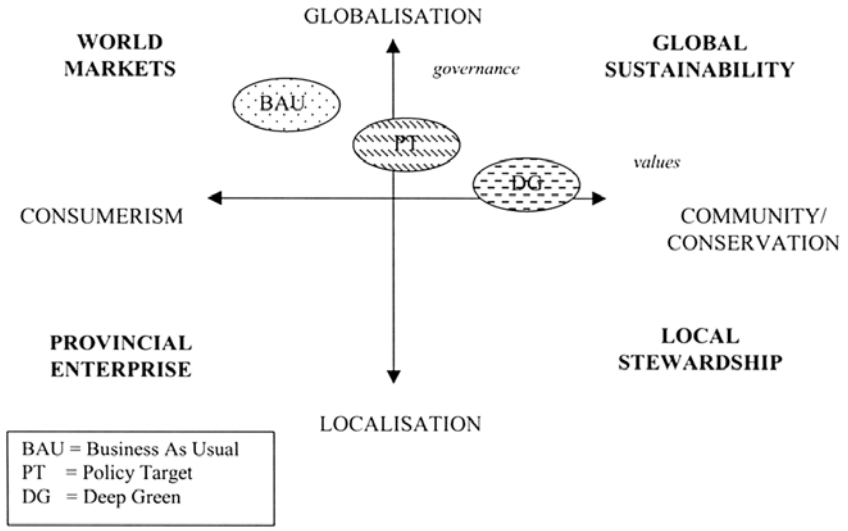

Figure 11.5 Illustrative scenarios.

World Markets, for example, is the equivalent of a baseline (almost trend) scenario; it is meant to portray conventional industrial/international capitalism continuing into the foreseeable future. Sustainable development is interpreted in its 'weak sustainability' form (Turner *et al.* 1998; Burbridge 2001). This scenario is characterised by a requirement to maximise total output (GDP), with widening income inequality. Environmental concerns are important but constrained to 'local' health and/or amenity concerns; international environmental agreements have relatively modest targets/standards.

Global Sustainability, on the other hand, is a scenario which contains the belief that environmental systems are often of infinite value and are the foundations of a sustainable economic and social system, not vice versa. Resource use efficiency/productivity can be radically improved via a mixture of regulation, economic incentive mechanisms and technological innovation. Sustainable development requires the redressing of global inequities of income and wealth, as well as efficiency gains. A move towards more globalisation of governance systems is supported.

Indicators and critical thresholds

Given the degree of scientific and socio economic (economic, social, political and cultural factors) uncertainty that exists about current and future environmental change issues and consequences, the three (or two) scenario-related perspectives are heavily influenced by the degree of risk aversion that

may be adopted by different stakeholders and the government on behalf of the whole of society. The so-called precautionary principle is a reflection of this concern about uncertainty and the sort of decision-making approach that should be adopted.

Different societal positions (perspectives) will encapsulate different approaches to the precautionary principle and the treatment of risk and uncertainty. The position taken over how to mitigate the uncertainty problem will also affect the indicators of change that are chosen and their interpretation. In many cases it will not be possible to determine single number outcomes for 'critical loads' of given substances, or 'critical thresholds'. Instead there will be standards/targets which incorporate different interpretations of 'safety margins', necessary to avoid breaching uncertain thresholds. Relevant environmental change indicators may of necessity be fairly crude measures of trends (positive and negative) relating to substance fluxes, ambient quality states and wider ecosystem changes, augmented by a qualitative assessment.

11.6.2 Data collection, monitoring and indicators

Official interest in quantifiable environmental indicators intensified during the 1990s as sustainability thinking came to prominence. They serve to reduce the complexity of environmental pressures, state changes and impacts and to increase the transparency of the possible trade-offs involved in policy options choice. Indicators do not, however, provide a panacea for scientific uncertainty and they also require suitable institutional structures to be in place to regularly collect and update the relevant background data.

11.6.3 Evaluation of project, policy or programme options

Managed ecosystems will be in an almost constant state of flux as the natural processes and systems react to human management interventions, which in turn, subject to various lags, produce more policy responses, i.e. a coevolutionary process characterised by continuous feedback effects. It is therefore important to be able to assess the impact of alternative sets of management actions or strategies in order to judge their social acceptability against a range of criteria such as environmental effectiveness, economic efficiency, fairness across different stakeholder interests (including different generations). Evaluation methods and techniques have to be matched to the chosen evaluation criteria.

A combination of quantitative and qualitative research methods is advocated in order to generate a blend of different types of policy-relevant information. This applies to both the biophysical assessment of management options and the

evaluation of the welfare gains and losses people perceive to be associated with the environmental changes and management responses. The main generic approaches which can form the methodological basis for strategic options appraisal are:

- cost-effectiveness analysis;
- extended cost-benefit analysis and risk-benefit analysis (including the distributional impacts across stakeholders);
- social discourse analysis; and
- multi-criteria analysis.

11.7 CONCLUSIONS AND RECOMMENDATIONS

In summary, comprehensive assessment of water resources and supporting ecosystems requires the analyst to undertake a number of tasks which need not be sequential depending on the policy context. But either in sequence or partly in parallel the following components need to be addressed:

(1) Determine the causes of water and ecosystem degradation/loss, in order to improve understanding of socio-economic impacts on ecosystem processes and attributes (e.g. with the aid of the DP-S-I-R auditing framework).
(2) Assess the full ecological damage caused by water and ecosystem quality decline and/or loss.
(3) Assess the human welfare significance of such changes, via determination of the changes in the composition of the water resource and ecosystem, evaluation of ecosystem functions, provision of potential benefits of these functions in terms of goods and services, and consequent impacts on the well-being of humans who derive use or non-use benefits from such a provision.
(4) Formulate practicable indicators of environmental change and sustainable utilisation of ecosystems (within the DP-S-I-R framework).
(5) Carry out evaluation analysis using monetary and non-monetary indicators (via a range of methods and techniques, including systems analysis) of alternative water usage and ecosystem change scenarios.
(6) Assess alternative water uses and ecosystem conversion/development together with conservation management policies.
(7) Present resource managers and policy-makers with the relevant policy response options.

The components presented here build towards the development of a holistic integrated framework for environmental indicators as part of an integrated system aiming at the provision of transparent, meaningful and useful information. This system can support and link decision-making at different

spatial and time scales with the objective of fostering the protection and sustainable management of natural resources. Focusing on environmental and social systems and their interactions simultaneously means that the corresponding indicator sets essentially provide the basis for a multi-criteria decision-support framework. Depending on the monitoring scale, in principle the relevant social and environmental effects of decisions can be analysed and evaluated simultaneously. The assessment should be carried out as a continuous 'process' which is conditioned by a policy and/or management context and is characterised by its cyclical nature with multiple feedback effects and requirements. The process is enabled via 'team-based' interdisciplinary/multidisciplinary research, utilising a toolbox of complementary analytical methods and techniques.

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12

Integrated assessment in transboundary water management: a tentative framework

Matthijs Hisschemöller

12.1 BACKGROUND AND OBJECTIVES

Water management increasingly faces the challenge of collaboration between science disciplines. This challenge is no less present or relevant in matters of transboundary water management. On the contrary, it is widely acknowledged that international scientific collaboration fosters political consensus and the effectiveness of international environmental agreements. Especially so-called

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'epistemic communities' correlate to progress at the political level.[1] It is not always easy to assess whether scientific consensus fosters political consensus or political consensus is sought through scientific jargon. It is anyhow important to realise that in present-day water management, as in other fields of (environmental) policy, the boundaries between science and politics are becoming increasingly diffuse and the role of stakeholder knowledge has become more important. Integrated assessment, i.e. the evaluation of all facts and values considered relevant for decision-making, therefore not only requires a collaboration between scientists from different disciplines, but also a dialogue between scientists and stakeholders about the different meanings attached to knowledge and the interests that may be served by certain scientific interventions. The major question that arises is how to integrate different viewpoints and insights from various scientific disciplines and how to assess their relevance? Methods for dealing with this question are still under development.

This chapter offers a framework for the integrated assessment of water management programmes that are meant to contribute to a sustained improvement of water quality. It focuses on the problem of integration of findings from different scientific disciplines in a transboundary context and the added value of a participatory approach in this respect (e.g. Hisschemöller 2000; Timmerman *et al.* 2001). First, in section 12.2, this chapter addresses the concept of integrated assessment as an approach for the evaluation of water management policies and programmes. Section 12.3 presents the contours of an evaluation framework. Section 12.4 wraps up and draws conclusions. Here, it is also argued where and when the assessment will benefit from a participatory approach.

12.2 INTEGRATED ASSESSMENT: WHAT IT IS AND WHY IT IS NEEDED

Integrated environmental assessment is generally defined as a research activity aimed at the identification and selection of policy relevant information from different scientific disciplines (Rotmans and van Asselt 1996; Hisschemöller *et al*., 2001). There may be disagreement as to whether integrated assessment is a *scientific* research activity as such; it is generally acknowledged that it involves both scientists as well as non-scientists (policy stakeholders) in a joint

[1] The concept 'epistemic community' was introduced in the policy sciences literature by Holzner (1968: 60–71) and was cited in a number of articles on science policy, before it was introduced in international relations studies by Haas (1992). See Hisschemöller *et al*. (2001).

effort to combine scientific expertise and stakeholder knowledge. Integrated assessment is a form of policy evaluation which explicitly takes into account the interdisciplinary character of the problems under scrutiny. Before dealing with the question 'How' the assessment must be carried out, this section addresses some issues that relate to 'What?' and 'Why?'. It deals with the following questions:

(1) What is the purpose of evaluation in general?
(2) Why must an assessment of water management be integrated?
(3) What makes integration such a difficult exercise?

These questions may look trivial and may be easily overlooked once the self-evidence of integration and interdisciplinarity is accepted, at least as a powerful rhetoric. However, it should be realised that in practice, integrated assessment is not self-evident, and notions such as integration, interdisciplinarity and stakeholder participation are still meeting with resistance among scientists as well as policy-makers.

12.2.1 What is the purpose of evaluation in general?

The purpose of evaluation is normally conceived of as to find out whether a policy or programme has been effective in realising its goals. This implies that both costs and benefits are made visible. In the evaluation of water management policies and programmes there may be a specific focus on assessing the benefits, because it may take years for them to become really visible. A second purpose of evaluation is to find out whether results are obtained against reasonable costs. In this respect, policy instruments are important in the evaluation. Questions may relate to issues such as: Are taxes more effective than subsidies? What is the cost of participation?

Policy evaluation may greatly benefit from monitoring. The availability of the right data is critical for identifying the strong and weak points of a policy programme at different points in time.

The evaluation of a policy programme can relate to the output that has been actually realised (ex post evaluation) and the output that is expected or anticipated (ex ante evaluation). Both types of evaluation are equally important but have different pros and cons. The most important advantage of ex post evaluation is that data and other observations are actually available (which is not to say that they are unambiguous), while the critical pro of ex ante evaluation is that unnecessary costs can be avoided. Table 12.1 distinguishes four types of possible evaluation outputs.

Evaluations are meant to be used to address weaknesses and to take action for improvement in due time. Programmes can be adjusted in conformity with the

latest insights. But evaluations do not automatically lead to policy adjustments. Especially important in this respect is that evaluation is not only a substance-related activity, but simultaneously a delicate process. If the information from the evaluation points to options for improvement, communication with those directly involved, the policy stakeholders, may be critical.

Table 12.1 Possible outputs in ex ante and ex post evaluation

	Evaluation ex post	Evaluation ex ante
Programme effective	Benefits actually realised	Benefits to be expected
Programme ineffective	Unnecessary costs, potential benefits	Costs to be avoided, potential benefits

Finally, evaluation is often used to convince the outside world that a programme or policy institution is doing fine. However, slogans or other forms of oversimplification, such as the reduction of measurements to one number, do not suffice.

12.2.2 Why must an assessment of water management be integrated?

Integration of information on water management effectiveness relates to the ecological, economic, social acceptance and governance issues involved. It is not all that obvious that each of these aspects has to be taken into account in programme evaluation. If the primary objective of a policy is the improvement of nature quality, why not just focus on its ecological effectiveness? In practice it will appear that integration cannot be avoided. There are, at least, three explanations for this.

The complexity of the policy or policy issue under scrutiny
Big projects in water management address so-called unstructured problems (Hisschemoller and Hoppe 2001). Problem structure has two dimensions: (1) the degree of certainty or consensus among the actors in the political process about what knowledge is relevant for addressing the issue at stake, and (2) the degree of consensus related to the values at stake. Unstructured problems are characterised by lack of certainty as well as lack of consensus. The policy actors have different interests and views. Hence, they may stress different aspects: economic, ecological, social etc. An even higher form of complexity arises

when persons or groups have contradictory conceptions of what can be labelled as 'the same thing', contested views and images of nature being an often cited example. But also the definition of water quality and the indicators relevant for quality assessment may become more and more contested, as water management may include different values at the same time. Water quality may get different meanings when it is applied to farming, swimming, drinking or industrial use. A related characteristic is that the unstructured problem cannot be split up into 'manageable parts' without losing sight of the whole. To address only one part inevitably has impacts on the other. To illustrate, increasing groundwater level to fight drought without finding a solution for the problems this causes for local agriculture improves the ecological situation but damages the (local) economy.

Legitimacy

If policy-makers act as if the problem is structured or only concentrate on 'manageable parts', they are behaving as if there is consensus on values or certainty on what knowledge is relevant while this may not be the case. Hence, the legitimacy of the programme may drop in the eyes of (part of) the stakeholders. They may feel that their values or knowledge (including local knowledge) are not taken into account in the programme. It is crucial for an evaluation to take into account the widest variety of issues and perceptions of the problems as reasonably possible. Once an evaluation itself gets contested, it undermines rather than strengthens a water management programme.

Integrated water management

At the national and international level, the need for an integrated approach in sustainable water management is widely recognised. In the Introductory notes to the EC Water Framework Directive,[2] the terms 'integration' and 'integrated' are used quite frequently. Already in 1996, the European Commission proposed an action programme on 'the integrated management and protection of waters' (7). In 2000, the Commission spoke out: 'It is necessary to develop an integrated Community policy on water' (9). It also stated that 'further integration and protection and sustainable management of water into other Community policy areas such as energy, transport, agriculture, fisheries, regional policy and tourism is necessary.' The Framework Directive 'should provide a basis for a continued dialogue and for the development of strategies towards a further integration of policy areas' (16). For coordination and integration purposes, the subsidiarity principle is considered highly important (18). Member states should develop integrated programmes of measures to promote water quality (26). For the purpose of environmental protection, there is a need for a greater integration

[2] http://europa.eu.int/eur-lex/pri/en/oj/dat/2000/l_327/l_32720001222en00010072.pdf/.

of qualitative and quantitative aspects of both surface waters and ground waters (34). It is interesting to note that whereas the actual Water Framework Directive to a large extent consists of definitions, no definition of 'integrated' or 'integration' is available. Elsewhere, under the EU Water Initiative, there is a description of what an integrated approach should entail: 'Much more integrated approaches to water resources management are thus slowly emerging. They take into account not only the engineering, but also environmental, socio-cultural, economic, financial and institutional dimensions. The EU is committed to this approach, particularly for national and transboundary river basins and has enshrined it in the recent legislation of the Water Framework Directive.'[3] There is a remarkable similarity with the Netherlands, where integrated water management has now been for almost ten years the core policy objective for the Ministry of Water Management. In the Dutch context, 'integrated' relates to the relation between water quantity and water quality, but also to the interplay between ecological, economic, socio-cultural and governance aspects.

Where policies tend to become more integrated, or at least claim that this is needed, policy evaluation cannot lag behind. Although Integrated Assessment does not offer a straightforward procedure for this kind of evaluation, it provides a useful background for developing methods and tools.

12.2.3 What makes integration so difficult?

Once the choice has been made for an integrated approach in water management programme evaluation, the evaluators face many new questions. Especially problematic appear questions related to the integration of disciplinary parts. Examples are: Is it desirable and possible to quantify disciplinary outcomes for ecology, economics, governance and social acceptance? Hence, can we then think of an overall score – one number – for the entire programme? How can double counting, i.e. the situation that the same aspects are counted in different disciplinary studies, leading to extra weight of this aspect, be prevented? As a minimum, the interrelatedness between the ecological, economic, socio-cultural and governance components should be made visible. What is the weight of the various components in mutual comparison? For example, are objectives with respect to governance equally important as ecological targets, or are they just a means to realise eco-targets? How to measure costs and benefits over a longer time period? If some benefits are more distant in time, the question seems warranted how precisely all benefits can be measured. These and similar

[3] Source: http://europa.eu.int/comm/research/water-initiative/framework_en.html/.

questions are considered relevant in relation to a framework for integrated assessment in the area of water management.

