SESSION III a

STRUCTURAL AND ECONOMIC DEVELOPMENTS

Review of existing structures, models and practices for transboundary water management in Europe – The implementation of transboundary water management – identification of present problems and a design for future research

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Introduction

Transboundary water management presents a significant number of major challenges to politicians, planners, administrators and scientists. In order to meet these challenges, policy makers need access to reliable and relevant information, not only concerning the physical attributes of water systems, but also concerning the special political and administrative conditions that characterise transboundary water policy-making and implementation. However, while 71 of the world's 261 international river basins are located in Europe, (Wolf, Natharius et al., 1999), much of the scientific work conducted in this field during the last decades has concentrated on water conflicts in other areas such as the Middle East, Africa, India and America. Although this work has often been of a high standard, and has contributed to the growth of knowledge in the field, much of it has been regionally specific and the results have been difficult to apply in other areas. So while many critical problems exist in Europe today, where they comprise of difficulties with both water quality and water quantity, many of the scholars working in the field of transboundary water management have taken their point of departure in other regions. Besides this, much research has taken what might be termed either a legal, or technical point of departure, that is, it has begun with legal principals of agreements and conventions, or in a natural science/engineering perspective. The research reported in this paper has taken a different approach, and it claims that it is of vital importance to analyse the role of public participation as well as the institutional and administrative cultures of the institutions and organizations engaged in transboundary water management in a European context. It is these institutions and organizations, often at the regional and local levels, that have responsibility for the practical implementation of nationally and internationally formulated policies, and it is within this area that our knowledge is particularly insufficient.

We are of course not alone in this view. In 1999, the National Research Council highlighted a number of research imperatives for the coming decade (Committee on Global Change Research, 1999). 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). 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 dependant on the specific conditions created by the interaction of two or more political and administrative systems.

The studies of European transboundary water management

The results and conclusions presented in this paper are based upon two major studies that were conducted by Linköping University and researchers of the Peipsi Center for Transboundary Cooperation (CTC) during the spring and summer of 2001. The first study was a review and analysis of published research on European

transboundary water management reported in academic journals, in books, and in official documents. The analysis of earlier research consisted of in-depth examinations of over 150 scientific articles, book chapters, and management reports, some of which provided theoretical perspectives while the majority described actual cases of European transboundary water management. This material is now available in a database consisting of references and abstracts. The second study consisted of eight case studies of transboundary water management in which primary and secondary material was collected and water management representatives were interviewed. The case studies were based on a large number of interviews and analyses of documents, and examined management practices in the following basins: the River Bug, River Daugava, Lake Inari, River Oder, Lake Ohrid, River Neman, Lake Peipsi, and the Spanish-Portuguese border. Both studies focused on a number of central issues such as the context of the transboundary cooperation, the formal frameworks for cooperation, public participation, and policy networks and processes. These were organized under the following question headings:

- What are the main incentives for cooperation in the region? Are they political, economic, administrative, environmental, etc.?
- In which forms does cooperation take place?
- What are seen as the main benefits of cooperation?
- Which problems is the cooperation attempting to solve?
- Who are the main actors, and how do they interact?
- What type of information is accessible, and who provides this information?
- How is public participation organized?

In this paper, the overview of the results is organized into three sections: context, public participation, and the policy and implementation processes. Detailed descriptions of the studies including publication and interview references, and in-depth presentation of the results are available in the MANTRA-East report to the EU of January 2002, accessible on the project intranet.

Theoretical background

The theoretical approach of the studies was based on regime, multi-level governance, and network theories. Regime theory is well established in the study of international environmental issues (Young, 1989), yet regime theory alone cannot fully explain the complexities of water management implementation, as implementation is primarily the responsibility of institutions at the regional and local administrative levels, not exclusively at the central State level. According to Holsti (Holsti, 1995), a regime is a form of international cooperation 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). Traditional regime theory has 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, Young et al., 1995,). In this respect governance theory contributes to our understanding of transboundary water management by stressing the importance of civic and business institutions and their inter-dependence with political and administrative institutions. The Commission on Global Governance expresses the concept of governance in the following way:

“At the global level, governance has been viewed primarily as an intergovernmental relationship, but it must now be understood as also involving non-governmental organizations (NGOs), citizens’ movements, multi-national corporations, and the global capital market. Interacting with these are global mass media of dramatically enlarged influence”. (Governance, 1995)

Governance theory describes flexible network relationships that are constantly changing (Smouts, 1998) and can provide insights into the important yet under-researched field 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 also take into account cognitive aspects of transboundary cooperation such as norms, values, and perceptions, and

recognise the importance in regimes of learning (Haggard and Simmons, 1987). Gerry Stoker (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, transnational, 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).

The context of European transboundary water management

Let us first look at the definitions of the transboundary water management problems presented. The secretariat of the United Nations Commission for Europe, for example, states that the pollution of transboundary waters is a widespread phenomenon in Europe. Transboundary waters are seen to be threatened by untreated or insufficiently treated municipal waste waters, chemical pollution from industries and agriculture, seepage from old and new landfills, accidental pollution and atmospheric depositions. Another problem often stated is that damages are caused by discharges of phosphorus and nitrogenous compounds, which stimulate eutrophication and sediment contamination, and by toxic and persistent substances (UNECE, 1994). This view of the problem as mainly dependent on physical conditions is representative of the way in which environmental issues are presented both in the literature review, and by the interviewees in the case studies.

There are two ways of understanding this dominant definition of the main problem. First it may simply reflect the authors and interviewees views that problems are predominantly physical and that they can in fact be solved by relatively simple, rational, efforts. According to this view, water quality problems can be solved by technical means, and water quantity problems by engineering. It may however also be a result of the efforts of the authors and interviewees to demonstrate the seriousness of the situation and to promote increased interest in the environment. In this case the descriptions of the seriousness of the problems together with what seem to be attainable solutions may partly be a strategy to force policy makers to redefine their interests in favour of water-related problems.

Looking at the main actors described in our studies, it has already been stated that the approach taken in this paper is that we must take into account both State (central and sub-central), and non-State actors such as the business sector and civil society. While this point of view is becoming more and more accepted, the study shows however, that in many cases the Government (or the State) is still considered to be the dominant actor in the management of transboundary water resources. For example, Dieperink states that the creation of the Rhine regime primarily was an accomplishment of the riparian (central) States themselves, although he does accept that the environmental movement and the private sector played a role in the dissemination of knowledge regarding the water quality in the Rhine (Dieperink, 1998). Other authors who have taken another view have pointed out the role of non-State actors. These include Nachtnebel, who explicitly mentions a wide range of conceivable actors that may have an important role in implementing regulatory programmes (Nachtnebel, 2000). Botterweg and Rodda (Botterweg and Rodda, 1999) also see transboundary water management as a complex process with many actors at different levels. They stress that both the development and the implementation of the actual work has to be done at a local level, and that national authorities, as well as the international agreements, are dependent on the compliance of the actors they cannot force by traditional government measures. Networks play a crucial role in this process; there is no single actor capable of forcing all actors to comply. The inclusion of a central and eastern European dimension in our studies also led to the identification of a problem not often mentioned in the predominantly western literature – that of lack of finances. Thus, while investments into infrastructure may have reduced the amount of untreated waste-water discharges in some of the case study regions, the funds available for water management are still much smaller than actual needs, as the interviews with water managers have demonstrated. Lack of funds to manage future industrial developments and tourism growth are also seen as serious threats to the ecological status of many of the regions studied.

The interaction of two or more States in transboundary water management demands special forms of international agreement. According to Beaumont (Beaumont, 2000) there have historically been basically two extreme positions when it comes to transboundary waters. The first is the position of "absolute territorial sovereignty". Upstream water suppliers have often taken this view and it is based on the principle that a State can use all water within its boundaries as it pleases. Proponents of this position also claim that the upstream State cannot be held responsible for damage resulting from its actions on downstream States. This is known as the Harmon Doctrine, named after a ruling by US Attorney-General Harmon in 1895 (Wouters, 1997). The alternative view, that of "absolute territorial integrity" is that the upstream State cannot develop transboundary waters if it will cause harm to the downstream State (Utton, 1973). This approach demands duties of the upstream State, but not of the downstream, and according to Beaumont (Beaumont, 2000) this is a view that has not received notable support from international lawyers. The 1972 Stockholm Declaration, and later the 1992 Rio Declaration have however formulated the key principles of modern international environmental law in another way. Principle 2 of the Rio declaration states that

"States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction."

This principle combines both rights and obligations, and provides a basis for agreements in the European context, where water problems are concerned with both water quantity and water quality. While problems of water quantity have traditionally dominated the southern European and Mediterranean context, transboundary environmental pollution is now a substantial problem for many central, eastern, and northern European countries. Problems of water quality also apply, of course, to the Mediterranean area, and are becoming increasingly accepted as such. In this type of problem, downstream countries usually suffer more from pollution than upstream countries. The Netherlands is for example heavily dependent on freshwater supplies from the Rhine, as about 65% of their freshwater is drawn from Rhine. At the same time the Rhine is one of the most polluted transboundary rivers in Europe as the Rhine drains some of the most populated and industrialised parts of Europe. The victims of the pollution in this case are waterworks and farmers in the Netherlands (Bernauer, 1996). The problem of transboundary water management can be approached in a number of ways.

We have already discussed regimes. As a response to particular transboundary problems, international regimes may emerge (Levy, Young et al., 1995), and regimes can be a way for States to steer policy formulation and implementation in a specific issue area when there is no central authority that can manage the issue. In the international context every State is usually considered sovereign and there is no formal supranational government. Another way of approaching the problems of transboundary water management is through the concept of governance, which has become increasingly useful as a way of describing the policy process in situations that are characterised by complex sets of interdependent institutions and actors. At the global scale, however, in practice environmental governance often fails to efficiently address environmental problems. This is partly because of the weak structures of the system of global environmental governance. The institutions dealing with the global environment are often controlled by competing interests unable to reach consensus (Claussen, 2001).