However, as already stressed, an integrated assessment should be more than the sum of its disciplinary parts. Framing the question in terms of 'How to bring together disciplinary parts of an evaluation?' may be the wrong problem to start with. For scientists, the practical challenge of integrated assessment in water management may be best referred to as to make a shift from multi-disciplinarity to interdisciplinarity. These are terms that have different meanings and connotations for many people.

As defined here, multi-disciplinary work studies issues from different mono-disciplinary angles: Multi-disciplinary = mono- + mono- + mono-disciplinary. In the case of evaluating a water management programme one starts to identify ecological, economic, legal, political and socio-cultural factors that are studied separately by ecologists, economists, lawyers, political scientists/sociologists and psychologists. Multidisciplinarity is to a great extent shaped by the body of methods and techniques that the several disciplines have available. In a sense – and this appears to be true for policy oriented research in general – the disciplines define the problem to be evaluated. Even if the questions are initiated in society, it is supply/science driven rather than demand/society driven. This is because science has its limitations and even more so scientists, who specialise themselves in certain fields or research strategies. Scientific methods can solve certain problems better than others. In the end, multi-disciplinary research is often left with a lot of interesting disciplinary outcomes but a lack of knowledge on how to relate these in a meaningful way. Hence, the overall picture is still missing.

In contrast, the main feature of interdisciplinary work is that it works the other way around. The mobilisation of research disciplines and methods becomes dependant on the problem that has to be addressed. If integration is taken seriously, it takes place right at the beginning and not at the closure of the evaluation process. The first step is an integrated problem analysis (see next section). Essential in this interdisciplinary process of cooperation is that categorisations fit in with the problem, as it is being defined or structured by stakeholders. Categorisations thus do not necessarily reflect disciplinary boundaries, which makes this process difficult for all researchers involved. The notion of interdisciplinary analysis brings about a shift in project focus from the conclusive stage to the beginning, the preparatory phase. Problem analysis takes a lot of time, much more than is usual in mono- or multidisciplinary research. If necessary, it might even take up to 40% of total project time and budget. Project managers or funders may not be confident that such an approach will pay off and they force a closure of the preparation stage in order to speed up the evaluation. As a general rule, everything that has not been adequately dealt with

at one point in a project will come back later on in a more messy form than the first time and will take more time. In that case, the project duration must be prolonged or the quality of the evaluation is likely to suffer. The more time that is spent on demand driven problem analysis, the more the quality of the evaluation will benefit. As a quality indicator, really good assessments produce counter-intuitive results.[4] Also, there are no 'purely' ecological, economic etc. costs and benefits. The major costs and benefits reflect the interrelatedness between disciplines and can therefore only become well articulated in connection with more than one discipline.

Hence, the distinction between multi- and interdisciplinarity is considered here of much more importance than one of terminology. Still, this does not change the fact that multi- or interdisciplinarity is always a matter of degree. The distinction cannot be absolute, simply because the limitations of the disciplines and their particular approaches and methods are not abandoned once we take an interdisciplinary stand. It therefore might be more accurate to refer to interdisciplinary practice as a dialogue between the disciplines, rather than an attempt to replace disciplinary science.

12.3 CONTOURS OF A FRAMEWORK FOR INTEGRATED ASSESSMENT

An integrated assessment should meet four requirements:

(1) to obtain an adequate understanding of the policy programme at hand, especially the policy problem, the anticipated or actual actions, and the opportunities and bottlenecks for realising policy;
(2) to identify and rank evaluation ***criteria*** for establishing the effectiveness of the programme;
(3) to obtain an adequate understanding of the various ecological, economic, socio-cultural and governance benefits and the way these are measured over time;
(4) an integrated judgement according to the criteria under (2).

[4] Dunn (2001: 425–6) makes this point when he argues: 'From the standpoint of communication theory and language, the information content of a hypothesis tends to be negatively related to its relative frequency, or probability of occurrence. Hypotheses that are mentioned more frequently – those on which there is substantial consensus – have less probative value than rarely mentioned hypotheses, because highly probable or predictable hypotheses do not challenge accepted knowledge claims.'

These requirements can also be considered four stages of the integration framework:

Stage 1: to obtain an adequate understanding of the policy programme at hand
To get an adequate understanding, the joint project team carries out this phase together. Hence, it is a valuable exercise in interdisciplinary cooperation. When partners from different countries are involved, they may become acquainted with different styles of policy-research collaboration. Three steps are distinguished in this stage:

(1) An integrated assessment, either being an ex post or ex ante evaluation, starts with identifying:
- the functions of the transboundary water system at hand,
- the actors (stakeholders) related to the respective functions and the way they use the water system,
- the stakeholders' conflicting interests,
- their views on present (negative) trends, desired future developments and the choices they are willing to make (scenarios),
- the critical knowledge available with respect to the water system and its distribution over the stakeholders (are there conflicting knowledge claims?),
- last but not least, the policy administration and (international) legal context for policy-making.

The results of this inventory are referred to here as the *problem map.* The construction of a problem map is a first critical step in integrated assessment. In principle[5] all elements have now been identified that are needed for a *successful integration.* The starting point is not a disciplinary framing of the possible problems, but a joint analysis of the physical and socio-economic conditions in the region.

(2) The evaluation then focuses on the policy programme that the parties involved with the transboundary water system are developing or are carrying out. Also in this stage, it is extremely important that the group carrying out the actual evaluation includes people from the various nations involved, who are aware of specific national policy styles and traditions that may affect (even unintended) the transboundary management plan. This stage supposes the identification of
- the policy goals,
- measures and instruments over time,

[5] In principle, because in the course of the evaluation process important new developments may come up that need to be taken into account.

- the justifications of goals, measures and instruments, including reference to the anticipated effects and, if the information is already available, bottlenecks in implementation;
- the role of different actors including governments and international agencies;
- the actions actually taken to implement the programme and how they are considered by affected stakeholders.

The outcome of this inventory is referred to as the *policy map*. The policy map may be different from the problem map in that it reflects specific choices made in the process of finding multilateral commitment. It is especially the possible exclusion of lines of thought which is addressed in the third step.

(3) The last and conclusive step in stage 1 is to systematically compare policy map and problem map. This exercise highlights answers to the following questions:
   (a) How does the actual or planned policy relate to the identified functions of the transboundary water system? Which functions are actually addressed and how?
   (b) Who are the actors involved and who are not (yet) involved? Why?
   (c) Which stakeholder choices are reflected in the policy programme with respect to future developments?
   (d) On what knowledge is the policy programme based and what available knowledge has not been used?
   (e) How have decisions been made? How have authoritative actors used their power? Is the policy programme supported by parliamentary decisions?

The outcome of this step will provide priority issues for the further evaluation. Now, we have a dynamic picture of actors, their (conflicting) beliefs, assumptions and values, the choices (explicitly or implicitly) made in the policy programme and/or its implementation, the knowledge used or under-utilised.

In the comparison between problem map and policy map two themes must be central:

- the ***why*** behind assumptions and choices;
- dealing with ***uncertainties*** over time. To what extent are uncertainties recognised? Is the programme flexible enough as to deal with them in due time?

Stage 1 can now be concluded with the formulations of questions for further evaluation research. These questions will be addressed in stage 3.

Stage 2: to define criteria for evaluation

Now, when we have a clear picture of the problems, the policy goals and specific measures, it becomes possible to address the question of when the transboundary water management programme must be considered a success. In this stage, criteria are defined that will be used for the measuring of success and failure in more discipline oriented studies on ecological, economic, political, legal and socio-cultural indicators in stage 3, as well as for reaching an integrated judgment in stage 4. It is very important that, by the end of this stage, the project team has a fairly good idea of how the criteria developed will be used to evaluate the outcomes of the different studies. To establish and rank criteria is very critical for a good evaluation and, hence, deserves serious attention.

Standard evaluation studies may identify the criteria for success or failure of a water management policy in line with the programme objectives. In this kind of evaluation, the focus is on the question as to whether targets have been met and on the costs. If the targets in transboundary water management are well defined, there is a good argument for deriving evaluation criteria from the stated programme objectives. This kind of evaluation is referred to as first order programme evaluation (Fischer 1990; 1994). In this kind of evaluation, the values that underlie the programme, in other words, the choices that were made initially in selecting the policies in response to the perceived problems, are not considered part of the evaluation. Because of this, the evaluation may get a technical, 'fact-oriented' character.

However, in water management, the targets are often far from clear; they are increasingly open for different interpretations, because they are the product of a compromise between many parties who have divergent if not conflicting views and interests. A typical example is the trilateral Danish, Dutch and German agreement which specifies an ecotargets approach in their joint policy to protect the Waddensea area (Turnhout 2003). Turnhout makes the observation that the ecotargets that came out of the trilateral negotiations are quite vague and distant from everyday reality in the area. Such an approach is often used to avoid or hide difficult choices in the policy process. Especially in cases such as the Wadden Sea policy, values are often contested by numerous stakeholders. If there is reason to believe that policies are based on ambiguous goals or contested values it is recommended to look back into the comparison between policy and problem map. In this kind of evaluation policy goals are not taken for granted, they are to be analysed, especially taking into account their ambiguous and controversial nature. This is exactly the reason that the first step in the evaluation is the problem map rather than the policy map, the (formal) policy or management plan.

Fischer (1990: 248) labels this kind of evaluation as second order programme evaluation. The distinction between first and second order discourse in policy evaluation is explained as follows: 'First order discourse … involves decision-making based on principles fixed in the value system governing the particular decision-making process in question. In second order discourse …evaluation turns to questions about the acceptability of the value system itself.' In second order discourse, criteria linked to the successful managing of scientific uncertainties or of conflicting actor views may become equally important as those that address the costs and benefits of actions within a framework of given ecological targets. Hence, next to matters of contents, the quality of the policy-making process, too, may become one of the leading criteria in the integrated assessment. Also robustness, e.g. capability of dealing with unexpected events, may become an important criterion.

In an interdisciplinary research team or a diverse group of end-users of the evaluation, criteria setting can be realised through methods that provide insights into how persons make categorisations. Such methods, mostly developed in psychology, provide insight into the way people, e.g. policy-makers, scientists and other policy stakeholders, look at the specific water management issues. One such method is repertory grid analysis (Kelly 1955; Dunn 2001).

Important for the choice of method for eliciting criteria is the decision as to who defines the evaluation criteria. Will it be the researchers who carry out the evaluation, policy-makers who are responsible for the programme, or a broader group of stakeholders? Researchers may rely upon expert judgements or they can consult others through interviews. But in cases of unstructured problems and the need for a second order evaluation, interactive methods may work better.

Stage 3: to obtain an adequate understanding of costs and benefits over time

The questions formulated in stage 1 are now fully addressed. This may happen in parallel disciplinary projects on the ecological, economic, socio-cultural and governance aspects of the policy or programme. Also interdisciplinary questions can be addressed in research projects. In fact, the kind of work done in this stage is not so different from the work done in evaluation studies all the time. What constitutes the main difference is that members of the project team are better aware of the contribution that the separate projects make to the whole, because of the attention they have given to a joint integrated problem analysis in stages 1 and 2. Feed-back meetings are organised on a regular basis to fine tune the separate projects and keep on track with the …

Stage 4: integrated judgement according to the criteria under (2)

Among engineers trained in water management, the idea is widespread that an integrated assessment should come up with one score or rate for an entire

programme. Therefore, the methodological question is framed as how to translate the figures for separate aspects into one overall judgment. With such an approach, there is the serious risk that one focuses on numbers rather than on an understanding of (causal) relationships. As evaluation is meant to improve a policy or plan, recommendations with respect to opportunities for improvement are more important. Recommendations may affect changes in the policy map, i.e. in policy instruments, the role of actors including governments and transboundary water management bodies, as well as specific actions to address ecological, economic, socio-cultural and governance aspects. However, in case of a so-called second order discourse evaluation, which highlights conflicting value patterns, the integrated judgment is likely to address changes in the problem map as well. Figure 12.2 summarises the types of recommendations that may come out of an integrated assessment.

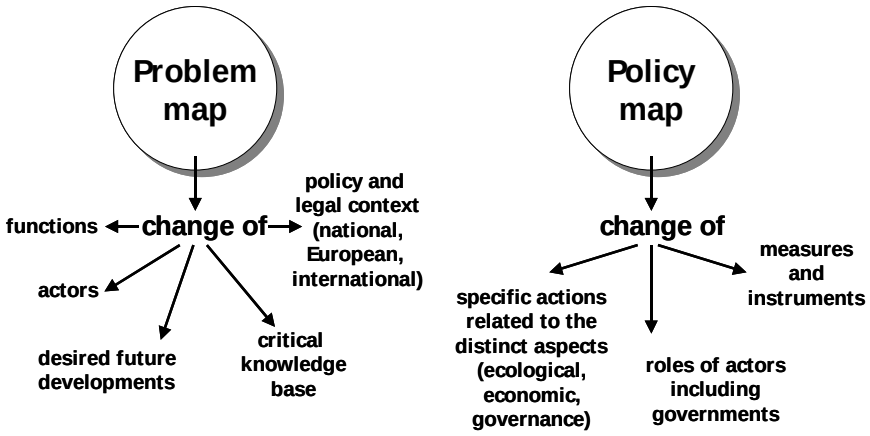

Figure 12.2 Possible recommendations resulting from an integrated assessment.

If conflicting values and problem frames are taken into consideration, what kind of outcome can be expected? There may very well be different outcomes or scores for various groups involved. The main methodological issue is then how to use the criteria developed in stage 2. This issue may be best clarified using a would-be set of evaluation criteria, developed by a would-be group of stakeholders in a transboundary water basin. These criteria are listed in Table 12.2.

It will soon be apparent that this list of criteria is unlikely to be internally consistent. Sustainability, understood as combined ecological, economic and social progress (triple p) means different things to many different people. Cost-effectiveness of policies and measures may be inconsistent with any of the other criteria, dependant on the choices one is inclined to make. For example,

restoring of a gradual transition salt–fresh may be incompatible with maintaining viable economic conditions for agriculture in that zone. Only huge costs may help to conserve a 'traditional' rural landscape, as a museum rather than an economically viable function. Even the ecological targets may come into conflict with one another, as some species which are typical for the rural landscape may be expelled by those that are typical for a transition zone.

It is not hard to see that such criteria can hardly serve as a consistent base for evaluation, but they may still have the very useful function of structuring a learning process among stakeholders with different views and – probably also – knowledge. The dialogue between stakeholders and water management authorities will then establish a situation where people learn about what is possible and what is not. They may also learn about what options are complementary and conflicting. Thus it increases a shared understanding of the complex relationships within the programme and the limitations and opportunities for change. This is not meant to argue that a participatory assessment must neglect opportunities to reach consensus. But the method used in the stage of integrated judgment can only lead to substantial consensus if inconsistencies are analysed and understood. Sometimes, this may lead to multiple outcomes, but this is always better than artificial consensus.

Table 12.2 An example of criteria underlying conflicting stakeholder values

Ranking	Criteria
1	Sustainable development of region (triple p)
2	Ecological diversity
3	Restoring bird species a and b typical for rural landscape
4	Restoring of transition salt–fresh water in coastal area, specific plants and birds related to this biotope
5	Maintain viable economic conditions for farming in coastal area (limiting group of farmers)
6	Cost-effectiveness of policies and measures
7	Maintain attractiveness for local people and recreation

12.4 CONCLUSIONS

This chapter argues that for water management, integrated assessments are necessary, because of (i) the structure of the problem, (ii) the risk of undermined legitimacy and (iii) the increased recognition of national and international policy agencies of these issues. An integrated assessment supposes an interdisciplinary approach: the assessment must take into account the problems and goals as they

are perceived by policy-makers and stakeholders and must not be governed by disciplinary interests.

This chapter refers to the possibility of carrying out the evaluation by an expert team or to extend the evaluation to involve also local policy stakeholders. This choice may very well depend on how the problem structure is assessed. In case of a structured or moderately structured problem, a first order evaluation (which leaves the goals and values themselves unaddressed) will probably suffice. When the problem is considered unstructured, a second order evaluation is needed, which also addresses conflicting problem frames and values. In that case, a participatory assessment is preferable, as it does justice to the real situation. To deny or to cover the real conflict between values and perceptions does not do any good. Such an assessment must highlight these and make them understandable for a wider audience. From there, it may identify specific actions and/or options for political choice.