Treaties, multi- or bilateral, thus usually reflect the lowest common denominator, and countries can also fail to ratify or implement a treaty's requirements. Despite this, treaties between countries are still often considered the best instrument of international environmental governance (Claussen, 2001). According to the UNECE, more than 100 conventions, treaties and other arrangements have been concluded between European countries in purpose to strengthen cooperation on transboundary waters (UNECE, 1994). Other authors estimate similar figures of the number of treaties and agreements. The European Topic Centre on Inland Waters estimate the number at 116 in Europe in 1995, and the UNECE describes 139 treaties, agreements, conventions and protocols in Europe and North America in 1995 (Breukel and Timmerman, 1996,). On a larger temporal and spatial scale, the Food and Agriculture Organization (FAO) has identified more than 3,600 treaties relating to international water resources throughout history (Hammer and Wolf, 1998). Lenard Milich and Robert Varady found nearly 300 international treaties that had been adopted for the purpose of avoiding conflicts over water (Milich and Varady, 1998). Jesse Hammer and Aaron Wolf analysed all treaties in the Transboundary Freshwater Dispute Database (hosted by Oregon State University),

which consists of approximately 150 treaties on international watersheds. 86% of the treaties were bilateral, a fact that indicates the difficulties of negotiations when the number of parties increases. Only 4% of the treaties focused on pollution; the most common focus was on hydropower (39%) and water supplies (37%) (Hammer and Wolf, 1998). In spite of the large number of treaties, there are still many transboundary waters that are not covered by agreements or other arrangements, or they are covered by agreements that do not take into account aspects that are important today (they often cover quantitative aspects and more rarely qualitative). This is valid particularly for the newly created States in the eastern part of Europe (Breukel and Timmerman, 1996). Perhaps this is because environmental problems have only relatively recently become an issue on the international agenda, although an understanding of the range and dignity of environmental problems has increased continuously since the 1970s. International law and institutionalised agreements concerning water are issues that seems to be taken for granted, although in many cases they still need to be developed. In the case of agreements on environmental protection on the intergovernmental level this still needs to be formulated in some cases, for example between Belarus and Lithuania, and in other cases, such as Lake Inari and the Paatsjoki River, better cooperation between the different Commissions involved in water management needs to be developed. Huisman et al (Huisman, Jong et al., 2000) consider that international law facilitates cooperation, and they claim that they find empirical proof of this.

In the light of the increasing interest in the management of transboundary waters, the future enlargement of the EU is of special concern. In October 2000 the EU adopted the Water Framework Directive (WFD) [1], a comprehensive directive that enjoins the Member States to organize the management of water in river basins districts. If these river basin districts cross national borders the Member States are obliged to set up international river basin authorities and to cooperate on the management of transboundary waters. If a river basin is shared with a non-member State, the Member State is obliged to try to cooperate with the non-member State. When the former Central and Eastern European Countries (CEECs) become members of the EU, the Union's border will move east, and new river basins will come under the jurisdiction of the WFD. In order to be accepted as members of EU, the candidate countries have to adopt the "acquis communautaire", that is, all the existing rules, regulations and agreements of EU (Croft, Redmond et al., 1999). The task of integrated transboundary water management in Europe is therefore to attempt to implement the WFD and other regulations and agreements. It is precisely during the implementation stages that problems often become acute, and the need for more knowledge to manage these problems becomes apparent. However, while a relatively large number of studies have been conducted on the policy-making stages of water management policy, the forces that facilitate or prevent successful implementation are less well known.

Public participation

While public participation has become more and more important in the rhetoric of transboundary water management, our studies show that, although the public's role is mentioned, or acknowledged, the public rarely plays a central role in the management of transboundary waters. Many of the formal institutions studied through the interviews also had an ambiguous attitude to public participation. According to many of our sources, the most important aspect of public participation is some kind of support or consent from the public, although an understanding of the problems is also considered important. There are of course alternative positions. In "Towards improved management of shared river basins", for example, Zaag and Savenije (Zaag and Savenije, 2000) discuss the role of the public in two ways. First, they consider that in negotiations between riparian countries genuine public participation can allow positions to be redrawn and secondly that the public can enrich the negotiations with new perspectives. Public understanding of project objectives is also considered important, as it is then expected that they will be more likely to support, or accept, the necessary measures. Several sources also stress the participation of stakeholders and citizens in the process of building trust and joint institutional arrangements between States. Olem and Duda, for example, state that stakeholders should be a part of the institutional arrangements, together with government actors from different levels (Olem and Duda, 1995). They acknowledge the difficulties in implementing transboundary water management policy without legitimacy at the various local levels. Blöch (Blöch, 1999) points out that the success of the EU Water Framework Directive requires more involvement of citizens, interested parties and NGOs, and that when the river basin management plans are established, information

[1] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, published in the Official Journal L 327 of 22/12/2000.

and consultation with these groups will be a necessity. Nevertheless, public participation enjoys relatively little interest, with the notable exception of the groups such as NGOs that have public participation specifically as their main focus. One of the authors that treat public participation is Auer (Auer, 2000) who stresses the public's and local communities' role in successful international environmental governance. 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. However, while empirical findings show that non-State actors, mostly NGOs and intergovernmental organizations (IGOs), are playing an important role in the international policy process, in particular knowledge building, information gathering and dissemination, policy promotion and policy assessment, many public officials were passive or even negatively inclined towards this cooperation. Some even saw the involvement of the public and NGOs as a potential problem. Margaret A. House (House, 1999) states that public participation in water management is desirable from a number of points of view. She argues for the logic of a certain public to influence the management of rivers since the public is actually living in the area concerned, and the public's view is rarely the same as those of interest groups or councillors who represent them. House's view is a very practical view, but it doesn't take the problems related to international river basins into account. However, her argument points at an important factor concerning the legitimacy of a management system: if the management system lacks support from the local citizens, the public, it may become an object for protests and the implementation may be obstructed.

The policy and implementation processes

Surprisingly, our studies discovered relatively little material about the actual decision-making and implementation processes, although some sources provided a brief picture of the complexity of the process of reaching decisions in the international arena and with different kinds of actors involved. Where material or information was provided on the decision-making process it tended to be speculative. Zaag and Savenije (Zaag and Savenije, 2000), for example, 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. They describe a system where good communication and good arguments prevail, and different actors have possibilities to make their voices heard. This view is compatible with a multi-level governance perspective were actors from different sectors and levels are involved in the decision-making process. It was also notable that even less material was found on the problems associated with policy implementation. A common view in this issue was that implementation should be undertaken in a national context, and few joint organizations with actual competence to take action independently were discovered. Huisman et al (Huisman, Jong et al., 2000) note this, and point out that most 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. The interviews provided more information about the policy processes, but even here it was difficult to gain in-depth knowledge of detailed aspects of implementation. What then can be done? Nachtnebel (Nachtnebel, 2000) notes that cooperation can involve joint communication, warning and alarm systems as important elements. One of the first actions of the Environmental Programme for the Danube River Basin (EPDRB), for example, was to develop an accident alarm system in order to minimise the serious environmental harm caused by industrial accidents such as oil spill and discharges of toxic and hazardous waste, radioactivity and risk related to hydro-technical works (Nachtnebel, 2000). Both the Rhine and the Elbe commissions have developed joint warning and alarm systems. Warning services on the Czech-Slovak-Austrian waters have also been adopted, and warning systems have been established between the Czech rRepublic and Poland, Poland and Slovakia, and Slovakia and Ukraine (UNECE, 1994). The Danube accident emergency warning system is modelled on the one operating in the Rhine, according to Botterweg and Rodda (Botterweg and Rodda, 1999). Monitoring and data production are in fact mentioned many times, and coordination of monitoring and assessment of the conditions of transboundary waters are seen as important activities for a joint commission.

Conclusions

It would seem that, in general, four categories of measures of joint organization could be identified. First, there are measures related to information or education. It is felt that Governments, industry, farmers and the public should be informed or educated by the joint commission in order that they change their perceptions of the problems, and following that, their behaviour. Data collection and dissemination, research and advising functions are seen in this context as such measures. Secondly there are measures related to the drawing up of plans that can set joint priorities, objectives and actions. Most often these plans have then to be ratified by the Governments. Thirdly, there are measures related to control. Monitoring and alarm systems are for example measures aimed at controlling that agreements are kept and accidents avoided. Fourthly, there are measures related to the transition of power. Commissions or joint river authorities may be equipped with power to enforce actors (from States to citizens) to comply with agreed actions and behaviour. They may also be given the competence to decide about fees or permits. Another task, related to the power of a joint organization, is the right to judge or settle disputes between the Parties.

A number of factors can hinder cooperation, such as lack of compatibility between monitoring, information and data management systems and lack of harmonization of rules and criteria for assessment of data and information (UNECE, 1994). If the parties doubt the scientific facts, international cooperation can also be frustrated. According to Zaag and Savenije (Zaag and Savenije, 2000), sustainable transboundary cooperation needs indisputable, scientific assessment of facts. 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? Our interviews showed that there are constant disagreements between ecologists and engineers on all levels from international commissions to NGOs. An effective river basin organization 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 organization and the national agencies and an organizational structure commensurate with responsibilities and legal status facilitates the work of a joint river commission (Savenije and Zaag, 2000). 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 (Zaag and Savenije, 2000), is the exchange of reliable data concerning the state of the water resource between riparian countries. Water management in many of the regions studied was also characterized by institutional complexity and insufficient economic base. 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 cooperation is the relative size of the potential partners. Lundqvist has proposed that cooperation 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 cooperation may become one-sided, and the larger partner may be able to dictate the conditions for the cooperation. Perhaps this helps to explain the ways in which administrative and economic actors dominate policy networks.

The prevailing opinion expressed in the study is that the management of water resources must take an integrated approach, and that all sectors of society that influence, or are influenced by, water resource management have to be considered in the management plans. The study shows that there is an emphasis on different tools or policy-styles in the case of integrated water management, but that integrated water management is primarily understood as a national level policy area. Integrated water management at the international level is usually not explicitly mentioned, and the local level is not always sufficiently taken into account. There seems to be a strong consensus that the appropriate administrative entity of international water is the river basin. Drawing upon historical evidence, Delli Priscoli (Priscoli, 2000), for example, even argues that the functional and spatial necessities of water form civilisations and promote integration. Savenije and Zaag (Savenije and Zaag, 2000) on the other hand emphasise that groundwater, and not just surface water, should be a part of the river basin concept. They also suggest that policy and strategy levels should be separated from the executive and implementation level, and that a joint water commission should be given the policy-formulating role while a river basin authority is given the role to execute, operate and manage specific projects.

What then can our studies tell us about the potential problems facing the implementation of the EU Water Framework Directive? Although it is in many cases seen as a potentially useful tool, a number of problems can also be identified, many of which are related to different forms and levels of governance that differ both in the degree of centralisation and to the extent that the business community and civil society are involved. In some cases, local government legislation does not allow for private sector involvement in providing municipal services. While some countries have developed or begun to develop river basin approaches, others still rely on centralised systems. Institutional complexity often leads to a lack of clear demarcation of responsibility between the different authorities engaged in transboundary water management. Lack of institutional and administrative competence is another problem often referred to. This is often central, both in the accession countries and especially in their eastern neighbours. This influences not only the ability of the administrations to implement agreed-upon legislation or cooperative initiatives, but also their ability to successfully implement bilateral and multilaterally financed projects. In the case of water management on the borders between the EU accession countries and the countries to the east of them, these issues are further complicated by a lack of funding and also by contradictory policy and implementation aims. Lack of comprehensive legal frameworks can also create problems, especially if the adopted legislation contains serious gaps, and in some cases, such as the Dvina River, no trilateral transboundary water commissions exist as yet. In the case of public participation the availability of information to members of the public, and the sometimes-incomprehensible ways that it is presented, constitute a limiting factor. In some of the examples public access to information was unequally developed on opposite sides of the border. In order to rectify these potential weaknesses, more studies need to be conducted into the institutional context, both formal and informal, of water management implementation. The importance of political and administrative cultures needs to be analysed, and a research strategy that takes into account the complexities of post-decisional politics and analyses various forms of rationality needs to be formulated. This is one of the major challenges facing the implementation of the Water Framework Directive, and transboundary water management in general.

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Investment vehicles for small and medium enterprises

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Background

Small and medium enterprises (SMEs) at all levels have always been an underserved population when it comes to obtaining financing. In industrialized countries, some groups of SMEs, such as minority or women-owned businesses in inner cities and rural communities, still have difficulty gaining access to credit. In developing countries, many banks do not have any products serving the emerging private sector. This situation is a major barrier to economic growth in areas such as inner cities or whole regions within developing countries. In the situation where the environment is threatened or contaminated, further financing is needed in order to remediate or adjust to the resulting situation. Often, small businesses are unable to find financing to address this need.

Financial institutions are often loath to offer credit to SMEs for a variety of reasons. Most banks perceive SMEs to be risky because they are unsophisticated, inexperienced, and unprofitable or marginally profitable as clients. The environmental sector is perceived as being even more risky, often because banks do not fully understand the science, benefit, or viability of a business in that industry. Small businesses with environmental hardships can potentially be the hardest to finance because banks' due diligence prevents them from taking contaminated property as collateral.

Over the years, different strategies have been developed for providing appropriate access to capital for the SME sector. Strategies for investment range from basic technical assistance in lending practices to socially-responsible venture capital funds. Most of these strategies tend to be locally-based with small geographic concentrations. Even in the case of large national banks, branches are the vehicles through which locally concentrated lending occurs. Locally-based methods tend to be the most successful because they lend themselves well to strong underwriting and monitoring. However, there are a few examples of fairly successful regional or even national strategies for providing financing to SMEs.

Shorebank Advisory Services

Shorebank Corporation in Chicago is the oldest and largest community development financial institution in the United States of America. Practices geared toward the small business sector have been successfully developed over 30 years and have been equally as successfully applied in the environments of developing countries. In 1997, Shorebank Corporation and Ecotrust, with technical assistance from Shorebank Advisory Services, created the first eco-bank in the United States of America, Shorebank Pacific, which is located in the Pacific Northwest area of Ilwaco, Washington. While this bank is still in its infancy, it has already created access to credit for small businesses that have environmental-friendly practices.

Overview of investment vehicles for SMEs

There are many broad-based strategies that have been applied to the SME sector for a variety of purposes. Most, if not all, of these strategies can and have been equally applied to issues related to water management.

Traditional financial institutions

Most large, regulated financial institutions do not focus on small business lending. As economic times boomed in the United States of America during the 1990s, these large institutions began going "down market" in order to increase their lending operations, which meant finding more small businesses to finance. Some banks even created entire small business lending departments to serve this sector. In developing countries, many donor agencies have created technical assistance programs around the creation or support of small business lending functions within existing banks. By and large, most of these programs involve a dedicated line of credit to the bank appropriate to its size and the economy, which will be used for

the express purpose of on-lending to a target population. A technical assistance grant will then be given to a service provider to help the bank meet its volume and portfolio quality targets and to build the necessary infrastructure to support the operation.

Shorebank Advisory Services (SAS) has worked as a technical assistance provider in this capacity in both the United States of America and Central and Eastern Europe. SAS approach is generally to teach effective lending practices geared toward small businesses, focusing on cash-flow based lending (versus collateral based lending) and management quality. Specialized training courses are held for local lenders and hands-on training continues through the life of the program. If bank management is cooperative, SAS may also provide assistance in creating policies and procedures, developing a stronger management information system, and informal mentoring of management to back up these practices.

The strength of this approach is that it uses existing, indigenous institutions that may be able to continue the practice of extending credit to small business in the long run. In the best-case scenario, the technical assistance builds the institution beyond just its credit practices, but may strengthen functional areas from personnel policies to general risk management. It also strengthens existing institutions, giving greater credibility to the sector, which contributes to a healthier and stronger economy.

One drawback to this approach is that in some cases, bank management is not at all willing to accept any kind of technical assistance and may, in extreme cases, completely shut out the technical assistance providers, thus compromising the quality of the portfolio. One way of reducing this risk is to either work with the technical assistance provider from the beginning in assessing and choosing the partner institutions, or work generally with smaller institutions, which may be more receptive to technical assistance.

De novo financial institutions

In cases where existing institutions either cannot or will not extend financing to small businesses, or where riskier types of financing are needed, the creation of a new financial institution may be warranted. The structures these institutions can take are varied and will be discussed below.

Formal, regulated financial institutions

Regulated financial institutions are entities such as banks and credit unions that are federally regulated by a central institution such as a central bank. Some microfinance institutions (MFIs) are large, formal institutions and are sporadically regulated depending on the country. The formation of such entities is often a long and cumbersome process, simply because of the fact that they are regulated entities and must adhere to the many regulations that must be met before operations can begin. In addition, the start-up and general management of the institution is extremely human resource intensive. Once operations commence, lending to small businesses is also subject to certain regulations concerning portfolio quality and delinquencies, among other things. However, if the bank or credit union keeps strong lending practices, it can make meaningful loans to small businesses in the long run. Mission-driven banks and credit unions are part of a growing industry in the United States of America. They deliberately locate and serve residents in low-income areas. To date, there is only one bank in the United States of America that focuses on environmental lending. This is largely due to the small market for environmental preservation or improvement projects and businesses.

Traditional loan funds

Circumventing the cumbersome process of creating a regulated financial institution, many loan funds have been created with the sole purpose of loan generation for targeted groups. These loan funds are “traditional” in the sense that they lend much in the manner of banks, but with a little more flexibility and little to no pressure from regulatory bodies, depending on a nation's laws and policy. The size of these loan funds depend on the target area, but can range from 500,000 USD to more than 30 million. Despite this range, most loan funds tend to be small and fairly lean, with a small staff of highly qualified lenders. Because these loan funds are typically small, they are usually very focused in terms of their target market. They either serve a small geographic area or a sub-group of business owners such as minorities or women. Larger loan funds that serve a broader geographic area tend to focus on a demographic group. A handful of loan funds have been created with the express purpose of serving an environmental end.

Loan funds are capitalized in a variety of ways. Much of their capital is generated from governments, foundations, individuals, and businesses. Federal regulation in the United States of America encourages a form of loan fund called the "multi-bank community development corporation", in which a group of banks pool their investments into one loan fund specifically for non-bank small business lending.

It is generally accepted that these loan funds may have a higher default rate than a regulated institution. However, loss rates generally should not exceed 5%.

Risk capital loan funds

Risk capital lending refers to riskier forms of investments. The most widely known form of risk capital is equity, or venture capital. This type of investment is extremely risky because it largely depends on the rapid growth of a small company, which is limited to a handful of industry sectors. However, typical returns on investment are high. For development-oriented venture capital, return on investment typically ranges from 15-25%, which is somewhat lower than the expected return on traditional venture capital.

Some risk capital funds incorporate "quasi-equity" structures, which unlike equity ensure regular payments along with a pre-determined exit strategy. These quasi-equity structures require a base interest rate payment, as in traditional lending, but also take a portion of profits at the end of defined periods. "Kickers" may also be structured at the end of the term of the investment, requiring a high payout upon exit.