As mentioned, the obligation to inform the public and organise public participation is laid down in important international agreements and in EU directives such as the Water Framework Directive (see also Chapter 8 of this book). It should be realised that public participation may be difficult, in particular with respect to transboundary projects. After all, these have to deal with diverging cultures among scientists, different languages and expectations, as well as a large number of (incompatible) institutions. The improvement of methods for participatory assessment and their application in a transboundary setting has therefore become increasingly relevant.

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13

From ‘we need more data’ paradigm to indicators in transboundary water management

Carolin M. Lorenz

13.1 INTRODUCTION

Human (over)use of goods and services provided by the river (e.g. provision of energy, use of river to discharge waste, use of floodplains for agriculture) has impacted the river ecosystem and its resources (e.g. loss of natural floodplains and wetlands, decrease of water quality, species extinctions). This degradation has led to a conflict among current river uses (e.g. fisheries, supply of water, recreation) and endangers future uses (e.g. loss of habitats and species, polluted sediments) due to irreversible changes made to the river.

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Policy-makers and water management bodies face the challenge to manage these complex spatial and temporal cause-effect relationships in watersheds and to cope with conflicting interests in order to attain a more equitable and sustainable situation than is presently the case. This asks for an all-encompassing approach, and hence concepts such as integrated or comprehensive river basin management have been developed (Downs and Gregory 1991, De Jong *et al.* 1994). The European Union has recognised the need for an integrated, basin-wide management approach by adopting the Water Framework Directive (WFD) in December 2000 (Commission of the European Communities 2000). River basin management needs practical instruments to implement such concepts in practice and to develop, implement and evaluate their policies. Indicators are potential tools. An indicator is defined here as a variable or some aggregation of variables, that describes a system or process such that it has significance beyond the face value of its components. The aim of this chapter is twofold:

- to analyse the potential of indicators as policy instruments for integrated management of transboundary river basins;
- to demonstrate this potential through a prototype set of indicators for the management of transboundary rivers.

This chapter has a Western-European focus, as their transboundary river management is relatively complex. Various European rivers flow through countries having different cultural backgrounds and different political systems. Furthermore, Europe has a number of supra-national institutions, such as the European Union, as well as international river basin committees (Rhine, Meuse, Scheldt), which can play a role in the development and use of policy instruments. However, the general principles presented in this chapter have a broader application to transboundary resource issues.

In the next section the need for a more integrated approach in river basin management is elaborated. In section 13.3 a set of potential pressure-state-impact-response indicators is proposed, and the application of this indicator set in transboundary river basin management is discussed in section 13.4. Finally, the requirements of the WFD will be compared with the proposed instruments, namely the development of PSIR indicators and their application in transboundary river basin management. The chapter closes with some discussion points.

13.2 ROLE OF INDICATORS IN RIVER BASIN MANAGEMENT

At present, a significant gap still exists between the concept of integrated water management and its implementation in practice. Three types of bottlenecks are identified by De Jong *et al.* (1994): 1) institutional fragmentation of water management, 2) communication problems within and between organisations, disciplines and countries due to the use of different languages, specialist language or disputes over competence, and 3) socio-political bottlenecks relating to views on water that are more oriented to single instead of multiple use.

In transboundary river basins the water flowing from up- to downstream crosses national boundaries, which adds a further complexity to management. Interests differ among riparian states. Downstream states bear the impacts of upstream use. Upstream states are less exposed to the negative effects of their use and may be less motivated to change their actions, for example to abate pollution. Furthermore, cultural differences in decision- and policy-making and in management approaches may complicate the introduction of effective management regimes. As an example of this cultural difference, Eberg (1997) compared the federal political system in Germany with the centralised system in the Netherlands and France.

Indicator frameworks may assist in overcoming the gap between the theory and practice of integrated water management in two ways. First, they can help to address information on economic activity, the condition of the river ecosystem and its supply of goods and services. This information will help to clarify the complex cause-effect relationships in rivers and provide decision-makers with essential information to make trade-offs between socio-economic aspects and the environment.

Second, the concept of indicators can help to streamline information flows between the different international, institutional and sectoral management levels. The variety of tasks, responsibilities and interests will cause differences in information needs among each layer of the hierarchical administrative structure and between up- and downstream states. Parameter definition and methodological approaches can vary between institutions and riparian countries, partly due to different scientific and policy cultures. Responsibilities with regard to data collection are fragmented. A streamlined and uniform flow of information will diminish both fragmentation and communication problems. Adoption of an indicator framework could structure the definition and description of information needs and the collection of information by international, institutional and sectoral management levels. Implementation of such a framework provides a common source of information and communication means for different stakeholders in management and policy-making.

13.3 POTENTIAL PRESSURE-STATE-IMPACT-RESPONSE INDICATORS

The aim of the indicators proposed here is to provide information for the development, implementation and evaluation of policies for integrated river management. Therefore, the indicators should describe the cause-effect relationships on a catchment scale. The use of one framework improves the linkage of indicator sets developed at different levels. The pressure-state-impact-response framework is used to describe cause-effect relationships between human use and the river (Swart and Bakkes 1995, Van Harten *et al.* 1995, Hoekstra 1995, Hammond *et al.* 1995, Rotmans *et al.* 1994, Adriaanse 1993, OECD 1994, Bakkes *et al.* 1994). A set of pressure, state, impact and response indicators and their underlying variables is proposed in Tables 13.1 to 13.4 (based on Lorenz 1999). These indicators focus on Western European rivers (e.g. the Rhine), which are mainly impacted by emissions of pollutants, river regulation and the building of dams and weirs.

13.3.1 Pressure

Pressure indicators describe the socio-economic use of the river and the changes made to river system by this socio-economic use. The relevance for river basin management is the provision of information on the contribution of the river's natural capital to economic activity in the region and the resulting pressure on the river ecosystem and its environmental goods and services. Table 13.1 gives an example of a set of pressure indicators.

Table 13.1 Potential pressure indicators for river basin management

System part	Indicators
socio-economic benefits	total value added of the use of river's goods and services total turnover of the use of river's goods and services total production of river's goods and services total employment with regard to use of goods and services
environmental pressure	
emissions	emission of substance x (in kg) or load of x (kg/m^3)
resource extraction	volume of extracted resource (kg or m^3)
system modification	% regulated river length number of dams and weirs % natural floodplain
pressure/activity	waste intensity energy intensity space intensity resource intensity

13.3.2 State

State indicators describe the functioning of the river (eco)system. They describe abiotic and biotic processes and elements. The relevance for river basin management lies in the intrinsic value of the river ecosystem, its life support function and its capacity to supply goods and services. The functioning of a natural river ecosystem has been analysed by a review of theoretical concepts in river ecology (Lorenz *et al.* 1997). Table 13.2 gives an overview of potential state indicators, which have been derived on the basis of this review. The state indicators apply to rivers of the temperate climate zone, such as the River Rhine.

Table 13.2 Potential state indicators for river basin management

System part	Indicators
abiotic	
longitudinal gradient of hydrology	stream order
	flow velocity
	flood pulse
geomorphology	channel size
	channel form
	channel substrate
lateral gradient from channel to terrestrial surroundings	surface of natural floodplain
	spatial distribution of natural floodplains
	habitat diversity
	vegetation pattern
	exchange of matter
longitudinal connectivity	number and location of barriers
lateral connectivity	river floodplain interaction
water quality	water quality
biotic	
functional	flux of matter (nutrients, minerals and organic matter)
	primary production/respiration ratio
	chlorophyll concentration
structural	gradient of algae, macro-invertebrates, fish from up- to downstream
	abundance of indicator species (e.g. top predators, species with complex life-cycles, migrating fish, floodplain species)

13.3.3 Impact

Impact indicators provide information on the supply of environmental goods and services. This is relevant for river basin management as a decline in the capacity to supply goods and services may have future, unspecified economic implications. Table 13.3 presents a number of impact indicators. The impact indicators are classified according to the type of good or service they describe. Standards like

drinking water standards, irrigation standards or swimming standards can be used as a target value for the supply of goods or services derived from the river.

Three types of impact indicators are distinguished. Regulation describes services provided by the regulation processes of ecosystems. Production describes the supply of goods. Carrier describes the service provided by the use of space in ecosystems.

Table 13.3 Potential impact indicators for river basin management

System part	Indicators
regulation	
assimilation capacity	load of waste assimilated
biodiversity	species diversity
water and sediment discharge	– discharge of water and sediment – flood frequency and risk
production	
water	volume of extractable water for industry and households
fish	biomass of consumable fish
energy	volume of extractable energy
minerals	volume of extractable minerals
carrier	
habitation	area of non-flooded floodplain
agriculture	area of fertile floodplain
navigation	– maximum number of ships – transportable load
recreation	potential recreation area

13.3.4 Response

Two types of response indicators are needed; one indicating the need for societal response and one describing the societal response itself (see Table 13.4).

The need for societal response can be described as a function of the difference between the target condition and the actual value of the pressure, state and impact indicators. Different weights can be applied to each P, S or I indicator, as in the following equation:

$$R=f[w_1(t_p-c_p),w_2(t_s-c_s),w_3(t_i-c_i)]$$

where:

R = need for response

$w_{1,2,3}$ = weighting factor

$t_{p,s,i}$ = target condition of pressure, state or impact indicators

$c_{p,s,i}$ = actual value of pressure, state or impact indicators.

The pressure, state and impact indicators, which are used to determine the need for response indicator, should have a cause-effect relationship. For example, the environmental pressure indicator describes the total emissions of nutrients, the state indicator describes the chlorophyll concentration, and the impact indicator describes the supply of drinking water. The reference levels can be policy aims of emission reduction or water quality and functional standards.

As a delay exists between the implementation of policy measures and the measurement of actual effect in the river environment, the development over time of the need for response is important as well. The spatial distribution of the need for response describes the distribution of use, ecological functioning and supply of goods and services between the up-, mid- and downstream part of the river (see Table 13.4). Societal response indicators can be derived from plans, policies and measures.

Table 13.4 Potential response indicators for river basin management

System part	Indicator
need for response	R
need for response change in time	dR/dt
spatial distribution of need for response	f ($R_{upstream}$,$R_{midstream}$,$R_{downstream}$)
societal response	planned and achieved emission reduction planned and achieved river restoration

13.4 DATA AVAILABILITY

Pressure indicators are based on socio-economic data provided by economic sectors and collected in socio-economic data-bases and statistics. State and impact indicators are based on environmental data derived from monitoring by the national or regional monitoring department of water management.

Conversion of data to the appropriate spatial scale can pose problems. Statistics tend to be collected for administrative regions, whereas these data are needed at a basin or subbasin level. Aggregation or disaggregation to the appropriate level is not always possible.

Information needs should drive indicator selection rather than data availability. Comparison with data availability may lead to modification of the indicator set, but should also feedback to more precise specification of data needs with more efficient design of monitoring programmes. An important element of the latter is co-ordination of socio-economic and environmental data collection and harmonisation of associated spatial and temporal scales. Changing variables means disruption of time series. While upgrading is necessary, a balance has to be found between better

information to be gained at that moment or information gained on trends from long time series of data (less than perfect). The development of indicators and their measurement by monitoring programmes has to be regarded as a continuous, dynamic process, as information needs and measurement techniques can change over time.

13.5 APPLICATION OF PSIR INDICATORS IN RIVER BASIN MANAGEMENT

Figure 13.1 presents an overview of how the concept of indicators may be used in river basin management. On an international level, a river basin commission with representatives of all riparian countries is responsible for the overall management of the basin (e.g. the International Rhine Commission). On the national level, each riparian country is responsible for management within their own administrative boundaries. The third level is the regional management, such as provinces, departments or federal states. On the lowest level, local management is done by municipalities or water boards.

As river basin management takes place on the international level, the international river basin management should reach agreement on the information needed and the subsequent set of PSIR indicators, their underlying variables, the measurement techniques, spatial scales and temporal frequency of data collection. The indicators proposed in Tables 13.1 to 13.4 serve as an illustration. The actual indicators used by river basin management will change over time and depend on changing policy phases (see, for example, Cofino 1995; Timmerman *et al.* 2000) and information needs. Determination of information needs and indicators can be done through a dialogue between selected stakeholders in the river basin including policy-makers, scientists and representatives of users of the water resources. Such a dialogue can take place in a workshop setting. Dieperink (1997) concluded from his analysis on the process of decision-making within the International Rhine commission that the intensive co-operation between scientists of the basin states gave a positive impulse to the achievement of international agreements by decision-makers.

Furthermore, agreement should preferably be reached on the target condition of the PSIR indicators, which reflects the objectives with regard to economy, society and environment of the riparian states. Transboundary river basin management has to deal with national governments having different political preferences and economic, environmental and social aims.

The process of developing indicators will promote enhanced clarity and transparency on these aims.

National river management provides for the data on a national level of the PSIR indicators. National management co-ordinates data collection by regional and local management. Data collection on the regional level is often done on different scales, like subbasin (e.g. diffuse emissions), river reach (e.g. monitoring of water quality and hydrology) or administrative region (e.g. socio-economic statistics, measures and policies). Data collection for transboundary river basin management can overlap with data requirements for local, regional and national management. As the management levels often have specific information needs, a complete overlap of data requirements for all management will probably not be current practice in water management. An assessment of present data requirements per management level can help to search for a set of river basin indicators having the largest overlap.

National management bodies aggregate the data from the regional and local level to a national scale and determine the value of the indicator. Aggregation can be done in a mathematical way (e.g. summing up all emissions per substance per nation) or by visualisation (e.g. water quality of the river by different colours).

International river basin management uses the information to assess status and trends, possibly with respect to joint targets conditions for 1) the socio-economic benefits derived from the river, 2) the ecological condition of the river, 3) the need for response, and 4) the spatial distribution of benefits and impacts between up- and downstream.

When there are needs for response, international river basin management has to make trade-offs between economic use of goods and services, ecological effects and socio-economic impact and between up- and downstream. Most often these trade-offs will be political compromises, which are established during negotiations between the different national riparian states. The compromises will be formulated in international agreements and plans. These plans are the basis for implementation of activities through national policies and measures. Schröder (Chapter 14 in this volume) gives an example of how international agreements are implemented at the national level.

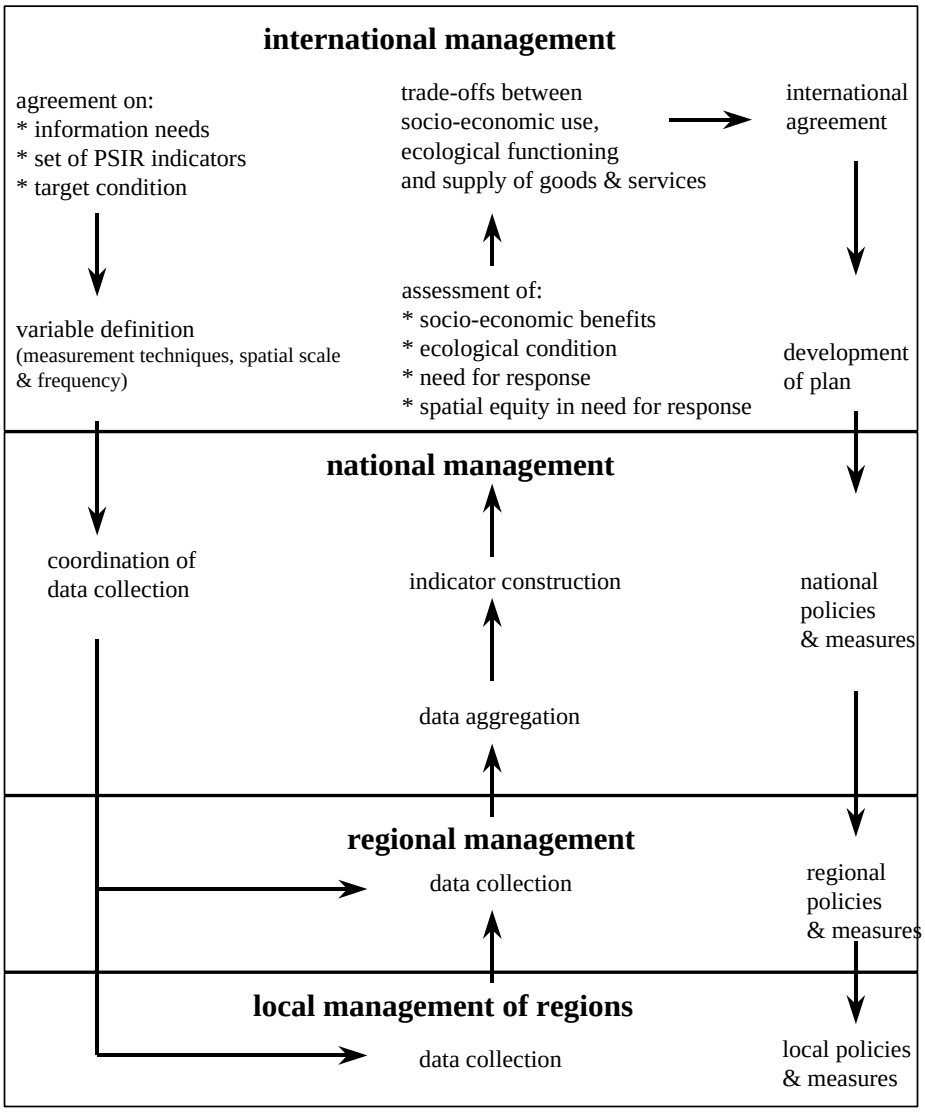

Figure 13.1 Proposed tasks and responsibilities of river basin management with regard to indicator development, data collection and indicator application in decision-making

13.6 COMPARISON WITH THE EUROPEAN WATER FRAMEWORK DIRECTIVE

The European Water Framework Directive (WFD) aims to implement the integrated, basin-wide management approach to the river basins in the European Union by establishing river basin districts and preparing a river basin plan every sixth year (Commission of the European Communities 2000). In this section, application of the PSIR indicator framework for the implementation of the WFD will be discussed.

Table 13.5 compares the PSIR indicator framework with the required information of the river basin plan according to the WFD, Annex 7. The pressure indicators provide information for the economic analysis and on the significant pressures, such as point and diffuse pollution, water extraction and hydromorphological changes. The state indicators include assessment of the ecological state of surface water on the basis of algae, macro-invertebrates and fish. Deviation between the ecological and chemical state of the waters and the 'good ecological state' or 'good ecological potential', being the policy objective for 2015 of the waters, brings about the need for response. The WFD demands a cost-effectiveness analysis of different measures, requiring the need to predict the effect of measures. Prediction can be done by linking the PSIR indicators to models to simulate relationships and dynamics.

The only information required by the WFD on the supply of goods and services (provided by impact indicators) is the supply of drinking water (see Article 7). Information on the supply of other goods and services, such as recreation, fisheries, navigation and energy extraction, is not explicitly required by the WFD. However, the negative impact resulting from the actual use of these goods and services has to be described as 'the impact of human activity' under paragraph 2 of the WFD.

In conclusion, the PSIR indicator framework can provide for the information needed for the WFD. Furthermore, the application of PSIR indicators in transboundary, national and regional management (as described in section 5) helps to implement the WFD, as it provides a way for transboundary river basins to harmonise:

- collection of information by indicators;
- setting of economic, social and environmental objectives;
- assessment of the state by comparing it with the objectives and;
- development and implementation of measures to achieve the objectives.

Table 13.5 Application of the PSIR indicator framework to the required information of the river basin plan according to the WFD. Paragraph numbers refer to the number in Annex 7 of the WFD, which lists the content of the river basin plan

PSIR	Paragraph	Required content of river plan according to the WFD
Pressure	2	summary of significant pressures and impact of human activity on the status of surface water and groundwater
	6	summary of the economic analysis of water use
State	4.1	state of surface water (ecological and chemical)
	4.2	state of groundwater (chemical and quantitative)
	4.3	state of protected areas (according to the habitat and bird directive)
Impact	4.3	state of protected water bodies used for drinking water supply
Response	3	identification and mapping of protected areas
	5	list of the environmental objectives established under Article 4 for surface waters, groundwaters and protected areas
	7	summary of the programme or programmes of measures
	8	register of programmes and management plans dealing with subbasins, sectors, issues or water types
	9	summary of the public information and consultation measures taken, their results and changes to the plan

13.7 DISCUSSION

The potential of indicators for integrated management of transboundary river basins is, firstly, that indicators can drive co-ordination of information needs and data collection by the different institutional, international and sectoral levels. This need for co-ordination of information needs and data collection has been confirmed by the results of two pilot-studies on the implementation of the WFD in the Netherlands (Bosma and Busch, 2002). These studies found that most data are available, but they are scattered over different institutions, spatial levels and sectors. The study by Nilsson and Langaas (Chapter 16 in this volume) on the role and use of environmental information in some selected transboundary water regimes further demonstrates the utility of using indicator frameworks to analyse information handling.

Secondly, indicator frameworks can help to meet the information needs of policy- and decision-makers. A set of pressure, state, impact and response (P-S-I-R) indicators measured at a river basin scale provides integrated information on the use and supply of goods and services, problems and their underlying cause-effect relationships, and possible trade-offs and their spatial distribution (particularly upstream versus downstream). The use of a same indicator set allows comparison of different river basins, which can provide

valuable information to river management, such as the cause of environmental problems or the effectiveness of measures.

Next to potentials the concept of indicators also has its limitations. There is a certain risk of misuse or misinterpretation, if an indicator is used to describe a different or broader objective or subject than it really does. A well-known example is GNP (Gross National Product), being an indicator for economic growth. GNP is, however, often equated with welfare, which is a much broader economic concept than economic growth (Ahmad *et al.* 1989). Therefore indicators should always be accompanied with clear statements as to their limitations. This reduces, but does not remove, the risk of abuse.

The high transparency of indicators can also hamper their use in the policy process. Turnhout (2002) researched the role of indicator use in the Dutch policy process and concluded that an indicator, which is too specific, rigid and not ambiguous enough cannot serve as boundary between policy and science or overcome political differences. On the other hand, an open decision-making and planning process, explicitly required by the WFD, asks for transparent information. Availability of quantitative information on economic and environmental effects may help to achieve international agreement on strategies, including interventions, investments and burden sharing. Political and legal action can be based on quantitative and transparent information and economic instruments (e.g. side payments of downstream state to upstream state to stimulate emission reduction upstream) can be applied more effectively. Specification of priorities and objectives will increase the transparency in transboundary river basin management decisions. Such transparency is a necessary condition for an effective dialogue between stakeholders and for effective public participation.

This chapter focuses on the Western European situation. For environmental issues, such as transboundary pollution, environmental awareness and economic prosperity are important background variables. Environmental awareness increases the willingness to invest in environmental policies and economic prosperity enables the parties to allocate financial resources for such investments. Furthermore, in Western european river basins political cooperation is already established through supranational organisations, such as the European Union. These boundary conditions for transboundary river management do not exist in large parts of the world. In the Middle East shortage of clean fresh water causes conflicts about water use. This conflict comes on the top of other existing conflicts (e.g. land ownership, religion) in this region. However, the cause of the water shortage is comparable to transboundary problems in Western Europe, namely the overuse of water in the upstream regions. We believe that transboundary cooperation and agreements will in these regions also be the only way to tackle transboundary problems in a sustainable way.

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14

Information as a basis for co-operation in Lake Constance

Heinz Gerd Schröder

14.1 INTRODUCTION

Lake Constance is the second largest prealpine European lake by area (570 km²) and volume (50 km³) and is shared by Germany, Austria and Switzerland. About 1.2 million inhabitants, local hightech industries, intensive agriculture and 2 million tourists per year frame a drinking water reservoir for more than 4 million people. Due to increasing human impact the lake and its catchment underwent drastic negative ecological changes causing a feedback reaction from the inhabitants and their representatives.

Crossborder co-operation has therefore a long tradition, and today almost 10 large and approximately 200 small transboundary associations work in the Lake Constance region (Blatter 2000). Besides common interests comprehensive information is one essential basis for sustainable co-operation.

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14.2 THE LAKE CONSTANCE REGION

14.2.1 Historical background

Boundaries between countries result from historical events and do not coincide with the boundaries of the catchment basins. The larger part of Lake Constance, also known as Upper Lake Constance, is the only region in Europe where national boundaries were never defined. Lake Constance therefore is a curiosity with respect to international law. Clearly defined national frontiers between Switzerland and Germany exist in the smaller Lower lake but in the Upper lake only the shallow water area from the shoreline to 25 m water depth is treated as national territory of the bordering countries. The major part of Upper Lake Constance is considered as common property, a so-called 'condominium'.

During the medieval period Lake Constance and its catchment belonged to the central part of one Swabian country. Neither at the end of the Thirty Years War in 1648 when the Swiss cantons became independent nor in 1815 after the collapse of the Holy Roman Empire were the boundaries of Lake Constance fixed. Consequently no national administration felt responsible for the lake; rules and regulations concerning its usage were missing.

14.2.2 Steps towards international co-operation

Since about 6,000 years ago when the first human settlements were established on Lake Constance fishery played an important role for the native people. During the 19th century radical socioeconomic changes and demographic development promoted the rapid impoverishment of numerous fishermen in the region. Excessive fishing ignored the ecological and economical consequences and exhausted the supply of usable fish not only in Lake Constance but also in other waters. Therefore in 1841 an international agreement on the protection of juvenile salmon between France, the state of Baden and some Swiss cantons was reached for the Rhine region. First attempts to regulate the fishery in Lake Constance date to 1869 but, due to the political situation, the negotiations were complicated and long drawn-out. In 1881 administrative delegates of the countries concerned proposed that all countries should work out their own national regulations in a similar manner. These so called 'Lindau decisions' indicated a first important step towards an international treaty.

At the same time an expansion of fisheries sciences took place in the late 19th century and numerous investigations raised scientific awareness about Lake Constance. These investigations delivered knowledge for measures such as the installation of the first fish hatchery, the definition of closed seasons and minimum legal sizes for trout.

In 1893 the ‘Agreement of Bregenz’ marked the beginning of sustainable co-operation between the countries of Lake Constance basin (Löffler 1990). However the condominium situation of Upper Lake Constance remained untouched by the convention.

14.3 DEVELOPMENT OF TRANSBOUNDARY CO-OPERATION

Transboundary co-operation is a compromise between complete independence and a legal federation. The aim of such co-operation is to make the most of both alternatives. Characteristic for co-operation is that the partners remain legally independent. They act together by free will and can cancel at any time; last but not least the partners derive a common benefit.

International co-operation in the water management of Lake Constance is the result of a long historical development. The solution of practical problems marked the beginning of the first international commissions and from the 19th century onwards the practice of transboundary activities showed successful results. Consequently commissions became part of the normal administrative policy of the bordering countries. Today at least 7 larger organizations are concerned with transboundary water management.

14.3.1 IBKF (Internationale Bevollmächtigtenkonferenz für die Bodenseefischerei)

The goal of the ‘Agreement of Bregenz’ in 1893 was the sustainable development of fishery in the lake through a lakewide protection and increase in valuable fish species (Keiz 1993). Therefore it was decided that meetings of an International Conference of Deputies for Fishery in Lake Constance (IBKF) should be held once a year. The IBKF works on consensus and its decisions do not directly create international law, but the bordering countries realize them according to their own national law. Besides ecological aspects the IBKF is also involved in economic decisions, e.g. restriction of fishing licences or definition of closed seasons.

Since the second meeting in 1895 fishermen were present at the IBKF meetings, and each fisherman has the chance to be heard and to be informed about actual problems by the IBKF deputies (Strubelt 1993).

Besides the successful struggle for sustainable fishery in Lake Constance the IBKF was also an important nucleus for transboundary water protection and water management. During the 1950s those involved in fishery saw at first hand

the consequences of eutrophication. Algal blooms, increasing biomasses and oxygen depletion in the deep water body were clear symptoms of this development; in 1951 far-sighted people installed a committee within the IBKF to support eutrophication research and invention of a wastewater plan. This formed the base for the foundation of the International Commission for the Protection of Lake Constance (IGKB) in 1959. In the 1960s the IBKF returned to its primary objective and fought against overfishing through a range of measures such as meshsize management and improved fish hatchery. Since 1979 the IBKF has been successfully engaged in the protection and support of threatened fish species.

14.3.2 IBF (Internationaler Bodenseefischereiverband)

In 1909 the International Fishermen's Association of Lake Constance (IBF) was founded as an international community of interests for the fishermen of Lake Constance. Since 1912 the IBF has been represented within the IBKF and struggles for the needs of the fishermen: often in agreement with the IBKF but sometimes also taking opposite positions. The latter happened whenever a limitation of net quantities or an extension of closed seasons occurred.

The International Fishermen Association of Lake Constance can claim paternity of the International Commission for the Protection of Lake Constance (IGKB): In 1950 a wastewater commission was established within the IBF (Entringer 1993). Later on in 1951 this commission became a committee of the IBKF and there formed the nucleus for the IGKB foundation in 1959.

14.3.3 IGKB (Internationale Gewässerschutzkommission für den Bodensee)

In the first half of the 20th century the IBKF was the only intergovernmental institution in the Lake Constance region. During the 1950s obvious changes in lake ecology, such as algal blooms and high biomass production, attracted public attention. Besides the activities of the IBKF waste water commission in 1953, a memorandum of the state of Baden-Württemberg called for joint action for the protection of Lake Constance. One year later the water economy associations around the lake appealed for similar action and long-lasting international negotiations started. Finally the International Commission for the Protection of Lake Constance (IGKB) was established in 1959 as a result of an international agreement between Baden-Württemberg, Bavaria, Austria, Switzerland and Liechtenstein. The main duties of the IGKB are observation of the lake, confirmation of the causes of its pollution, recommendation for co-ordinated preventive measures, and discussion of planned use of the lake.

The IGKB commissioners meet at least once a year and the deputies determine measures by the principle of unanimity. As consultant agency the commission cannot decide on rules and actions connected with environmental protection but the regional governments are obliged by agreement to transform the recommendations of the IGKB into national law. A technical and scientific board of experts serves as official consultant to the commission. The experts study the scientific and technical problems proposed by the commission and examine the research carried out. The working results are summarized and published in so-called green reports (annual investigation data of the lake monitoring) and blue reports (case studies and special topics).

In 1967 the first guidelines for the prevention of pollution were published as a standard for national jurisdiction. Later on in 1972 and 1987 these guidelines were revised and today a stepwise adaptation to the recent environmental requirements is in progress. In 1987 the IGKB published a memorandum where for the first time an ecosystem approach was presented in a European cross-border region.

IGKB has mainly concentrated its efforts on the problem of eutrophication. In order to preserve the lake ecosystem from further degradation more than €4 billion have been invested in sewage treatment facilities. The result is a significant reduction of the phosphorous concentration in the lake and a recovery of the lake ecosystem. During the last decade hydrophysical modeling of water bodies and long-term observations of chemical and biological parameters have come to the fore in the discussions.

Since 1994 the IGKB has published twice a year the popular leaflet ‘Seespiegel’. This brochure has a circulation of 15,000 copies and offers current information about Lake Constance and the IGKB. Electronic ‘Seespiegel’ copies as well as selected blue reports and general information about the IGKB (in German) are offered by the website http://www.igkb.org/. From 2003 on the yearly green datareport will be available as a digital version on the IGKB website. In 1998 the GIS-related ‘Lake Constance Water Information System’ was established by the IGKB.

According to Blatter (2000) the foundation of the IGKB has provided a strong legal basis for a common environment regime and has institutionalized cross-border co-operation through a commission and a variety of working groups and boards. In a more general view the IGKB mission leads to a reduction of uncertainty, to a harmonization of standards and policies and last but not least to ensuring co-operation. Measured in terms of real impact the joint activities to protect the water of Lake Constance represent overall a successful environmental regime (Müller 2002). Nilsson and Langaas (2002, and Chapter 16 in this volume) have performed a comparative analysis of environmental information

management in selected transboundary water regimes in Europe including Lake Constance and in particular IGKB. Their study also confirms the significant and successful role and use of environmental information in the functioning of IGKB and thus in the management of Lake Constance.

14.3.4 AWBR (Arbeitsgemeinschaft der Wasserwerke Bodensee-Rhein)

In 1968 the Syndicate of the Waterworks in the Lake Constance-Rhine (AWBR) region was founded as an international non-government organization. From their responsibility for the water supply of more than 10 million people the 72 municipal waterworks play an important role in the prevention of water pollution.