Other risk capital funds are "mezzanine" or subordinated debt funds, which take the form of traditional debt, but tend to be riskier because a second position is taken on collateral. This kind of financing is necessary for businesses that already have debt and need additional financing. However, all of their assets are already under lien. A subordinated debt lender will provide the additional financing necessary and take a second position on the borrower's assets because they are assured that the company is able to grow and repay all its debt obligations. However, for the sub-debt lender, this means that if the loan goes bad, the person with second position will often get little to nothing in the event of liquidation.

These types of funds mentioned above tend to be larger in capital than traditional loan funds and can often cover larger geographic areas. Risk capital funds for environmental purposes have been established in developing countries throughout Central and Eastern Europe as well as Latin America.

Guarantee funds

Guarantee funds are not direct lending operations, though they underwrite loans in the same way that traditional lenders do. Funds are committed to loans that are of acceptable risk to the guarantee fund. In the case that the loan defaults, guarantee funds can be drawn to cover the payments owed to the lender. This is often an effective tool to encourage existing institutions to take on a little more risk than they are currently taking. Guarantee funds are usually targeted and can be regional in scope. As an example, the Small Business Administration in the United States of America guarantees small business loans and has different programs for different kinds of loans through financial institutions throughout the country.

Case examples of investments in projects related to water management

These cases are examples drawn from ShoreBank Pacific's portfolio and are illustrative of commercial lending that supports the use and protection of water resources.

Capital Divers, Inc.

Located near the shoreline of southern Puget Sound, Capital Divers sells scuba equipment and offers training and dive trips to exotic and local destinations. The company's owners are strongly committed to protecting the health of marine ecosystems. They are collaborating with another organization on Project Aware, which involves divers in environmental cleanup projects and environmental advocacy. The owners also helped establish the Washington State Underwater Parks Program, which has successfully protected several fragile marine areas.

Environmental Engineering

This borrower is an established regional civil and environmental engineering firm that is developing a new specialty: sustainable engineering. This division's projects include a fish-friendly hydropower project and an innovative agricultural fish screen technology that would keep fish out of irrigation ditches. Shorebank Pacific provided this borrower with an operating line of credit.

Stormwater Management, Inc.

ShoreBank Pacific made a loan for the purchase of a truck to improve this customer's delivery service. The company manufactures a proprietary product that uses composted leaves and other natural media to filter oil, heavy metals and other contaminants out of road run-off. The company is installing its filters in new and existing industrial developments and along highways nationwide.

Organicare, Inc.

This customer is an alternative lawn and tree care company that fertilizes with chicken manure, fishmeal, and other natural soil amendments instead of synthetic fertilizers and other compounds. The company's natural fertilizers do not break down in the soil or move into water as fast as the synthetic compounds do, so far less migrates into local waterways. ShoreBank Pacific made a loan for a new lift truck to help expand the company's service territory.

Clean Water

ShoreBank Pacific made a loan to a neighbourhood NGO water association so it could upgrade two very small community water systems into one somewhat larger system, with new water lines, meters, pumps, and a larger water storage tank. This customer provides drinking water to more than eighty households. The new system allows for home construction on sites in the community that formerly did not have access to drinking water.

Which role for economics in the implementation of the EU Water Framework Directive?

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The Water Framework Directive

December 22, 2000, is likely to remain a milestone in the history of water policies in Europe: the Water Framework Directive (or the Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy) is published in the Official Journal of the European Communities.

This Directive is the result of a process of more than 5 years of discussions and negotiations between a wide range of experts, stakeholders and policy makers. This process has stressed the widespread agreement on key principles of modern water management that form today the foundation of the Water Framework Directive.

How best to summarise the Water Framework Directive?

How best to summarise the 72 page document of the new Water Framework Directive? The concept of integration and its many facets and definitions form the main thrust of the Water Framework Directive.

- Integration of environmental objectives, combining quality, ecological and quantity objectives for protecting highly valuable aquatic ecosystems and ensuring a general good status of other waters;
- Integration of all water resources, combining fresh surface water and groundwater bodies, wetlands, coastal water resources at the river basin scale;
- Integration of measures in a common management approach for achieving the environmental objectives of the Directive. Programmes of measures are defined in management plans developed for each river basin;
- Integration of water legislation into a common and coherent framework. The requirements of some old water legislation, e.g. the Fishwater Directive [1] have been reformulated in the Water Framework Directive to meet modern ecological thinking. After a transitional period, these old Directives will be repealed. Other pieces of legislation (e.g. the Nitrates Directive [2] and the Urban Waste-water Treatment Directive [3]) must be coordinated in the river basin management plans where they form the basis of the programmes of measures;
- Integration of disciplines, analyses and expertise, combining hydrology, hydraulics, ecology, soil sciences, technology engineering, economics to assess current pressures and impacts on water resources and identify measures for achieving the environmental objectives of the Directive in the most cost-effective manner;
- Integration of stakeholders and the civil society in planning and decision-making, by promoting transparency and information to the public, and by offering an unique opportunity for involving stakeholders in the development of river basin management plans;
- Integration of management and policies from different Member States, for river basins shared by several countries, existing (e.g. the Rhine, the Tajo) and/or future (e.g. the Danube) Member States of the European Union.

[1] Council Directive 78/659/EEC of 18 July 1978 on the quality of fresh waters needing protection or improvement in order to support fish life, published in the Official Journal L 222 of 14/08/1978.

[2] Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources, published in the Official Journal L 375 of 31/12/1991.

[3] Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment, published in the Official Journal L 135 of 30/05/1991.

Moving towards implementation

The Directive implementation has already started in Member States and also in candidate countries to the European Union. For example, many initiatives and pilot studies have been launched in a wide range of river basins (be national or international). And there is no week without events aimed at informing relevant parties and raising awareness about the Water Framework Directive and its implications.

Of particular importance for the implementation of the Water Framework Directive is the common implementation strategy agreed by Member States and the European Commission in May 2001 in Sweden. The main objective of this strategy is to provide support to the implementation of the Directive by developing common understanding and coherent guidance on key elements of the Water Framework Directive. 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.

In the context of this common implementation strategy, a series of working groups and joint activities have been launched. A working group (short-named WATECO standing for WATer Framework Directive and ECOnomics) has been created to deal specifically with economic issues. The main objective of this working group is the development of a non-binding and practical guidance for supporting the implementation of the economic elements of the Water Framework Directive with emphasis on its 2004 requirements. The first consolidated version of the guidance has been finalized in August 2002.

Which role for economics in the Water Framework Directive?

Costs, discount rate, prices, taxes… The use of economic terms in the water sector has increased over recent years – and not only from de side of economists. Economic issues also affects ordinary people – as consumers who pay for water supply and sewerage services; as taxpayers for supporting heavy investments in the water sector; and increasingly as human beings eager to protect water resources for themselves and for future generations.

The Water Framework Directive clearly acknowledges the economic dimension of water and makes the polluter-pays principle operational, a novelty in European Union environmental legislation. It integrates economic principles, approaches and instruments in water policy-making and in the development of integrated river basin management plans. More specifically:

- Member States have to perform an economic analysis of water uses for each river basin (Article 5, Annex III);
- The analysis will lead to the identification of the set of measures likely to achieve the environmental objectives of the Directive at the lowest costs. Its results will be reported in the river basin management plans (Annex III, Article 11);
- Member States will promote pricing policies that provide an adequate incentive for more sustainable use of water resources. Clearly, pricing should encourage users to use less water and to reduce pollution (Article 9);
- Also, Member States shall ensure an adequate recovery of the costs of water services by the main water uses, disaggregated into at least agriculture, households and industry (Article 9);
- Finally, economic issues are investigated for the designation of water bodies which hydro-morphology is heavily modified as a result of anthropogenic influence. And economics have a role to play in the justification of time and objective derogation proposed by Member States (Article 4).

A wide range of economic methodologies and tools may be used for developing the economic analysis. It is important to stress the need to systematically integrate economic and non-economic issues and expertise, e.g. for characterising the river basin or assessing the most cost-effective set of measures for achieving the environmental objective of the Directive.

The experience and expertise in developing economic analysis to support policy decisions at the river basin scale is limited in most EU Member States and candidate countries. Key constraints in undertaking the economic analysis include a poor economy-related information base, limited expertise and capacity, and limited awareness among water experts and stakeholders about the role of economics in water management and policy.

The WATECO working group

The WATECO working group has been launched in December 2000 in the context of the common strategy agreed by Member States and the Commission for supporting the implementation of the Water Framework Directive. This working group led by the Ministry of Land Planning and Environment of France and DG Environment involves approximately 45 experts and stakeholders from EU Member States and candidate countries.

The main objective of the WATECO group is the development of a non-binding and practical guidance to support the implementation of the economic elements of the Water Framework Directive. Emphasis is given to the 2004 requirements and obligation of the Directive.

The activities developed by WATECO include:

- A review of existing experiences and expertise in the application of economics into water policy/management;
- The development of a series of documents on the economic elements of the Water Framework Directive and their integration into an overall approach;
- The organization of several awareness and discussion workshops on the economic elements of the Water Framework Directive (e.g. targeted to stakeholders, targeted to experts from Central and Eastern Europe);
- The scoping (assessing the feasibility) and testing of proposed economic methodologies and approaches in a series of national pilot river basins in Greece, Germany, France, Spain, Sweden, the United Kingdom and one international river basin, the Scheldt shared by the three Belgium regions, the Netherlands and France;
- The Lille III Conference entitled "From economic enigma to operational reality – implementing the economic elements of the Water Framework Directive" that took place in Lille 18-19 March 2002.