The AWBR is a politically and economically independent association having a scientific reputation, long lasting experience with monitoring programmes, as well as substantial human resources. It supports efforts and measures to preserve the purity of lakes, rivers and related ground water bodies and fights dangers to the municipal water supply on a national and international scale.

In co-operation with the board of directors a technical and scientific advisory board is working on actual problems concerning water protection, drinking water supply and legislation. AWBR initiates scientific investigations, performs its own monitoring programmes and works out emergency plans. Besides a yearly general meeting workshops and seminars are carried out and statements and papers are published on water-relevant topics. Public relations work is done through press releases and its own website (http://www.awbr.org/). The AWBR sees itself as an attorney for clean water and tries to sensitize the population by providing information.

14.3.5 IBK (Internationale Bodenseekonferenz)

By recommendation of Baden-Württemberg the International Conference of Heads of Governments (IBK) was founded in 1972. It is a ‘soft-law’ organization without formal agreement or legitimation by the national parliaments (Höhn 1997). Nevertheless the participation of the government leaders gives this commission at least great political importance.

At its beginning the IBK was an informal platform for discussions concerning regional planning and environment protection. Later on political issues also became part of IBK’s agenda and institutionalization took place. In 1995 a formal statute was created and a budget for public relation and its own projects was provided.

The conference of the government leaders meets once a year. A permanent board of leading officials prepares the annual conferences and carries out the

decisions with the help of 6 commissions (education, science and research; culture; public relations; environment; traffic; economics; health).

In 1994 a development concept for Lake Constance was passed to invent a long-term transboundary perspective. The aim of this concept is the protection of regional characteristics and a further development in a sense of harmony with nature, culture and economy.

An overview on the structure and the activities of IBK is given on the website http://www.regio-bodensee.net/.

14.3.6 ISKB (Internationale Schiffahrtskommission für den Bodensee)

Since the Middle Ages free navigation was practiced on Lake Constance and in 1867 the bordering states agreed on a first international regulation for navigation and harbors in Lake Constance. In 1973 this agreement was revised and the International Navigation Commission for Lake Constance (ISKB) was established as a regulatory body for navigation by Austria, Switzerland and Germany. Navigation is part of the federal policy and therefore representatives of federal authorities are members of the ISKB. The commission cannot decide on rules but by agreement the regional governments are obliged to transform its recommendations into national law. For practical reasons the lake area was subdivided into three parts where the national authorities execute control missions.

The Lake Constance Navigation Rules were defined in 1975 and transformed to national law one year later. According to technical progress and environmental needs the rules have been continuously revised and in 1996 strict regulations to minimize the exhaust gas of boat engines became valid.

Compared to the IGKB the environmental engagement of the ISKB is weaker because the latter is mainly concerned with technical and administrative navigation purposes. The ISKB is not active in publicity.

14.3.7 Bodensee-Stiftung/Umweltrat Bodensee

The Lake Constance Foundation (Bodensee-Stiftung) was founded by six private environment organizations from Austria, Germany and Switzerland as an international non-government organization in 1994.

The Environment Council of Lake Constance (Umweltrat Bodensee) is formed by eighteen private environment organizations and acts as scientific advisory board of the foundation.

The promotion of sustainable agriculture, tourism and economy in the Lake Constance region is a fundamental goal of the foundation, besides traditional activities for the protection and development of nature, landscape and natural ressources.

A team of seven full-time activists works on projects such as environment education, protection of water and nature, leisure activities and tourism, agriculture, traffic and municipal environment protection. The foundation is sponsored by private companies and works in national and European government projects.

As a non-government organization the Lake Constance Foundation has long experience with public relations and presents its activities on its website http://www.bodensee-stiftung.org/.

14.4 INFORMATION IN LAKE CONSTANCE

C.F. Weizsäcker defines information in two ways: 'Information is only that which can be understood' and 'Information is only that which generates (new) information'. In other words data and knowledge have to be relevant for problem solving and decision-making and they have to be transferred in a suitable way from the 'information producer' to the 'information user'.

14.4.1 Specification and timing of information

During its long history transboundary co-operation at Lake Constance was based at least on three different kinds of information.

Table 14.1 Information species in Lake Constance region

Specification	Examples
Scientific and Technical	Limnological, physico-chemical and biologic data (IGKB)
	Wastewater treatment plans (IGKB and engineering bureau)
Administrative and Political	Guidelines for the prevention of pollution (IGKB)
	Development concept for Lake Constance (IBK)
Public and Stakeholder related	Leaflet 'Seespiegel' (IGKB)
	Navigation rules for Lake Constance (ISKB)

Scientific and technical information delivered basic data on the natural environment and technical know-how, guidelines and political development concepts were typical for the administrative and political information sector and

last but not least public and stakeholder information formed the third species of information. These different specifications did not occur simultaneously but showed up in certain phases (Figure 14.1).

Scientific, administrative and stakeholder information date back to the 19th century or at least to the beginning of the 20th century whereas technical, political and public information have a much shorter tradition.

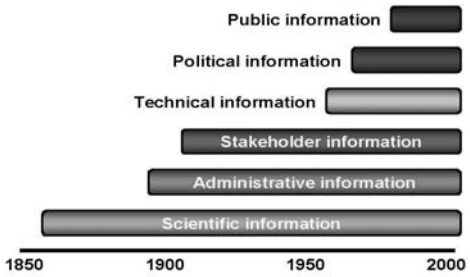

Figure 14.1 Timing of specific information

As pointed out earlier scientific progress provided essential information about the natural environment and allowed the development of management strategies. In 1868 the Association for History of Lake Constance and its Surroundings was founded with the aim to support historical and natural science research of Lake Constance.

In 1919 the Institution for Research of Lake Constance was founded by the town of Constance and one year later in 1920 the private Association for Lake Research and Lake Management and a related institute were established in Langenargen. Whereas the Constance institution looked after the basic research on the lake the activities of the Langenargen institute were predominantly dedicated to fishery problems and delivered basic tools for fishery management. The results of research were translated to stakeholder (= fishermen) related information as part of the administrative management process (IBKF, IBF).

14.4.2 'Prod-User' Information at Lake Constance

During the 1950s Lake Constance underwent dramatic ecological changes (Güde et al. 1998). The focus as well as organization of local scientific information producers changed too. While at the beginning scientific activities were concentrated on practical fishery aspects, now ecosystem research became more and more important. In 1960 the former private Institute for Lake

Research was nationalized and became part of the water administration within the Baden-Württemberg state ministry of environment. From this time on the institute took over most of the monitoring and applied research for the recently founded International Commission for the Protection of Lake Constance (IGKB). Scientists of the institute themselves became members of the IGKB working groups and the expert board. They were information producers as well as information users at the same time. On the other hand Swiss and Austrian researchers also became members of the commission. Within the working groups the results were discussed and prepared for dissemination by so-called green (monitoring) and blue (research) reports. Based on these results the yearly commission meetings prepared resolutions such as the 'Guidelines for the Prevention of Pollution' of 1967 which provided administrative information for national jurisdiction.

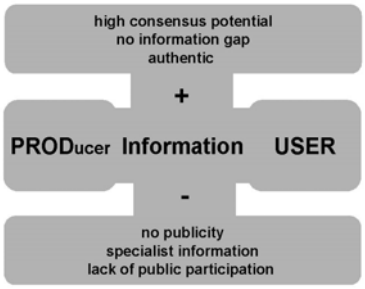

Figure 14.2 "Prod-User" Information

Information 'prod-users' are quite common for the technical-administrative commissions at Lake Constance (Figure 14.2) and this may be one reason why transboundary co-operations have been successful so far. Due to the common scientific and technical background there is no information gap between producers and users of information. As the producers mostly present their own data and knowledge their information is considered highly reliable and therefore well accepted. Last but not least a great number of the information 'prod-users' live near the lake and show a high personal identification with their work and the lake. Thus people often talk about 'our lake' rather than about the Swiss, Austrian or German part of the lake. However 'prod-user' information practice also shows some disadvantages. As there is no great need for 'translation' of knowledge some of the information produced remains expert information insofar as the reported data are difficult to understand for non-specialists.

Until the mid 1990s public information and public participation were rarely found within commission's work. The situation altered when in 1994 the first environmental non-governmental organization started to work in the Lake

Constance region. Today public information is more or less practised by most transboundary organizations, e.g. the IGKB leaflet ‘Seespiegel’ or the websites of IBK and Bodensee-Stiftung.

Up to now information is mainly restricted to traditional natural sciences disciplines. A ‘tailor made’ monitoring, including information analysts, economists and sociologists as proposed by Timmerman et al. (2000) has not yet developed in the Lake Constance region.

14.4.3 The Information Triangle

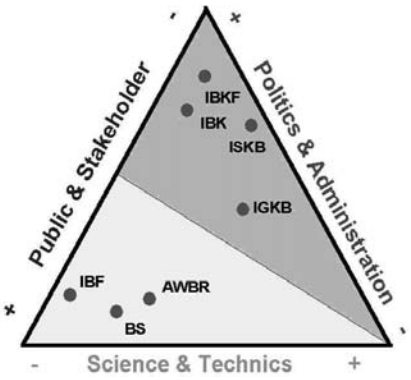

Figure 14.3 Transboundary organizations and their information

The main points of interest in information species are significantly different within the transboundary organizations at Lake Constance. With respect to the three information species different groups can be distinguished (Figure 14.3).

The IBKF and ISKB commissions are based on international treaties between the bordering states and the IBK is a conference of government leaders. Consequently, the main emphasis of these transboundary organizations is laid on politics and administration information, with low to moderate participation of science and technics information and almost low amounts of public and stakeholder information. Except for IBK ‘prod-user’ information is very common whereas public participation, as well as incorporation of sociological or economical aspects, is lacking.

In the case of the International Commission for the Protection of Lake Constance (IGKB), science and technical information is of quite high importance. Nevertheless IGKB is also ‘prod-user’ dominated and in a way ‘un-public’.

The other group is composed of the non-government organizations IBF, AWBR and Bodensee Stiftung. These organizations use a high amount of public and stakeholder information and show low to moderate interest in science and technics information. Information concerning administration and politics plays only a minor role within the information spectrum.

Although the transboundary organizations of Lake Constance show distinctly different information behaviour there is an increasing inter-organizational exchange of information. Members of IGKB are also members of IBK and vice versa. AWBR is represented in IKGB and as mentioned a representative of IBF is member of IBKF. Bodensee-Stiftung works in projects launched by IBK and IGKB. Through these activities some kind of formal and informal international network of information has been established within the water management organizations of Lake Constance.

14.5 CONCLUSION

Pragmatism characterizes most of transboundary co-operation in the Lake Constance region.

Usually information routes are short and straight-lined due to the fact that most of the information-producers are at the same time information-users in the commissions and have at least similar scientific and/or technical knowledge. This means also that information producers know the information users and ‘speak the same language’ concerning information transfer. This is one of the advantages of the so-called technical commissions and at least one reason for the success of the environmental protection so far.

A second important point is that a great deal of information producers work and live in the Lake Constance region. This means the motivation of their work is quite high for they are to some extent stakeholders for their own home environment.

The federal structure of all countries bordering Lake Constance leads to a high involvement of local people in the commissions work. Inhabitants of the states and cantons respectively outnumber the representatives of the federal administration from Vienna (Austria) and Bern (Switzerland) in the commissions. German federal representatives attend in the yearly commission meeting as observers only because of the selfgoverning-power in water management of the regional states.

Transboundary co-operation in Lake Constance was established decades before the Aarhus Convention in 1998. Information was and to a large extent

still is used as a kind of technical device in co-operation processes. Dissemination of information is almost restricted to the administrative sector. Therefore transboundary co-operation lacks public participation. Caused by the successful technical management focusing upon the elimination of excessive phosphorous loads from larger human settlements of the last decades, the public was not so much involved in environment protection policy.

The different character of the international organizations in water management of Lake Constance is mainly the result of a historical development. Nowadays public interest becomes more and more important and also stakeholder organizations claim for their interests with more emphasis. On the other hand eutrophication as one of the biggest challenges in the past has been successfully overcome by the traditional prod-user commission IGKB. The commissions therefore are in a certain phase of re-orientation and public information and public participation will become increasingly important thereby. Moreover a more intense collaboration between the transboundary organizations towards an international network will additionally strengthen international co-operation in the future.

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15

The Spanish-Portuguese transboundary water information and management approach

Rosa Matos

15.1 INTRODUCTION

The international water resources shared by Spain and Portugal have been the object of regulation since 1864 (Spanish Kingdom and Portuguese Republic 1864) through several Conventions signed by the two neighbouring countries. These Conventions had the regulation of the hydroelectric potential of the border stretches as a major purpose. A broader framework for co-operation on the protection and sustainable use of water on shared river basins was established in 1998. The 'Convention on Co-operation for the Protection and Sustainable Use of the Waters of the Spanish-Portuguese River Basins', signed

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at the Albufeira Summit, Portugal (Spanish Kingdom and Portuguese Republic 1999, 2000), on the 30 November 1998, establishes, above all, a framework for co-operation on the water protection of shared river basins and their aquatic and associated terrestrial ecosystems. The sustainable use of water resources and mutual assistance in extreme situations of flood, drought and accidental pollution incidents applies to the Minho, Lima, Douro, Tejo and Guadiana (Article 2) river basins. This Convention is also a landmark in the application of the principles established by the European Union (EU) and international law to transboundary waters.

The main objective of this chapter is to analyse the output of the Spanish-Portuguese Convention on shared river basins as far as the production, exchange, use and dissemination of information and environmental management approach is concerned. Section 15.2 focuses on the Spanish-Portuguese Convention information approach and section 15.3 on the experience and outcomes of IBERAQUA Project, related to information access and public participation. Section 15.4 refers to the scheme pursued by the Spanish-Portuguese Convention on management decisions. In section 15.4 the Guadiana river basin is used to illustrate the implications of this management approach in the sustainable development of the Spanish-Portuguese international river basins. We finish with section 15.5 discussing how this information and management approach should be improved in the future.

15.2 THE SPANISH-PORTUGUESE CONVENTION INFORMATION APPROACH

An institutional framework (Articles 20, 21, 22, 23) was established to accomplish the objectives of the Convention, composed by the Conference of Parties and by the Commission for the Implementation and Development of the Convention.

The Conference of Parties is the body in charge of political issues arising from the application and development of the Convention, with very wide powers and composed by representatives determined by each government and presided over by a Minister from each of the Parties.

The Commission for the Implementation and Development of the Convention is foremost a working body composed by the Portuguese and Spanish delegations, each with nine delegates nominated by each of the States. These delegates are responsible for carrying out studies; collecting, processing, exchanging and managing information; recognising the occurrence of conditions that trigger exceptional regimes: floods or droughts; implementing the technical and administrative procedures for co-operation under both normal and

exceptional conditions, and developing those procedures, in particular through the preparation of additional regulatory instruments and proposals for amendments to the Convention. Thus, rather than being merely a body charged with the interpretation of the Convention and the resolution of disputes, the present Commission has a set of clearly defined responsibilities that need to be carried out in perpetuity by its own specialised team.

In January 2001, the Commission adopted Rules of Procedure establishing a 'plenary session', 'sub-commissions', thematic and territorial 'working groups' and a 'forum of public audience' as major elements. Plenary sessions are being held once a year. The sub-commissions and working groups are composed exclusively by members of the Commission, although the Commission can also invite external experts to assist them when they consider necessary. Sub-commissions and working groups have been conducted at irregular intervals between Lisbon and Madrid. Until now, no meeting of the 'forum of public audience' has been celebrated, either by Portugal or Spain.

Since November 2001, several sub-commissions and working groups (WG), both exclusively composed by governmental representatives, have been functioning: WG on floods; WG on droughts; WG on the co-ordinated implementation of the Water Framework Directive; WG on the establishment of the scope of information and protocols needed for measures of follow-up and control information exchange; WG on the assignment of the responsibilities established in the Conventions of 1964 (Convention on the regulation of the hydroelectric potential of the border stretches of the Douro river and its tributaries) and 1968 (Convention on the regulation of the hydraulic potential of the border stretches of the Minho, Lima, Tejo, Guadiana and Chança rivers and its tributaries); WG on the study of the sustainable use of the international stretch of the Guadiana river; a sub-commission to deal specifically with the Guadiana river, an *ad hoc* WG on abstractions on the left Guadiana river bank and an *ad hoc* WG on land expropriation for the development of the Alqueva dam project in the Guadiana river.

This extensive list of plans and projects focused on the Guadiana river basin show that the Commission puts a great effort and resources into this river basin. This clearly indicates the importance of projects developed in the Guadiana river for both countries, particularly the Portuguese Alqueva dam project developed in the south region of Alentejo. Furthermore, specific matters referring to the Alqueva dam project and the abstractions in the international stretches of the Guadiana river were the main object of deliberation.

According to the Commission Rules of Procedure (Deliberation II/2) and written answers from the Portuguese and Spanish delegations, conclusions and recommendations from the working groups and sub-commissions and reports on

fora of public audience are to be forwarded to the respective Delegation's President and integrated in Reports to the Plenary, being considered working confidential instruments. They can be adopted as Commission Decisions only after their approval by the Plenary. Decisions are considered effective if none of the Parties formally request their revision or their presentation to the Conference of Parties, after 2 months of their adoption.

As well as the Convention itself, the work of the Commission for the Implementation and Development of the Convention is almost unknown to the general public and even to the regional and local administration and water users, both in Portugal and Spain. The Plenary Decisions and agendas of the Plenary and working groups are not available for free public consultation in any media. As an example, the governmental web pages barely include any reference to the Convention. Information can only be acceded under a formal request to the President of the Portuguese Delegation – until now a representative of the Ministry of Foreign Affairs, or to the President of the Spanish Delegation – a representative of the Ministry of Environment. In addition, no Annual Report on the evolution of the matters addressed by the Convention and the national state of implementation of the agreed measures has yet been produced, as demanded by the text of the Convention (Article 7).

15.3 THE IBERAQUA PROJECT

Under the present situation and a future scenario of scarce information and lack of public participation, and based upon its previous work in helping put forward the principles established in the Convention and the Water Framework Directive in respect to transboundary waters, EURONATURA and IIDMA developed the IBERAQUA Project (http://www.euronatura.pt/; http://www.iidma.org/).

EURONATURA, the Centre for Environmental Law and Sustainable Development, is a Portuguese non-profit research centre on environmental law, policy and science. IIDMA, the International Institute for Law and the Environment, is a Spanish non-profit organisation founded to contribute to environmental protection and to promote sustainable development through the study, development and effective implementation of environmental law.

EURONATURA and IIDMA have been actively involved in promoting public participation as a paramount condition for the sustainable management of shared water basins in the framework of transboundary co-operation, as recognised by the Water Framework Directive (Article 14). EURONATURA and IIDMA believe in fact that the enhancement of participatory processes can contribute to the effective implementation of legal, institutional and even informal water management mechanisms.

The IBERAQUA Project aims to contribute to the development of a co-operative regime for the management of shared river basins in the Iberian Peninsula.

The IBERAQUA Project seeks the achievement of four main objectives:

(1) Research the Water Framework Directive and the Spanish-Portuguese Convention, given the specific administrative, legal and economic characteristics of each Spanish-Portuguese basin. The relationships between the Water Framework Directive and the Spanish-Portuguese Convention will be analysed and complementary elements between them will be identified.
(2) Inform stakeholders and water managers of the outcomes of the IBERAQUA analysis.
(3) Facilitate a training process in terms of public participation, in order to promote debate and institutional change, regarding enhanced public participation in water management regimes.
(4) Start a process that could lead to the establishment of a *Forum of Iberian water users*, if feasible and appropriate.

These objectives are being accomplished through the research carried out by EURONATURA and IIDMA. The development of a general paper on the Water Framework Directive and the Spanish-Portuguese Convention and other specific papers focusing on each of the three main transboundary river basins analysed, the Douro, Tejo and Guadiana, supported the organisation of workshops in each of these river basins.

As a result of the research conducted to date, as well as of the workshops held on Douro, Tejo and Guadiana river basins (June, October and December, 2002), EURONATURA and IIDMA became aware of the lack of knowledge of the Water Framework Directive and the contents of the Spanish-Portuguese Convention among regional and local administration, stakeholders and civil society. These main interest groups were not familiar with the provisions set by those instruments and emphasised difficulties in obtaining information handled by the Administration, namely the water administration and the Commission for Implementation and Development of the Spanish-Portuguese Convention. Furthermore, these discussions revealed the lack of substantive transboundary co-operation, particularly at local and grass-root levels, and the urgent need to foster public participation under the Water Framework Directive implementation process.

As a key instrument for the management of international river basin districts and the implementation of the Water Framework Directive on the Iberian Peninsula, the Spanish-Portuguese Convention raises several concerns on access to environmental information and participation, that need to be further

developed. The Convention establishes that both Parties shall give access to information on the aspects under the jurisdiction of the Commission when presented with a reasonable request (Article 6). EURONATURA and IIDMA have presented co-ordinated requests for information about the work of the Commission, such as agendas, meeting reports, decisions and lists of documents exchanged by the Parties. However, only some of the requested documents were provided by the Commission.

15.4 THE SPANISH-PORTUGUESE CONVENTION MANAGEMENT APPROACH

Following the spirit of the Water Framework Directive, Article 4 of the Convention establishes that co-ordination is to be conducted via a co-operative mechanism, including:

- regular and systematic exchange of information;
- provision of information to the public;
- development of consultative exercises and other activities by the bodies established under the Convention;
- adoption of technical, legal, administrative measures to apply and develop the Convention.

The co-operative mechanism established by the Convention as the basis for the management approach developed is clearly the co-ordination between both States instead of a shared or joint management of water. Each State has management competences in its own territory, on a basis of mutual respect for sovereignty. It comprises rules and principles regarding water quality, prevention and control of water pollution, water uses and flow regimes.

Flow regimes should be defined by the Commission with the aim of ensuring good water status, guaranteeing current and foreseeable uses and complying with the regime set by the 1964 and 1968 Conventions. Until that regime is defined, the Additional Protocol to the Convention defines a provisional flow regime. This Protocol establishes a minimum yearly water flow for each of the reference stretches of the international rivers. Nonetheless, the minimum flow is not applicable if precipitation is lower than the medium precipitation registered in the same period of the previous hydrological year. During a drought period, water is managed primarily to guarantee priority uses such as domestic and economic uses, namely forestry production, and the maintenance of environmental conditions, either in the river or the estuary, considering the intrinsic conditions of the natural flow regime. Since both States follow different measuring methods, however, it is difficult to compare and co-ordinate these decisions.

As far as concerns water quality, the Convention requires that water quality objectives shall be achieved through the co-ordination of management plans and programmes of measures in the terms and dates established by community law. The objective of achieving good water quality is then remit to the process of implementing the Water Framework Directive, which is still further from being accomplished. Besides, no definition of common measuring parameters has yet been envisaged by either Member State.

Regarding the transboundary impact assessment and according to the Convention, both countries are obliged to assess the transboundary impact of new projects prior to their approval, to assess the transboundary impact of plans and programmes (strategic evaluation of transboundary impacts) and *a posteriori* assessment of the transboundary effects of projects and activities.

15.5 THE GUADIANA RIVER CASE

The water management in the Guadiana river basin is one of the main concerns for both Portugal and Spain due to its particular characteristics with long transboundary stretches, unique ecosystems and hydrological stress. Nearly 40% of the decisions of the Commission for the Implementation and Development of the Convention concern river basin water management and related projects for this river.

This section looks at some particular aspects of the management of the Guadiana river basin in order to analyse how the Convention mechanisms of co-ordination of decisions have contributed to guarantee its sustainable management. It will particularly focus on the establishment of flow regimes and the application of transboundary impact assessment.

15.5.1 Flow regimes management in the Guadiana river basin

According to the Convention, two monitoring stations (Badajoz and Pomarão) were established with the aim of measuring the Guadiana river basin flows using two different time scales: annual (hm^3/year) and daily (m^3/s). The second measure intends to secure a minimum flow of 2 m^3/s even if a higher flow would be needed to accomplish the agreed annual values. From a legal point of view, it can be considered that the minimum flows required by the Convention are better assured in the Guadiana than in the other four international river basins, for which there is only an annual minimum flow required. In this case, water retention in Spain during the dry seasons can be counterbalanced by higher flows when there is a higher hydrological availability. On the contrary, the minimum flows in the

Guadiana river basin are even secured in dry years since Spain agreed to mobilise the water stored in its dams during those periods (Article 16).

The flow regimes management in the Gaudiana river basin were also subject of much attention of the Commission of the Convention. The Commission produced a Decision with the purpose of guaranteeing the daily average flow and annual flow defined by the Convention Additional Protocol by means of preventing any influence related to the existence of abstractions in the main stream of the Guadiana river between the confluence of the Caia and Cuncos rivers. If compensation of abstracted water with an additional flow release is impossible, those abstractions shall be suspended. With the aim of accomplishing this objective, a limit of 2 years was established for the installation of flow measurement equipment in those stations.

Two main concerns related to the water flow management are stressed here.

(1) There is no refined technical guidance applied to the environmental management of abstractions and water retention in Portugal. According to the Convention, the Portuguese Water Institute (INAG) developed a technical guidance document concerning the environmental management of the flow regime in the Alqueva reservoir during the first period of operation. This document emphasised the advantage of dynamic management, to be changed daily if necessary. Concerning the sustainability of this management procedure a comment can be made: Spain and Portugal agreed on the development of a study on the 'Environmental conditions in the Guadiana estuary and the adjoining coastal zone' (LNEC 2000) before the floodgates would be closed. The first two phases of this study, which consisted of a diagnostic characterisation of the Portuguese bank, were in fact reported to Spain through the Commission of the Convention. Paradoxically, the floodgates of the Alqueva dam were closed before the conclusion of the study, although its final results were supposed to regulate the environmentally sound flow management in the Guadiana river as well as determine the operational measures to minimise the Alqueva project impacts in the estuary. The Portuguese governmental National Laboratory LNEC, responsible for the study carried out in Portugal, justified this non-accomplishment with the absence of an answer to the requirement of updated information about the reservoirs along the international stretch, especially Spanish reservoirs. Consequently, it can be concluded that the fact that technical reference data is still not available was the main alleged impediment to the determination of the ecological flow needed to maintain the aquatic ecosystem downstream of the Alqueva dam.

(2) According to the Convention (Annex to the Additional Protocol), the Commission shall revise flow regimes defined in the Additional Protocol

> for all international river basins whenever any infrastructure project is planned for the international stretches of the river basins or the international stretches of its tributaries. However, under this statement, it seems impossible to foresee the maintenance of ecological needs in either country in a medium or even long period of time.

Based on these considerations it may be concluded it is still unclear how sustainable management of the Guadiana river basin flow will take place, as problems of co-operation (lack of data exchange) and uncertainty about ecological needs persist.

15.5.2 Transboundary impact assessment (TIA)

According to the Convention, both countries are obliged to assess transboundary impacts of projects and activities jointly identified (Article 9) as well as to conduct a consultation to minimise or attribute the impacts (Article 8). The transboundary impact assessment of surface abstractions in the Guadiana river basin, including water transfer to other river basins, was already referred to in the 1968 Convention, that allowed these transfers both for Spain and Portugal as long as both countries maintained the minimum natural dryness flows as well as flows needed for common use. Although this rule emphasised a narrow concern about environmental protection, it did not set any specific volume to be fulfilled by the Parties, thus rendering its fulfilment impracticable.

TIA for surface water abstraction is a binding demand of the Spanish-Portuguese Convention for all the projects with an effective consumption of more than 5 hm^3/year, including water transfers. The Alqueva dam project falls under those requirements since a transfer between 50 and 150 hm^3/year is expected to irrigate important areas of the Sado river basin. Nevertheless, when the Spanish-Portuguese Convention entered into force, the Alqueva environmental impact assessment (1985) was already approved as well as an authorisation for EU financial support (1997), and the Global Alqueva Irrigation Plan (1997) was also established, authorising the referred water transfer. This indicates a similar strategy adopted by Spain and Portugal to promote partial studies that intend an information update and allow for decisions concerning issues that are not included in the environmental impact assessment. A good example of this is the ‘Study on the sustainable use of the international stretch of the Guadiana river upstream of the Pomarão control station’, agreed in January 2001.

15.6 CONCLUSIONS

The Spanish-Portuguese Convention represents, in the Iberian Peninsula, a step forward in international co-operation and in accordance with the main principles of the Water Framework Directive that entered into force 2 years after the Convention. Applicable to the Minho, Lima, Douro, Tejo and Guadiana river basins, it covers a territorial domain compatible with the Water Framework Directive, as it includes surface and underground waters, aquatic ecosystems and the associated terrestrial ecosystems. Although the objectives of the Convention are integrated with the majority of principles established by the Water Framework Directive, including river basin management, it does not explicitly require joint management. Further, the Convention is primarily set up to regulate and control flood regimes thus add control.

As indicated by this chapter, and in particular illustrated by the Guadiana River Basin case, the work carried out under the Convention with respect to the application and revision of the flow regime regulations was mainly based on politically driven criteria. Therefore, there is still a long way ahead for the Iberian States to consolidate and integrate the scientific and technical knowledge and data into their decision-making process.

It is crucial to strengthen the importance of actions at the lowest possible decision-making level where the greatest difficulties in complying with national, Iberian and European legislation have been identified, appropriately oriented by common principles. Public participation is a key aspect in this development, as the involvement of users and interest groups from the start is a guarantee of effective implementation. Nonetheless, and in spite of the willingness of both national delegations to provide access to information, the different mechanisms of public participation inscribed in the convention, in particular the Forum for Public Audience, need further development.

Co-operation between local and regional administrations on transboundary projects in the Spanish-Portuguese river basins is intense, but the river basins are managed in both countries by different bodies of the national, regional and local administration, while co-operation on the river basin scale is co-ordinated exclusively at a national level. A national inquiry developed by IBERAQUA designed to analyse Spanish and Portuguese water stakeholders, knowledge and views on the implications for Portugal and Spain of the implementation of the Water Framework Directive and the Spanish-Portuguese Convention showed that stakeholders claimed that the means and mechanism put forward by the Convention do not correspond to their expectations and suggested the creation of new joint basin administrative institutions under the framework of the Convention. These would co-ordinate the exchange of information and guarantee the

mechanisms established by the Spanish-Portuguese Convention, and providing a more effective and active public participation.

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16

A comparative study of information management in three transboundary water regimes in Europe

Susanna Nilsson and Sindre Langaas

16.1 INTRODUCTION

During the last decades, there has been a continuous call for more integrated management of rivers and lakes, interrelating different social, economic, and environmental aspects of water issues (for instance UNECE 1996; Global Water Partnership Technical Advisory Committee 2000; Savenije and van der Zaag 2000). Further, the river basin has emerged as the most appropriate management unit for protection of water, as opposed to more conventional administrative or political units (cf. the EU Water Framework Directive). Integrated water resources management according to river basins, or for that matter, all planning

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and policy-making, require adequate and understandable information (Dinar 1998; Naff 1999). Since about half of the world's total land surface belongs to river basins shared by two or more countries (Wolf *et al.* 1999), this requirement has an international dimension. A common way for states to co-operate around transboundary waters is to establish river basin institutions, such as joint water commissions. Among the most important functions of such institutions are monitoring of water quality and quantity, development of action programmes, standardisation of data collection and sharing of relevant data (Savenije and van der Zaag 2000; Enderlein 2001). The development of information needs and strategies for information collection, storage, analysis and use (information management) are closely related to these functions. Few studies, however, have critically examined such needs and strategies.

This chapter presents a study on the overall information management in three transboundary water regimes in Europe. The chapter has two main objectives. The first objective is to present frameworks or conceptual models, which might be applied for clarifying or facilitating the understanding of information management in transboundary water regimes. The second objective is to provide knowledge of and examine differences and similarities of information management in three transboundary water regimes in Europe. More specifically, the information related activities of the institutional bodies established for transboundary co-operation in Lake Neusiedl (basin shared between Austria and Hungary), Lake Constance (basin shared between Switzerland, Liechtenstein, Germany, Austria and Italy) and Elbe River (basin shared between Germany, Czech Republic and Poland) are examined. The study is not only restricted to examining differences between regimes, but the information management in the regimes is also, in more general terms, related to the 'requirements' of information, implied by integrated water resources management.