Before the guidance document is submitted for agreement to the EU water directors (by end of May 2002), a series of discussion and evaluation events will be organized:

- A workshop with key water managers for assessing the usefulness of the economic analysis proposed in the guidance document and the demand for economic input from water managers for taking their decisions.
- An evaluation by selected experts in the field of water and economics. These experts will assess the completeness, rigor and economic soundness, practicality and understandability, and usefulness of the guidance document.

Key issues

Characterisation of the river basin: linking biophysical and economic information

The first step in the development of river basin management plan is the characterisation of the river basin as required under Article 5 of the Water Framework Directive. This characterisation identifies key water uses and pressures in the river basin, their impact on the status of water bodies, and provides information on the socio-economic importance of existing uses and economic sectors using and polluting water resources. Issues in the process of characterising the river basin include:

- Which water uses to be investigated? And how to assess the "significance" of these uses for water management in the river basin?
- At which spatial scale relevant to water management should economic information be collected and key socio-economic indicators computed?
- How to integrate biophysical information and economic information to ensure they can effectively be combined to help identifying key water management issues in the river basin?

Often, the economic information base required for characterising river basins will be scattered between a wide range of organizations and institutes, e.g. the Ministry of Environment and environmental agencies for biophysical information, but also statistical offices, the Ministry of Economy/finances/budget, or specific research institutes and universities. To ensure adequate integration between biophysical and economic information, a mixed team of water engineers and economists is best suited to develop the characterisation of

the river basin. Also, assessing data gaps and follow-up activities for filling these gaps should be fully integrated into the characterisation process that will remain dynamic.

Socio-economic information to be collected and combined with information on pressures and uses (in terms of abstraction, pollution, etc.) include:

- Population connected to specific water services (in absolute terms, in relative terms as compared to the total population of the river basin);
- Turnover and employment of key economic sectors/water users (in absolute terms, in relative terms for the river basin or the country);
- For agriculture: cropped area, main crops, irrigated area, livestock density, average input uses (fertilisers, pesticides);
- Number of users for specific uses, and related economic turnover (e.g. for tourism linked to water-sports)
- Price of water services and cost-recovery level (for the main sectors, other sectors if relevant).

Food for thought…

- Which uses need to be considered? Which economic sectors? Which pressures and impacts?
- Which information and economic indicators should be collected/computed?
- Where are likely information gaps (in terms of missing information or information at the "wrong" spatial scale)? For which economic sectors/uses? Which data (available information) should be used for a first (short-term) analysis? Which information should be collected in priority (short-term, long-term)?
- Integration and scale: how to ensure adequate link between economic and biophysical information? At which scale should socio-economic indicators be computed? Is it necessary to consider different scales for doing the analysis as compared to reporting?
- Are there examples of good illustrations and good practices of characterisation of river basins that include a well-developed economic component? Which lessons (in terms of methodology, information, expertise) can be already drawn from these examples?
- How should the biophysical and economic information be organized and structured? Which role for a geographic information system? Is it possible to integrate economic-related variables into a geographic information system?
- Which expertise is required for the analysis? Which possible role for stakeholders in the analysis?
- Which main constraints (short-term, long-term) for undertaking the analysis? Which solutions (short-term, long-term) for solving (some of) these constraints?

Where will we be in 2015? Assessing trends in water demand and supply

Most of the water systems are in constant evolution: new uses develop, some uses disappear, pressures on water resources are modified as a result of changes in the use of polluting inputs or adoption of new water-saving technologies, mitigation measures are put in place to reduce environmental damages, the demand for water from given economic sectors are altered as a result of changes in the macro-economic conditions, etc.

Such dynamics and evolution need to be considered in the development of river basin management plans. It is important to assess how the main pressures and uses will evolve over time from now up to 2015, as this will have an impact (whether negative or positive) on the status of water bodies. Measures for achieving the objectives of the Water Framework Directive will then be devised for tackling significant water management issues likely to exist in 2015 and that are not necessarily the ones faced today in river basins.

The assessment of trends in key pressures and uses is a complex task. It requires:

- Investigating the likely changes in key macro-economic policies and sector policies, at European and national level. For example, changes in the Common Agricultural Policy will affect agriculture and the pressures the sector imposes on water resources (and thus on the status of water bodies);
- Investigating changes in technologies and input/output policies (e.g. water pricing) that will affect water demand and pollution from key sectors and pressures;
- Investigating climate change that may affect water resources availability (overall, in terms of temporal and spatial distribution) in a given river basin;

- Investigating changes in pressures that result from the implementation of existing water directives and environmental legislation (e.g. implementing the Nitrates Directive).

Food for thought…

- Which key factors and policies should be considered for analysing the likely trends in pressures, water supply and water demand up to 2015? Which policies should be considered at the EU, national or regional level?
- How to account for the impact of climate changes? (Is it an important issue after all?)
- At which scale should we assess changes in key pressures? For the entire river basin, for sub-regions where these pressures are particularly significant?
- Which methodologies could be applied for assessing trends in key pressures?
- Do trend analyses for key economic sectors already exist (at national, EU level)? How to assess their relevance and quality?
- Which environmental and socio-economic indicators should be computed and investigated in the trend analysis?
- Where are likely information gaps (in terms of missing information or information at the "wrong" spatial scale)? For which economic sectors/uses? Which data (available information) should be used for a first (short-term) analysis? Which information should be collected in priority (short-term, long-term)?
- Are there examples of good illustrations and good practices in assessing tends in water demand, water supply and key pressures? Which lessons (in terms of methodology, information, expertise) can be already drawn from these examples?
- Which expertise is required for the trend analysis? Which possible role for stakeholders in the analysis?
- Which main constraints (short-term, long-term) for undertaking the analysis? Which solutions (short-term, long-term) for solving (some of) these constraints?

Selecting cost-effective measures to achieve the environmental objectives of the Water Framework Directive

The Water Framework Directive offers Member States the possibility to implement a wide range of measures to achieve its environmental objective of good water status. However, in its Annex III, the Directive requests Member States to undertake a cost-effectiveness analysis to identify the set of measures for achieving the environmental objective at the lowest cost.

Undertaking a cost-effectiveness analysis requires information on:

- The costs of different measures;
- The effectiveness of these measures (what is the likely impact of each individual measure on the water status of given water bodies).

Overall, the cost-effectiveness analysis ranks different package of measures according to the ratio between cost and likely environmental impact. And it selects the package with the lowest ratio. To be performed, it requires an integration of economic and technical disciplines and expertise.

Looking at a wide range of measures requires looking at different costs (investment, operation and maintenance costs, but also possible economic costs resulting from changes in economic activities) spread over different time periods resulting from different lifetime for investments.

Investigating the effectiveness remains also a complex issue. Indeed, the impact of individual measures is often known on a limited number of environmental parameters, but rarely on their combination nor on complex biological indicators. Also, combining two measures may lead to an impact on water status that is not the simple addition of their individual impacts. Finally, many measures will impact on a series of water bodies and not only on the water status of a single water body.

Food for thought…

- Which costs should be considered for the cost-effectiveness analysis? Should the same costs for different measures be considered, e.g. costs of a waste-water treatment plant, versus costs of restoring a wetland, versus costs of changing water price policy?
- How to account for the distribution of costs over time? Which method should be used to be able to compare measures with different lifetime?
- How to assess the effectiveness of measures? Is the method the same for e.g. new waste-water treatment plant as compared to changes in water prices?
- How to assess the effectiveness of a combination of measures?
- What is the potential role for models and simulation tools in assessing the cost-effectiveness of measures? Under which conditions/for which types of measures are such models/tools likely to be most useful/appropriate?
- Where are likely information gaps (in terms of missing information or information at the "wrong" spatial scale)? For which economic sectors/uses? Which data (available information) should be used for a first (short-term) analysis? Which information should be collected in priority (short-term, long-term)?
- Are there examples of good illustrations and good practices of cost-effectiveness analysis undertaken at the river basin scale? Which lessons (in terms of methodology, information, expertise) can be already drawn from these examples?
- How to deal with uncertainty in the cost-effectiveness analysis? How to account for uncertainty in the choice of measures?
- How to deal simultaneously with measures that are implemented at different scales (sub-basin, basin, country, EU)?
- Which expertise is required for the analysis? Which possible role for stakeholders in the analysis?
- Which main constraints (short-term, long-term) for undertaking the analysis? Which solutions (short-term, long-term) for solving (some of) these constraints?

Integrating economic concerns for defining environmental objectives

The Water Framework Directive defines its quality objectives of good and high water status based on a series of chemical, hydro-morphological, quantitative and ecological criteria. Under specific circumstances, well defined by the Directive, Member States may aim at lower environmental objectives or at reaching these objectives within a longer time frame. The use of such derogation is well spelt-out in Article 4 of the Directive and includes:

- The designation of heavily modified water bodies where it is not possible to bring surface water bodies back to their natural hydro-morphological conditions as a result of man-made modifications;
- The development of new sustainable development activities and new modifications in the morphology of surface water bodies that may have a negative impact on the status of water bodies.

To designate water bodies as heavily modified, or to justify lower environmental objectives, Member States need to develop a series of tests that investigate:

- The impact of a change in the hydro-morphology on existing uses (for heavily modified water bodies only);
- Alternative options for providing the same service that would have a lower overall environmental impact and that would not have disproportionate costs;
- The economics of the proposed modification or new activity by comparing its costs and benefits;
- The likely impact of the existing or new modification on related water bodies and protected sites.

Food for thought…

- Which economic analysis should be undertaken to designate heavily modified water bodies?
- Which types of alternative options should be considered in the analysis? (local alternatives for providing the same service, national or global alternatives)
- How to assess the overall environmental impact of these different options? Which environmental issues should be considered in assessing this overall environmental impact?