The material for the study was collected through semi-structured interviews with delegates and consulting experts for the transboundary water commissions for Lake Neusiedl, Lake Constance and Elbe River. In addition, other sources of information, such as treaty and convention texts, reports, and Internet material were also gone through. Two frameworks, the Information cycle model and the DPSIR (*D*riving forces, *P*ressures, *S*tatus, *I*mpacts, *R*esponses) framework, guided the data analysis. A more thorough description of the background and method of the study have been reported in Langaas *et al.* (2002).

16.2 FRAMEWORKS FOR INFORMATION MANAGEMENT

In this study, the Information Cycle model and the DPSIR framework were used as a basis for analysing questions related to information management in transboundary water settings. These approaches are not unique in any sense, but there are several other theories, models or frameworks equally suitable to apply for a better understanding of information management in transboundary water regimes. For example, the Information Cycle (Figure 16.1) is similar to other models, such as the communication model presented by Sadler (1991). The Information Cycle model was suggested by Timmerman *et al.* (2000) for facilitating water policy- and decision-making and the UN Economic Commission for Europe (ECE) task force on monitoring and assessment (1996) has recommended the cycle for water quality monitoring system design. The model describes the essential steps in the continuously on-going process of information production (and use), starting with definition of information needs and strategies, followed by data collection and analysis, which finally leads to information utilisation for water policy and decision-making. One main objective of the Information Cycle model is to facilitate the dialogue between information producers, such as experts and scientists, and users, such as policy- and decision-makers. Based on experience Timmerman *et al.* (2000) claim that defining the information needs often is the most critical, most important step in the cycle. Ideally, information users should identify information needs in co-operation with information producers (Timmerman *et al.* 2000).

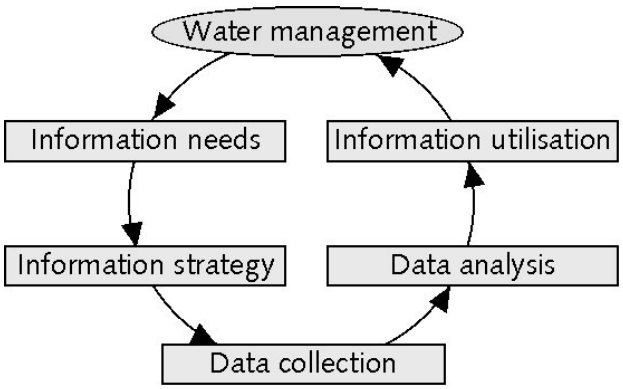

Figure 16.1 The information cycle (from Timmerman *et al.* 2000).

Another model increasingly used for management and assessment of environmental information is the DPSIR framework (e.g. UNEP/CEU 1997;

Harremoës and Turner 2001; Lorenz *et al.* 2001; Timmerman *et al.* 2003) (Figure 16.2), which builds upon a state of environment reporting model originally developed by the Organisation for Economic Cooperation and Development (OECD). The framework assumes that there are interrelated links between social, economic and environmental systems, such as (EEA 1999):

- Driving forces (D) of environmental change (e.g. economic activity, transport);
- Pressures (P) on the environment (e.g. discharges of waste water);
- State (S) of the environment (e.g. water quality in rivers and lakes);
- Impacts (I) on population, economy, ecosystems (e.g. water unsuitable for drinking, biodiversity loss); and
- Responses (R) of the society (e.g. river basin protection).

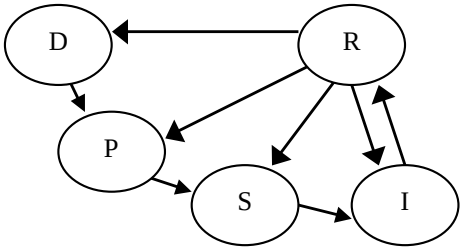

Figure 16.2 The DPSIR framework for reporting on environmental issues (from EEA 1999).

The Information Cycle model and the DPSIR framework were considered as quite suitable tools for examining the information management in transboundary water regimes. Furthermore, the frameworks were also regarded as appropriate for relating the information management in the regimes, in more general terms, to information needs implied by integrated water resources management. Typically, these information needs may be connected to the basic ideas of integrated management, such as a co-ordinated management of water, land and other resources in a sustainable manner, involving all stakeholders (Global Water Partnership Technical Advisory Committee 2000).

Thus, the Information Cycle model was used for understanding *how* information is managed, as the cycle describes the processes of information production (and use). Since the DPSIR framework, on the other hand, allows a grouping of different types of information into relevant and easy understandable categories, the framework was used to address the question *what*. More specifically, the following questions were examined: what are the information needs, how are information needs and strategies defined, what type of data and information is collected, and how is it used?

16.3 INFORMATION MANAGEMENT IN THREE TRANSBOUNDARY WATER REGIMES

In general, there are several actors on various administrative and geographical levels that take an active part in the modification and management of a water resource. There are not only national governments involved, but also regional and local authorities, public and private enterprises, NGOs and the general public play important roles (Gooch *et al.* 2002). Although there are different actors involved in modifying and managing a water resource, and consequently also involved in the information related activities around the resource, this study was restricted to consider only information management of formal transboundary water regimes. The primary motive for focusing on regimes was simply that they are often regarded as having a key role in transboundary water management (Delli Priscoli 2000). International regimes can be defined as 'sets of implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations' (Krasner 1983). In practice, however, the conception of regimes is often narrower. Conca (1996) describes this narrower understanding as 'a specific form of international institution, in which states actively and consciously bend their behaviour toward the attainment of a collective purpose.' Thus, this study focused on the agreements set up by states to co-operate in water management issues. Of special attention were the information related activities of the transboundary water commissions established to fulfil the agreements.

For clarification, the effectiveness of the regimes, i.e. to what extent regimes have succeeded in solving the problems they were set up to deal with, was not addressed. Although increasingly the focal point for research on international regimes (e.g. Andresen 1996; Stokke 2001), the question of effectiveness was simply beyond the scope of this study.

16.3.1 The case regions and transboundary water regimes

The three case regions Neusiedl, Constance and Elbe differ considerably in their characteristics (Table 16.1). In the first place, Elbe is a river and Neusiedl and Constance are lakes. Further, factors such as the size of the basins and the number of inhabitants vary considerably.

Table 16.1 General characteristics of the case regions

	Neusiedl	Constance	Elbe
Surface area/length	315 km^2	570 km^2	1090 km
Basin	1 120 km^2, shared between Austria (85%) and Hungary (15%)	11 500 km^2, shared between Switzerland incl. Liechtenstein (50%); Germany (28%); Austria (21%); and Italy (0,4%)	148 270 km^2, shared between Germany (65%); Czech Republic (34%); Austria (0,6); and Poland (0,2%)
Population	123 000 (110 inhabitants/km^2)	1 500 000 (130 inhabitants/km^2)	24 700 000 (165 inhabitants/km^2)
Water uses	Recreation; reed harvest; scientific studies; fishing	Drinking water supply; fishery; shipping; recreation	Drinking water supply (via riverbank infiltration); industrial water supply; irrigation; navigation
Main environmental issues	Regulation of the water level; slight eutrophication	Eutrophication The situation has improved vastly since the late 1970's	Pollution of nutrients, heavy metals and organic substances From 1990/2000 there has been a great improvement in water quality

In all case regions, legal agreements about co-operation in transboundary water issues have been concluded and operational components in the form of joint commissions have been established. The Hungarian-Austrian water commission was established in 1956, the International Commission for the Protection of Lake Constance (IGKB) in 1960 (see also Chapter 15), and the International Commission for the Protection of the River Elbe (ICPE) has existed since 1990. There are both similarities and differences in the regimes (Table 16.2). The contracting parties are national or regional governments and there is in general no representation of stakeholders or other similar groups in the commissions. The commission delegates are not politically elected, but are civil servants, mainly highly educated technicians. The resolutions of the delegates are made by the principle of unanimity and are later to be approved by the member governments. The mandates of the commissions differ somewhat. In the Constance and Elbe regimes, the focus is on protection of the water

resource and improvement of the water quality, while in the Neusiedl regime the main focus is co-operation on technical and economic water management issues.

It should be pointed out that, at least, the Constance and Elbe regimes generally are regarded as very successful co-operations. The great improvements of the water quality in Constance and Elbe during the last decades are to a high degree considered to be the result of the work of the commissions (Blatter 2001; IWAC 2001).

16.3.2 Information needs and strategies

The study showed that information is mainly needed to observe and agree upon the current status of water (S, I), to examine to what extent problems are still present and if measures have the intended effect (S, I, R), and to identify causes of pollution (D, P) (Table 16.3). The Constance and Elbe commissions also saw a need for data and information in order to be able to recommend preventive measures. The information required appears to be primarily defined with the commissions' own needs in mind and with little consideration of the information needs of stakeholders or the public. This was also expressed by some of the interviewees: 'the main reason for data collection is to provide data for a professional base for decisions which have to be taken by the commission' (statement by one of the interviewees). An exception to this is the Elbe commission, where the need for information for communication with the public was explicitly acknowledged. The information needs, or reasons for the commissions to manage environmental data and information are quite well defined, generally corresponding to the tasks of the commissions stated in the legal agreements on which the co-operations are based.

The information needs and strategies are defined at commission meetings, where consulting experts describe the situation and make proposals on changes in the data and information collection for commission delegates. As the delegates are mostly highly educated technicians or natural scientists and thus experts themselves, although having the role of decision-maker (or, rather, 'resolution-maker') in the commissions, it makes little sense in this context to discuss the often lacking dialogue between information users and producers, as stressed by Timmerman *et al.* (2000) (see 16.2). However, it is worth further addressing the role of the delegates, which is twofold: within the commission they act as decision-makers (information users), while outside the commission they are information producers/communicators for higher policy levels. It might be reasonable to assume that the problem stressed by Timmerman *et al.* (2000) concerning the lacking or non-working dialogue between information users and producers may rather be present in the contact with higher policy levels. However, this was not specifically examined in this study.

Table 16.2 International water regimes as foundations for management of transboundary water resources

Basin	Commission	Legal basis	Contracting parties	Mandates	Power of implementation
Neusiedl	Hungarian-Austrian water commission[1]	Treaty between the Hungarian People's Republic and the Republic of Austria concerning the regulation of water economy questions in the frontier region, 1956	Hungary and Austria	- make decisions on the practical solution of technical and economic water management problems and promote co-operation in water questions; - plan hydraulic works and approve of methods of execution and maintenance; - supervise, account for and accept jointly executed works and measures; and - suggest measuring operations and preparation of studies in connection with hydraulic construction work	The commission makes decisions by the principle of unanimity and the decisions are later brought up to and approved by each national government.
Constance	International Commission for the Protection of Lake Constance (IGKB)	Convention on the Protection of Lake Constance Against Pollution, 1960	Austria, Switzerland, the German federal states Bavaria and Baden-Württemberg[2]	- observe the status of the lake; - confirm the causes of pollution; - recommend co-ordinated preventive measures; and - discuss planned utilisation of the lake	Resolutions of the delegates are made by the principle of unanimity. The resolutions are given as recommendations to the bordering countries, which have to consider the recommendations and realize them in the best possible way according to national law.
Elbe	International Commission for the Protection of the River Elbe (ICPE)	Convention between the Federal Republic of Germany and the Czech and Slovak Federal Republic and the European Economic Community on the International Commission for the Protection of the Elbe, 1990	Germany, Czech Republic and EU	- identify major point sources of pollution and estimate pollution from diffuse sources; - propose limit-discharge-values and specific quality objectives; - propose and co-ordinate joint measurement programmes; - compile standardized methods for water quality classification; - propose actions for reduction of discharges of harmful substances and measures for avoidance of water pollution because of accidents; - describe the hydrological situation in the Elbe area; - provide information about various biotopes and propose improvements for aquatic and coastal communities; and - promote co-operation and exchange of information	Resolutions of the delegates are made by the principle of unanimity. The resolutions are given as recommendations to the member states and the implementation is up to the governments to decide upon.

[1] Commission for all border waters between Hungary and Austria.

[2] Liectenstein has one representative in the commission, the German federal government is observer of the commission work and the Association of the Lake Constance-Rhine Waterworks (AWBR) has one representative in the Board of Experts.

Table 16.3 Information needs (and uses) of transboundary water commissions

Information needs (and uses)	Category according to DPSIR framework	Basin
Observe and agree upon the current status of the lake/river	S, I	Constance, Elbe, Neusiedl
Examine to what extent problems are still present and if measures have had the intended effect	S, I, R	Constance, Elbe, Neusiedl
Identify causes of pollution	D, P	Constance, Elbe, Neusiedl (?)
Recommend preventive measures	R	Constance, Elbe
Discuss planned utilisation of the water resource	D, P, S, I, R	Constance
Communicate information to the public about status and improvements	D, P, S, I, R	Elbe

16.3.3 Data collection

S and I information, collected through monitoring of physical, chemical and biological parameters, dominate the regular and systematic data collection performed within the frames of the commissions (Table 16.4). In all basins some sort of joint monitoring programme is managed. In most cases, the joint monitoring programme is also part of national or local monitoring networks and the monitoring is generally performed by regional water authorities, research institutes and the like. In Neusiedl, there are nine stations managed jointly with monitoring twelve times per year, in Constance there are six monitoring stations with a monitoring frequency of about twice per month, and in Elbe samples are taken from twelve monitoring stations at least 13 times per year. Although not as frequently or systematically collected as S and I information, P information, such as emissions of nitrogen and phosphorous from sewage treatment plants, are collected within regular intervals in Constance and Elbe. R information is only regularly and systematically collected in Elbe. Here an action programme for the period 1996–2010 has been developed which comprises recommendations on measures, for example, to reduce the load from sewage treatment plants and guarantee migration of fish, for improving the conditions of

the water in the basin and the Elbe itself. The realisation of suggested measures is evaluated and the results presented in a report every second year. The last report covers the period 1998–1999. Neusiedl and Constance do not regularly collect D information. It is rather unclear if D information is regularly collected for Elbe. When estimating load from diffuse sources, which has been done within the frames of the Elbe commission, there is a need for information about crop types, animal farms, urbanisation processes and number of households in the basin, so this type of information must at least occasionally be collected. However, the collection of D information in Elbe is in any case not as frequent and systematic as the collection of S and I information.

Table 16.4 Types of data collected according to the DPSIR framework. '+' indicates that data is regularly collected while '-' indicates that data is not regularly collected.

Basin	D	P	S	I	R
Neusiedl	-	-	+	+	-
Constance	-	+	+	+	-
Elbe	?	+	+	+	+

Monitoring data and other types of data are stored in joint databases set up within the frames of the Constance and Elbe commissions' work. For the Constance commission, data is stored at a research institute and in Elbe, data is stored at the secretariat of the commission. For Neusiedl there is no joint storage of data, but the data is kept at regional water authorities. In general, there are no problems for commissioners to have access to data, primarily from monitoring programmes, collected within the frames of the commission. Exchange of information is often required through the treaties or conventions on which the commissions are based.

16.3.4 Information use

Information is mainly used for internal discussions and decision-making. In general, consulting experts report on results and progresses for the delegates at the commission meetings. Technical reports, or in the case of Neusiedl, results written down in the agenda of the commission meeting, serve as a basis for the discussion. As the delegates are highly educated civil servants, they have no problems in understanding the generally quite technical and complex information. The delegates later communicate the information to higher policy levels at national or regional governments, which are to finally approve or disapprove the resolutions of the commissions.

The commissions mainly use passive channels, such as technical reports and websites, for communicating with interest groups and the public (Table 16.5). Elbe is an exception to this as they arrange a meeting once a year with the NGO community, allowing for an open discussion on issues of interest for NGOs. The commission for Neusiedl communicates very little itself with interest groups and the public. Instead, the main channel for communication there goes through the regional water authorities.

Table 16.5 Means for communicating information to interest groups and the public. '+' indicates use of the information channel while '-' indicates no use of the information channel

Basin	Press conference	Technical reports	Internet	Newsletter	Workshops/meetings
Neusiedl	+	-	-	-	-
Constance	+	+	+	+	-
Elbe	+	+	+	-	+

16.4 DISCUSSION

This discussion will focus on two issues. First of all, differences in information management between the regimes and their possible explanations will be discussed. Second, information management in transboundary water regimes in Europe today will, in more general terms, be related to the 'requirements' of information implied by the concept of integrated water resources management.