- How to assess "disproportionate" costs? Which comparison/tests to assess whether costs are disproportionate or not?
- Are there examples of good illustrations and good practices of costs and benefits assessment of new modification and economic activities impacting on water status? Which lessons (in terms of methodology, information, expertise) can be already drawn from these examples?
- Which expertise is required for the analysis? Which possible role for stakeholders in the analysis?
- Which main constraints (short-term, long-term) for undertaking the analysis? Which solutions (short-term, long-term) for solving (some of) these constraints?

Assessing existing and foreseen levels of recovery of the costs of water services

Article 9 of the Water Framework Directive requests Member States to ensure by 2010 an adequate recovery of the costs of water services by water uses, disaggregated into at least agriculture, households ad industry, and taking into account the economic analysis according to Annex III and the polluter-pays principle.

Assessing cost-recovery levels requires a good understanding of:

- Who uses and who pollutes water;
- The costs related to the provision of water services;
- What do current users and polluters pay for water services;
- Which are the existing subsidies supporting water services.

Food for thought…

- Which services and uses to consider in the cost-recovery analysis?
- Which costs should be considered in this analysis?
- How should taxes and subsidies be accounted for in this analysis?
- At which scale should the analysis be undertaken and should cost recovery be reported? (individual service supplier scale, area with common pressure from water services, sub-basin, river basin)
- How to allocate costs to different uses in case of multiple use infrastructures?
- Are there examples of good illustrations and good practices of cost-recovery assessment? Which lessons (in terms of methodology, information, expertise) can be already drawn from these examples?
- Which expertise is required for the analysis? Which possible role for stakeholders in the analysis?
- Which main constraints (short-term, long-term) for undertaking the analysis? Which solutions (short-term, long-term) for solving (some of) these constraints?

Linking the economic analysis with the information, consultation and participation process

The Water Framework Directive promotes the active participation of all interested parties, and the information and consultation of the public in the development of river basin management plans. The economic analysis being an integral component of the activities that lead to the river basin management plan, information, consultation and participation also applies to the economic analysis.

Clearly, the economic analysis builds on a wide range of information and expertise that do often lie with stakeholders and the main water users. It is then important to ensure this information and expertise is mobilised for strengthening the economic analysis. Also, stakeholders and the public are likely to be interested in some of the output of the economic analysis. For example:

- How much does the programme of measures cost?
- Who will pays for the programme of measures? And what will be resulting changes in water prices?
- What is the economic impact of implementing the programme of measures on specific economic sectors?
- Are accompanying measures and financial support proposed for helping loosing sectors/poorest users to adapt/pay for the costs?

Food for thought…

- Which stakeholders can contribute to the economic analysis? For which reason(s)/which added value?
- How could stakeholders participate in the economic analysis? At which stage of the economic analysis?

- Which information (which variables, which format, which communication means) should the economic analysis deliver for informing the public about the economic dimension of the proposed river basin management plan?
- Which information (which variables, which format, which communication means) should the economic analysis deliver for informing stakeholders and interested parties about the economic dimension of the proposed river basin management plan?
- Are there examples of good illustrations and good practices of stakeholders' involvement in economic analysis/integrated river basin management plans development? Which lessons (in terms of output, approaches, constraints, factors for success) can be already drawn from these examples?
- Are there examples of good illustrations and good practices of information and consultation of the public on economic aspects of river basin management/water policy? Which lessons (in terms of request for specific economic information, approaches, constraints, factors for success) can be already drawn from these examples?
- What are the main constraints in the participation of stakeholders in the economic analysis process?
- What are the main constraints in informing and consulting the public on economic issues? Any specific constraints linked to economics as compared to other elements of the integrated river basin management plan?

Testing some elements of the WATECO guidance document on economics – the Scheldt case study

Background

Among the activities developed by WATECO*,* the testing of the guidance document on several river basins has been identified as a key one.
One of these is the case study of the Scheldt river basin. This case study combines two specific characteristics:

- The river basin is international, shared by three countries;
- Experts in the field of economics and also in impact and pressures are involved.

This testing activity has been approved and supported by the International Commission for the Protection of the Scheldt (ICBS).

Two one-day workshops of the WATECO and IMPRESS [4] group members took place in Amsterdam in November 2001 and in Bruges in January 2002.

According to the discussions on the general approach, it was decided that three case studies should be undertaken focusing on different objectives of the WFD, namely:

- Water quality;
- Groundwater abstraction;
- Morphology.

For each case study, a specific team with its working programme and timetable have been set.

This paper presents the main preliminary outputs of this testing activity, the main issues arising, the assessment of the parts of the guidance document tested and proposals for improving it.

Finally some ideas are developed on the potential follow-up to this testing activity undertaken on the Scheldt International Basin.

The elements of the guidance document tested

The objective of the three case studies is to illustrate and test the 3-step approach developed by the WATECO working group, making use of the insights gained in other case studies, such as the scoping activity undertaken on the Ribble.

[4] Working group under the Common Implementation Strategy dealing with analysis of pressures and impacts.

Linked with the test of the approach, the following information sheets have been used and assessed: costs and benefits estimation, cost-effectiveness analysis, baseline scenario, and disproportionate costs.

Short presentation of the Scheldt International Basin

Location

Belgium (Walloon Region, Flemish Region, Brussels Capital Region), France and the Netherlands.

Description of the river basin district

	Area (km²)	**Inhabitants**
France	18,499	4,480,000
Walloon Region	3,787	1,300,000
Brussels Capital Region	162	959,000
Flemish Region	11,493	5,497,000
The Netherlands	3,229 (*)	450,000
TOTAL	37,170	12,686,000

(*) Surface water + land

The Scheldt rises in France, to the north of Saint Quentin, flows through the Walloon Region, the Flemish Region and the Netherlands before running into the North Sea. The length of the river is 350 kilometres. The Scheldt and its tributaries are lowland watercourses with low rates of flow and discharge. A major part of the river is canalized. More than 250 weirs and sluices are forming artificial connections between parts of the river and between the river and its tributaries and canals. Upstream of Ghent, the Scheldt is canalized for 138 kilometres.

The part of the Scheldt between Ghent and Vlissingen is a unique area, considerably influenced by tides. The estuary contains zones of freshwater, brackish water and saline water comprising channels, shallow water areas, tidal flats, salt pastures and their biotops.

The river basin district has an area of 37,170 km² and a population of 12,686,000 inhabitants.

The population density per municipality varies strongly in the different parts of the river basin district: from less than 100 inhabitants/km^2 in rural areas such as the upstream part of the Leie or in some villages of Zeeland to more than 2000 inhabitants/km^2 in urban parts such as Antwerp, the Brussels Capital Region and Lille.

The river basin district of the Scheldt has a very dense network of waterways and motorways. This has encouraged the creation of a considerable industrial and urban structure. The inland navigation network is strongly developed and is in its largest part adapted to the European dimension of 1,300 tons.

The land use of the Scheldt river basin district is varied. The river basin district is highly urbanized. It includes several industrial areas. The areas destined to agriculture are quite consistently spread over the whole territory. Woodlands represent only a limited part of the total area and are mostly situated in the north-east of the river basin district (Kempen), in the neighbourhood of some major cities (the Brussels Capital Region, Leuven and Valenciennes) and in the sub-basin of the Haine. Important wetland areas are situated along the Scheldt between Ghent and Vlissingen, like the Verdronken land van Saeftinge, the largest brackish water pasture of Western Europe.

The entire coastal zone is a favourite destination for many tourists. As a consequence, the Flemish coast has undergone some serious changes. In the Netherlands and France, the coastal zone has kept a more natural character.

Main preliminary outputs of the three case studies

Water quality

The specific items for the test case “water quality” were:

- Elaboration of a method for water quality analysis;
- Availability of data;
- Upstream/downstream interdependencies;
- Discussion on baseline scenarios;
- Discussion on cost-effectiveness.

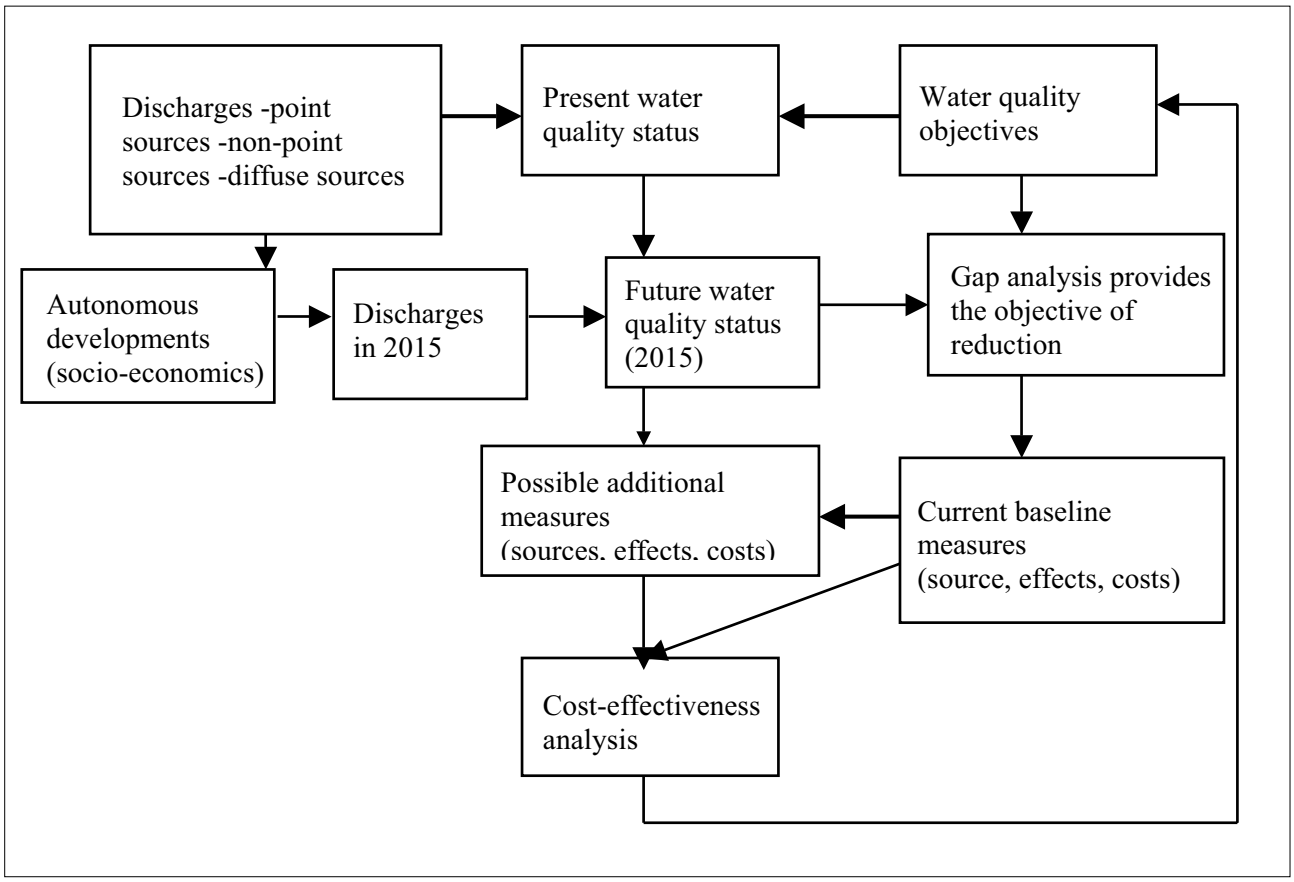
Method for water quality analysis– Requirements and tools for adequate analysis

A working method for the assessment of the environmental impact of different water uses and the gap identification has been developed and applied. The "pressures", and target groups, identified are industry, households, agriculture and shipping.

The key element of the working method is the calculation of the loads of the different parameters/groups of parameters (multiplication of concentrations and flow). In order to calculate the water quality gap different steps have to be made.

Successively the emissions (expressed in loads) and the immissions, the total allowable loads and the measured water quality have to be calculated. The comparison between the total allowable load and the measured load implies the load reduction that has to be realised (see Figure 1).

Figure 1. Scheme for analysing the water quality and determining the "load to be reduced"



In order to determine the total allowable load, the existing water quality objectives have been taken as the starting point and are assumed to be the objectives of the Water Framework Directive.

For the case study, the gap identification has only been done for the following parameters: COD, Zn and N.

Availability of data

The following problems have been observed concerning the data available:

- Data are fragmented and incomplete. Some of the parameters are not monitored in some regions. For example the emissions of zinc coming from shipping are monitored in the Netherlands but not in

the Flemish region or other regions. COD emissions are not monitored in the Netherlands and France, but they are in Flanders, Brussels and Walloon. The total discharges/emissions of different parameters in the Scheldt estuary are unknown;
- There are different approaches for inventory and different working methods. The proposed method for the analysis has already been used in Flanders but not in other regions;
- The link between economic data and ecological data is incomplete or does not exist for different target groups. Thus in most of the regions there is no direct link between the emissions/discharges of an economic sector (for example the industry) and economic data such as turnover, employment, etc.

As a consequence, data collection and validation is time-consuming.

Upstream/downstream interdependencies

The international approach to the test case "water quality" is appropriate. Changes in the pressures caused or measures undertaken by the target groups upstream influence the water quality downstream. The upstream - downstream relationship can be analysed by dividing the river basin into different portions and calculating the net loads discharged into the river basin. At present, this relationship is limited to regional level. The volume of the loads discharged in different regions is known. The enormous area of the catchment entails a high level of uncertainties and assumptions about the discharges and their impact on water quality. A balance has to be found between the level of detail and the accuracy and the number of assumptions that have to be made.

Another tool which can be used to study upstream - downstream interdependencies is modelling. For some catchments a modelling system is being or has already been developed. Modelling is a very complex activity which takes a lot of time and requires a lot of detailed information.

Until now there is no "approved" approach through which the upstream-downstream relationship can be described.

Discussion on "baseline scenarios"

For the gap identification in 2015 different scenarios (assumptions) are built for the different target groups, industry, households, agriculture and shipping.

The following assumptions have been made:

- Emissions from the industry: the emissions from the industry increase with the economical development in various regions. Thanks to technological development the emissions decrease by 1% annually;
- Emissions from households are mainly influenced by the population growth, the average size of households and the expansion of water treatment capacity;
- Emissions from shipping: see industry;
- Agriculture: emissions are influenced by the implementation of relevant environmental law, e.g. the Nitrogen Directive.

Data on developments are often:

- Available at national level but not at regional level, e.g. the economic data on industry, such as growth expectations;
- Available at regional level but not at river basin level, e.g. population growth, water consumption per inhabitant;
- Difficult to quantify due to information gaps or lack of models, e.g. there is no awareness of the link between the economic development and its effect on the emissions/discharges in most regions.

Discussion on cost-effectiveness

The collection of data necessary for the costs-effectiveness analysis appeared to be very difficult and time-consuming. The rate of data unavailable, especially with regards to the combination of measures, costs and effects of measures is very high.

There is also a lack of information on the existing measures taken by different target groups.

Groundwater abstraction

Objectives

The WFD indicates in Article 4:

"(ii) Member States shall protect, enhance and restore all bodies of groundwater, ensure a balance between abstraction and recharge of groundwater, with the aim of achieving good groundwater status at the latest 15 years after the date of entry into force of this Directive, in accordance with the provisions laid down in Annex V, subject to the application of extensions determined in accordance with paragraph 4 and to the application of paragraphs 5, 6 and 7 without prejudice to paragraph 8 of this Article and subject to the application of Article 11(3)(j);"

As regards the WFD objectives, quantitative issues concerning groundwater can be summarised in the following question: Do the abstractions exceed the natural recharge (today and in the baseline scenario)? If so, what are the possible measures and their cost-effectiveness?

One of the purposes of the case study in the Scheldt international river basin was to deal with the specific character of international basins. Therefore, the testing activity was originally planned to deal mainly with the carboniferous limestone, an aquifer shared by Flanders, Walloon and France in the surroundings of Lille, Mouscron and Tournai.

For practical reasons, explained below, this was not possible, therefore it was decided to characterize all groundwaters around Lille and further to focus on another aquifer (chalk aquifer) which is only used by France.

Preliminary Conclusions

- The adequate scale for the assessment of groundwater abstraction is the scale of public networks.
  Public networks can use different types of resources and can be shifted from one aquifer to another. Therefore such groundwater aquifers cannot be studied independently. Water abstraction for any other purposes can be monitored at such scale;
- For international groundwater, the first step of assessment should be to perform joint monitoring of piezometry and water abstractions.
  In case of water scarcity, all users might try to justify their own use and ask for restricting other uses. No reliable justification can be made without a common basis of understanding of the present uses and natural recharge of the resource;
- Definition of the baseline scenario should be negotiated.
  Which measures are included in the baseline scenario and which ones should be implemented under the WFD is a political choice, which might alter the costs and effects of all measures;
- Indirect costs can influence/alter the cost-effectiveness of any measure.
  Water saving may affect the cost-recovery of existing infrastructures for water supply and water treatment, mainly because fixed cost will be recovered on a lower volume and drinking water or waste water will remain longer in pipelines. Therefore water saving may change the efficiency of such facilities. It may induce an increase of the price of the water to cover additional operating costs. Otherwise, the resulting cost may be supported through worse performance of the system such as more losses or more pollution;
- Since the initiator of measures is not always the Member State itself, because the scale of groundwater units could be the municipal scale, in order to secure cost-effective measures, transactions must deal with transfers of responsibility to municipalities to achieve the objectives of the WFD.

Morphology – cost-effectiveness analysis of possible morphological measures in the Scheldt estuary

Objectives

From a methodological point of view, the case addresses several issues that have not been addressed in earlier case studies:

- Cost-effectiveness analysis of morphological measures, which are expected to be quite different in terms of characteristics, costs and benefits from the water quality measures that have been studied so far;

- Assessment of cost categories that have not yet received much attention, in particular the incidence of economic losses caused by restrictive, regulatory measures and the reduction of productive areas; and the evaluation of disproportionate costs in a transboundary river basin.