16.4.1 On differences in information management in transboundary water regimes

The study revealed differences in the information management in different transboundary water regimes. The results indicate that of the transboundary commissions examined in this study, the Elbe commission has the most comprehensive information management, followed by the Constance commission and, lastly, the commission for Neusiedl. This statement is based on the identification of the information needs, which showed that Elbe was the only commission seeing a need for information to stakeholders and the public. Further, relating the data collection to the DPSIR framework, it was shown that the Elbe commission had the most integrated approach in terms of the most regular and systematic collection of (D,) P, S, I and R information. The Elbe commission can also be considered to most actively communicate information to the public by, for example, regular meetings with the NGO community. The least extensive information management was found in the commission for Neusiedl, where only S and I information is regularly collected and few

channels are used to actively communicate information to the public. The information management in the Constance commission appear to be neither as extensive as in the Elbe commission, nor as moderate as in the commission for Neusiedl.

There may be several reasons for the differences in information management between the commissions. A hypothetical explanation may be that the differences are related to factors such as the diversity and perceived significance of environmental issues in the basin, indirectly influenced, for example, by the number of inhabitants, number and type of industries, and portion of agricultural land in the basin. Another explanation might lie in the history and mandates of the regimes (cf. chapter 15).

In the Elbe river basin there are chemical and pharmaceutical industry, paper and pulp industry, metal industry, and mining. Over half of the land is used for agriculture. Further, the water is used for drinking water supply (via riverbank infiltration), industrial water supply and irrigation (IWAC 2001). This can be compared with the Neusiedl basin where there are no industries in the basin, but the majority of the land is used for agricultural purposes. The water resource itself is used for recreation, reed harvesting and fishing. Based on these facts it can be argued that Elbe faces a higher diversity of environmental problems than Neusiedl. If the range of environmental problems is large it may be assumed that this poses higher demands on management of different types of information, explaining – at least partly – the differences between the commissions. Further, the many users of water in the Elbe basin might put a higher pressure on governments, to act for generating reliable information for decisions, compared to basins where the number of users is few.

As stated earlier, the information management may also be related to the history and mandates of the regimes. The Elbe regime is the youngest, concluded in 1990, and the mandates for the commission the most extensive, comprising tasks such as identification of major pollution sources, co-ordination of monitoring programmes and suggestion of remediation measures (Table 16.2). The primary objective of the establishment of the Elbe regime was to overcome the severe transboundary problems with pollutants in the river basin. The Constance regime was set up in 1960 as a response to the increasing phosphorous levels in the lake, and subsequently the main task was to halt the eutrophication of the lake. The regime for Neusiedl is actually not committed to *protect* the water of the lake, but the main focus is to take decisions on the practical solution of technical and economic water management issues. The Neusiedl regime was set up in 1956 as a consequence of the end of World War II. As Hungary became a one-party communist state and Austria a westernised nation, the countries were forced to set up some sort of rules on

how to manage the quite extensive drainage system, all along the border, which in earlier times had all been part of the Austrian-Hungarian empire. So, considering the increased awareness for environmental degradation of water resources in the last decades and the notion of an integrated approach as a solution to the problems, the mandates of the commissions probably reflect the point in time when the regimes were concluded. In addition, the acute reasons for the establishment of the regimes may also play a role in explaining differences in information management.

16.4.2 On information for integrated water resources management

Although there are differences in information management between the studied regimes, similarities can also be distinguished. If the differences were the point of departure for the previous section, this section will attempt to make some analytical generalisations regarding information for integrated water resources management.

One common feature of the commissions is that they all are expert/technical commissions. This has been referred to as the technical/scientific paradigm in river basin accords (Milich and Varady 1999). In this paradigm, experts, often hydrologists and engineers, are given broad authority to prioritise issues to be addressed, choose tools and targets, and determine the extent of public involvement. The weaknesses of this paradigm according to Milich and Varady (1999) is that decisions on critical social/environmental policy are allocated to engineers, who often are not capable of assessing the potential adverse effects of their decisions.

Considering the organisation of the commissions in focus in this study, they appear to match the technical/scientific paradigm. The technical domination is reflected in several ways. It is shown in the information needs, which are mainly defined with the commissions' own needs in minds, and in the regular data collection, which is dominated by S and I information, collected through monitoring of physical, chemical and biological parameters. Further, the paradigm is also visible in the means for communicating information to the public, which is mainly done through passive channels.

As mentioned, S and I information dominate the regular data collection performed within the frames of the commissions. Clearly, S and I information from monitoring is needed and according to van der Zaag and Savenije (2000), the gathering and sharing of such information is a basic requirement for building mutual trust between member governments. However, for a more integrated management of water resources, other types of information originating from the basin are also needed. A recent study where the use and valuing of

environmental information in the decision-making process was examined showed that decision-makers mostly used D and R information. Information about the state of the water system was not directly used in the decision-making process (Timmerman *et al.* 2003). Our study showed that S and I information were the types of information given the highest priority in terms of data collection. Thus, at a first glance the results from the two studies appear to be contradicting. However, this is not necessarily so. Again, the answer might be connected to the technical/scientific paradigm. As technicians and experts dominate the commissions, they probably value 'hard scientific data' more than information about, for example, the socio-economic situation in the basin.

16.5 CONCLUSIONS

This study showed that there are differences in the information needs, data collection and information use between different transboundary regimes in Europe. The differences may be connected to factors such as the diversity and perceived significance of environmental issues in the basin, and the history and mandates of the commissions established to fulfil the agreements on which the co-operations are based.

Despite the differences in information management between the regimes, there are also similarities. A technical/scientific paradigm appears to dominate in transboundary water regimes. This is visible in the information needs which mainly are defined with commissions' own needs in mind, in the data collection which is dominated by S and I information and in the communication with stakeholders and the public which mainly are done through passive channels.

If information management in transboundary water regimes in the future is to more fully meet the 'requirements' of information implied by the concept of integrated water resources management a change of mind might be needed. This comprises:

- Definition of new information needs, taking into account the needs of stakeholders and other interest groups. Recognising information needs of other groups will probably require an involvement of these groups already in the definition process. This involvement will contribute to a more participatory management of water resources, as emphasised by an integrated approach.
- A more balanced data collection, where not only S and I information, but also D and R information originating from the basin is collected.
- Development of more participatory fora and mechanisms, such as meetings and workshops, for communication with stakeholders and the public.

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17

Conclusions

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17.1 INTRODUCTION

Water management faces an increased number of pressures on water use while the impacts of these water management problems stretch out further and further in space. As these problems cross borders, the importance of cooperation between countries and regions sharing water resources is growing. The significance of environmental information as a basis for water management and an essential part of cooperation is consequently mounting. Therefore it is essential to know the role of environmental information in the context of transboundary river basin management and how it is used in decision-making. In this book, we have tried to capture these aspects of information from a range of perspectives. In this chapter, on the basis of the water management framework of Savenije and Van der Zaag, we will try to summarise what we feel are the essentials when dealing with the subject.

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17.2 POLITICS

Information in general is considered to be an essential basis for decision-making. This view builds on the conception that decision-making is largely a rational process. The use of information in decision-making has however proven to be rational only up to a certain point. In the political sciences discipline, environmental problems are defined as being basically social problems. The nature of such a problem is largely built on norms, values and beliefs of the individuals involved. Therefore, different people will appreciate information on environmental problems in a different way. The use of the information will consequently be dissimilar, depending on the user of the information and is as such not purely rational. Next to these two dimensions of rational and value-based use of information, a third dimension is the social-practice model where the role of culture and habits are emphasised as driving people's behaviour. In this model, the dominant societal norms and values are the main drivers. Information plays a role in all three dimensions but it may be obvious that this role is not straightforward.

In the constellation of decision-making, the flow of information between actors comes into sight. Communication is the process of transferring information between people. In communication, the content as well as the appreciation of the information play a role as discussed above. Another aspect in communication is the power connected to the possession of information. As the lack of information can hinder proper definition of a situation or can hinder appropriate action, control over information gives an advantage over those who do not have this information. In transboundary river basin management, the upstream countries especially have a tendency to restrict information exchange, as it is not in their direct interest to give full access to the available information. Only when common understanding of the situation is reached and common interests are recognised can cooperation take shape. Underlying common understanding is mutual trust that diminishes the aspect of power. But building of trust, both within and between groups, is a lengthy process.

Communication is also a process with often many different actors that each process and transfer information. The type of network the actors are in can, for instance, determine if the information reaches the appropriate actors. In a transboundary situation, the role of the 'communication gateway', the formal or informal connection between the countries, is very important in the process of conveying information.

Decision-making and management takes place on different levels, ranging from the local to the international level. The above-mentioned information and communication issues play their role on each of these levels, as well as between

the levels. Additionally, each level collects and disseminates information on a scale unlike other levels, complicating comparison of information on the different levels. This implies that good communication can only take place in an interactive process where the perception of information is tested after it is transferred.

17.3 TECHNICAL COOPERATION

Transboundary cooperation requires exchange of information. Production of information historically takes place in a situation where the producers of information are at the same time also the users of that information. As these 'prod-users' usually have a natural science background, emphasis in information production lies with physico-chemical and biological information. The significance of socio-economic information for decision-making is, as a result, generally underestimated. As environmental data is rarely used in the decision-making process as long as it does not show a direct and clear connection between and impact of the physico-chemical and biological conditions to changes in the economic and social situation in a given transboundary water region, the efforts put into information production are insufficiently used.

The information cycle provides a framework for information production, but has its limitations, as it does not support the flow of information through transboundary river basin management. As presented in the information cycle, information production requires specification of information needs prior to production of information. This specification of information needs should ensure a thorough thinking through of what information is really needed, while the assumptions that different stakeholders have of the value of certain types of information are made more explicit. Nevertheless, it is stressed here that determining the goal of producing and disseminating information should even precede determining what information should be produced.

Cooperation in information requires an interactive approach in defining the goals and determining what information should be produced, that involves the relevant actors. This is needed to account for the differences between the actors in interests, values and cultural background. As the actors may act at different levels, information has to account for these different levels and the scales connected to the levels.

In the transboundary situation, cooperation in information production and dissemination should also account for differences between the countries. Such differences exist in technical abilities, but even more in different approaches. Integration of similar disciplines on either side of the border is therefore needed.

Dissemination of information requires presentation that provides insight into the situation. Especially the spatial distribution of, for instance, pollution sources

(hot spots) can provide insight not obtainable through tables or descriptions. Geographical information is therefore highly supportive in communication. Tools such as GIS to analyse and present information geographically, and the Internet to open up information sources are inevitable in this respect.

17.4 INSTITUTIONS

Institutions can range from distinct organisations to networks of people. Whatever form an institution has, usually there is a legal framework that sets the context of the institution. Such a framework is a significant driver for institutional behaviour and the professional activities within an institution. One model to describe institutional behaviour distinguishes between rational, bureaucratic and political institutional behaviour. The use of information within these respective types of organisations can respectively be orderly and rational, procedural, or disorderly. Differences in these types of institutional behaviour on either side of the border can hinder cooperation.

The ever-changing external environment requires institutions to adapt their organisational structures to create an enabling environment that can cope with the new situation. But institutions have a history that makes them work as they do and this history makes it difficult for institutions to change. As a result, the external environment changes more rapidly than institutions can. One consequence of this may be that institutions cannot deliver the required information.

In a transboundary context, institutions from the countries involved are created in a different legal framework and have a different historical and cultural background. Cooperation between such institutions is in this context not easy and will require extensive time. One corollary of differences between institutions is the reluctance to give access to information. Reasons for this can be, for example, lack of understanding, fear, ignorance, lack of motivation or need for power. Especially in the political institutional model where information is used strategically, information will be regarded as a source of power, which will in turn lead to secrecy. Such secrecy will impede building of the trust that is, as stated above, a precondition for cooperation.

Transboundary commissions as institutions are necessary instruments for cooperation in transboundary river basin management. Historically, the composition of such commissions is expert-based. This incorporates the danger of a technical bias. Also, these commissions usually have a limited size and operate on a high, abstract level. The advantage of these characteristics is that consensus can be reached rather easily and that consequently practical measures (such as transboundary waste water management, international navigation rules)

can be put into practice in a very effective manner. The disadvantage is that the commissions generally operate on a national level whereas the public concern lies on the local level where the problems are more concrete and many people are involved. To overcome this problem, the need for public participation in transboundary river basin management is obvious.

Participation can take place in a range from inclusion, where stakeholders and the public are consulted in order to optimise the river basin management goals, to participation, where stakeholders and the public are actively involved in the process in order to satisfy as many goals as possible. In either case, if the actors in the participatory process are taken seriously, full access to information for all the actors is needed.

One channel to get information to the public is through the media. A major fear in bringing out information through the media is that the sender loses control over the message where the media is a powerful communication channel. On the other hand, clear messages cannot easily be changed.

17.5 INTEGRATED WATER RESOURCES MANAGEMENT

Transboundary river basin management nowadays demands an integrated approach. Such an integrated approach has to account for differences in spatial scale and time scale as the various disciplines work on such dissimilar scales. One approach to deal with this diversity is the use of indicators. Definition of indicators necessitates a process of specification of information needs on the basis of which indicators can be defined. Nevertheless, indicators are defined to be directly used in the decision-making process. This can lead to a situation where defining indicators can become highly political.

Cooperation between disciplines is needed in transboundary river basin management as expertise in isolation can limit the capacity to solve problems. Such cooperation has to overcome the mismatches between the disciplines, of which the issue of scale is an important one. Another mismatch that is easily overlooked is the difference in definitions. The same term can have a different, but often closely related meaning in another discipline that may hinder correct understanding of each other’s information.

Integrated management necessitates integrated assessments based on an interdisciplinary approach. Such an approach demands that the problem, touching upon ecological as well as socio-economic interests, is the starting point for evaluation, not a singular discipline. The process of evaluation of the problem should as much as possible be an effort of joint disciplines.

Preparation is necessary to agree on work that has to be done, like doing an assessment of the river basin management situation. This preparatory work is often disregarded as being of minor importance related to the 'real' work of doing the actual scientific analysis within one's own discipline. An integrated approach conversely entails extensive preparation to ensure that the right problem is addressed in the right way. The need for this preparation cannot be overemphasised.

17.6 SHARING OF INTERNATIONAL WATER RESOURCES

Sharing international water resources requires that common goals are set. Sustainable use of water is an international acknowledged goal in this context, but a further working out of sustainability gives a wide range of outcomes based on various assumptions of socio-economic effects. In this light it should be emphasised that there is economic support for strong sustainability, aiming at maintenance of the ecosystem integrity, as the basic assumption for river basin management.

If strong sustainability is the goal, an integrated approach in which the functional diversity of water resources is taken into account has to be taken. Integration of the functional diversity necessitates participatory processes that include stakeholders and the public. If stakeholders and the public are given the right to participate, this should include the right to full access to information in order to certify a balanced dialogue. A next step in giving access to information will be a response to information needs as expressed by stakeholders and the public. The dialogue resulting from the participatory process can become a social learning process that eventually encourages the production of better information. The dominant technical/scientific bias in many transboundary commissions, however, hinders such involvement of stakeholders and the public.

Internationally shared interests facilitate sharing international water resources. Countries that share the same water body, use the water in a similar way and encounter the same problems will be more likely to cooperate, as a joint effort is less costly and provides better results. International lakes management may from this perspective be more effective than transboundary river management as the water management problems of a lake are shared by all bordering countries, while in rivers the downstream problems are often not of direct concern for the upstream country. Although international legislation works to solve this problem, in practice the upstream-downstream inequality hinders cooperation.

17.7 SUMMARY

Concluding it can be stated that information is an essential element in transboundary water resources management. Information is used to support decision-making and to evaluate the effects of water resources management decisions. Information production lags behind developments in water management. Although integrated water management was introduced more than a decade ago, information still focuses on ecological components of water bodies and largely ignores the importance of socio-economic data. Some aspects that hinder production of such improved information are:

- strong boundaries between different disciplines that are not easily overcome;
- consideration of information needs and the goals of information dissemination prior to producing information is insufficient and the relevant actors are reluctant to participate in these processes;
- differences in institutional behaviour that hinders cooperation between these institutions; and
- insufficient tuning of organisational structures to the needs of the external environment.

Even though better information may be produced, the use of information will still be limited because of:

- different valuation of information by people with dissimilar beliefs, values and norms, and different cultural habits;
- insufficient access to information for all actors;
- insufficient communication channels; and
- insufficient coordination between the different levels and scales.

This book describes much of the causes and processes that cause these limitations and provides assistance in overcoming them. We hope that the ultimate effect of this book may be improved water resources management based on excellent information.

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