Preliminary conclusions

- There was sufficient information available to fulfil the first step of the assessment system, the characterization of the Scheldt estuary. Sufficient information was also available to make a preliminary rough assessment of main human-induced pressures and impacts on morphology and subsequent ecological status. Nevertheless there is still a substantial lack of knowledge on the dynamical behaviour of the Scheldt estuary and the correlation between morphology and ecological status;
- It was difficult to rank the economic importance of different water uses, as this type of information is not (yet) available at the level of the river basin and is often not linked to economic water uses. To be able to perform an economic characterisation of the river basin it will be necessary to develop integrated information structures, that pay specific attention to economic water uses at disaggregated levels of the river basin;
- Although information about the distribution of activities should not necessarily form part of the characterisation, especially with international river basins, it seems important to do so. This information can be used both for the selection of options and for the economic evaluation of measures, as the distribution of water uses determines also the distribution of costs and benefits;
- Despite that in the case study the objectives were simply copied from the "Long-Term Vision Scheldt Estuary" study, in reality the objectives will need to be derived through the designation process of heavily modified waters. This involves defining the good ecological potential for the (sub-)river basins in order to specify which morphological changes are regarded as irreversible and which as reversible. This is a complicate process that could not be illustrated in the case study due to the time constraint;
- Another simplification with regard to the specification of objectives consisted in the assumption of morphological objectives being independent from other developments (water quality for example) and in assuming a clear relationship between objectives and measures (a clear dose-response relationship). These assumptions needed to be made, otherwise it would neither be possible to define specific objectives with respect to morphology nor to define any measures. However, they are rather strong assumptions that do not hold, as large uncertainties with regard to the eco-morphological behaviour of estuaries remain. In the case study, these uncertainties were dealt with by paying explicit attention on how to include uncertainty in the analysis of cost-effectiveness of measures;
- Assuming that it is always possible to achieve the final objective, either directly or by implementing additional measures, it is possible to incorporate uncertainty in the analysis of cost-effectiveness by accounting for the extra costs of additional measures. In this way, it is not required to predict and describe the exact contribution of measures to the ecological objectives set (a relationship that is problematic because of the lack of information with regard to morphological behaviour) uncertainty can be included by using expert judgement to assess the probability of the defined measures being sufficient to reach the set objectives. Summing up probability times costs results in an expected cost figure that included the uncertainty of effectiveness in a rough, but effective, way;
- The cost framework supplied by the worksheets on cost issues and cost-effectiveness is applicable to the assessment of morphological measures. Although, the assessment of costs in the case study proved to be difficult, this is not due to the inappropriateness of the framework, but is the result of a lack of firm empirical data on the socio-economic and physical system in the Scheldt estuary. Especially in assessing the category of "other direct costs" many blank spots remained. However, the case demonstrated that for most of these costs, values could be assumed on the basis of existing studies and general economic data;
- However, to establish a sufficiently reliable estimate for the costs caused by restrictions in navigation, it would be necessary to perform a high-quality cost-benefit analysis, taking into account (among other) long run forecasts of goods flows and world fleet characteristics, an assessment of the impact of access costs on port choice, shifts of traffic between ports within and outside the estuary. Such a study is very expensive in time and money, and cannot be undertaken in the context of the development of river basin management plans. However, the costs involved are of such a magnitude that they cannot be left out from the cost-effectiveness analysis either. The only solution is then to use benchmark data from recently conducted cost-benefit analyses of good quality, provided these are available;

- The "Worksheet on cost-effectiveness" includes a model cost sheet drawn up by the Environmental Agency of England and Wales with a more detailed presentation of capital and operating costs than the one used in the case. It has been specifically developed for the assessment of pollution control measures, and was therefore of limited immediate use for the present case. The worksheet was very helpful, though, in reminding that capital and operating costs encompass many more elements than a superficial inventory would identify. The identification of the various types of costs of a water-related policy measure is therefore a step deserving special care. It could be useful to develop detailed cost models for all important types of measures (water quality, morphology);
- When assessing the cost-effectiveness of the alternative options it is crucial to account for uncertainty. By using broad and general indicators like the probability of measures being effective and the extra costs involved if measures are not effective, uncertainty can already be included. It is important to do so, as it makes the variability of the outcomes explicit. Including uncertainty, thus functions as some type of a robustness test of the cost-effectiveness analysis performed. Besides, it offers decision makers the possibility to choose not only on the basis of the cost-effectiveness of alternatives, but on the variability of costs as well. This could in its turn also influence the assessment of disproportionate costs, as a wide cost range might be more difficult to finance (ability to pay) then a cost range that is more controllable;
- For a first screening of disproportionate costs, an expert group panel seems to be an efficient method of assessing the level of disproportionate costs. However, the group needs to receive input, both in terms of an analysis of the ecological impacts as with regard to the socio-economic impact. Ideally, after a first screening of broader impacts, the impacts assessed would be fed back to the cost-effectiveness analysis, leaving the broader, societal impacts to be included in the plan agreement phase. Subsequently, the most cost-effective scenario can be assessed for disproportionate costs. The sequence of first assessing ability to pay, then comparing the costs to the costs of benchmark projects and finally comparing costs with benefits seems to be logic, leaving the expert group to decide whether all three steps need to be taken;
- It seems important to further elaborate where the wider socio-economic impacts and distribution of costs and benefits will be assessed when designating the river basin management plans. This is important not only because these impacts need to be systematically included when assessing the river basin management plans, but also because this step will be crucial to ensure stakeholder participation.

Assessment/proposals for the guidance document

Method of analysis

The methodology developed to determine the loads to be reduced has to be assessed by the IMPRESS working group.

Uncertainty about the relation between emission reductions and impacts on the quality has to be reduced. This is necessary because of the different approach of the economic analysis (decisions on the load reductions at the emission level) and the water quality approach (decisions at the water quality level).

Upstream / downstream

Further multidisciplinary discussion on a feasible approach to tackle this problem is necessary.

Breaking up the river basin into smaller portions of catchment is a proposal for the medium-term. For the long-term it is proposed to elaborate modelling systems for the whole river basin.

Baseline

More insight on developments is necessary in order to produce reliable scenarios for the future. For example the knowledge between the technological evolution and the impact on discharges of the different target groups is an important element.

Cost-effectiveness

- It is probably more cost-effective develop an interregional/international project for the inventory of measures, with regional updating and specifying possibilities;
- Distinction between measures and instruments and, accordingly the type of costs that have to be taken into account;
- Agreement on definitions, costs, approaches, etc.

Follow-up

The test performed on the Scheldt has been developed in a very short period and has faced several challenges:

- Identification of data availability and use of the data for the subsequent steps of the approach (including information needs of the main users);
- Establishment of working links with a wide range of experts for building the baseline scenario or assessing the effectiveness of the measures (which requires the use of a model or at least some assessment provided by experts).

Considering the time constraint, many simplifications or assumptions have been made and the data was rather identified than collected and used. The involvement of stakeholders, identified as a key issue, has been limited.

The "Scaldit" project – an integrated test of all the guidance documents provided through the common strategy – was proposed to the European Commission on 15 February 2002. This project should give an opportunity to make progress on what has been started on the Scheldt testing.

Acknowledgments

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Adapting the law of water management to global climate change: an American perspective

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Introduction

There is little reason for doubt today that the planet is undergoing significant and even alarming climate change. After nearly a millennium of a slow but steady cooling trend, the twentieth century has seen a dramatic upsurge in average global temperatures that has steadily accelerated as the century wore on. These changes – whether the result of human agency or otherwise – inevitably impact on the patterns of precipitation around the world. Our responses, whatever they are, will have to be carefully planned in order to be sustainable rather than ultimately self-destructive as were many of the adaptations after the end of the Ice Ages.

Adaptations to global climate change will necessarily focus on the management of water resources. Freshwater is, after all, one of the most essential resources for human survival, let alone for human thriving. Because of the variability of water in quantity and quality, water, while found nearly everywhere, is often in the wrong place, or inadequate in amount, or too impure. Usable forms of water are a scarce and valuable commodity. Despite the limitations in the amount of usable water on the planet, there has been a nine-fold increase in per capita consumption of water worldwide since 1900, arising from changing technologies and changing personal habits (Commission on Sustainable Development, 1997). The burgeoning global population further increases demand, at least in societies that do not adjust their water consumption patterns to current realities (Dellapenna, 1997a).

How global climate change will impact on human societies will not be known for a century or more. Furthermore, the impact of climate change specifically on water resources will not be uniform. Thus projecting the actual impact of climate change on the water available for human use even in large river basins remains highly uncertain. For example, Gene Stakhiv found that all but one of six projections of the impact of climate change on the flow of the Nile at Aswan predicted significant increases over the next century (Stakhiv, 1998). Forecasted increases ranged from 6 percent to 137 percent, but one projection predicted a decline of 15 percent. With such uncertainty one cannot recommend precise legal responses to projected climate change even on the level of a river basin, let alone for the entire planet. Yet certain generalizations are possible.

Global climate change is likely to add considerable stress to existing legal regimes as water management systems struggle to adapt to the altered precipitation and flow patterns. Many existing legal regimes already feel stress as they struggle to respond to the increasing and changing demands for water without unduly destabilizing existing expectations expressed in investments in water use facilities (Brans et al., 1997). To the extent that global climate change reduces the supply of water in particular basins, competition between new or enlarged uses with existing uses can only intensify. If global climate change leads to an increase of water supplies in particular basins, it would at least temporarily ease stress on the water regime in that basin, although possibly creating a need for new legal responses to flooding or the like.

The question then is whether existing legal regimes can be modified at the local, national, and international level to better accommodate change without so unsettling water users as to provoke extensive, and perhaps violent, resistance. Too much legal response can produce as much social turmoil as inadequate legal response certainly will. In light of such concerns and believing that existing engineering tools are fully adequate to manage the transition, Stakhiv argues for "adaptive management" over what he terms an "anticipatory strategy" (Lins and Stakhiv, 1998; Stakhiv, 1998). By this he means applying existing legal regimes with little or no change, counting on the flexibility already in such regimes to adapt gradually to the pressures induced by a combination of population growth, climate change, and technological innovation.

In my view, major changes are in order for existing legal regimes regardless of how significant climate change will be on hydraulic patterns. Population change and increasing demand per capita for consumptive uses of water have already rendered existing legal regimes obsolete if they are too inflexible. Factoring in the enormous increases for non-consumptive uses – for the protection of environmental, ecological, and

aesthetic values – the ability of existing legal regimes to adapt is open to serious question. Global climate change can only exacerbate these problems.

The national dimension

Traditionally, different legal regimes have been used for dealing with water in surface water bodies, groundwater, and weather modification. In addition, most societies have special rules relating to pollution, navigability, and to deal with ecological or environmental needs. For more than 50 years, experts in many water-related fields have consistently argued that such an approach is obsolete, that only the integrated management of the waters of an entire basin can deal adequately with the mix of uses and needs that compete for the resource (McDonald and Kay, 1988; Rice and White, 1990; UNESCO, 1991; United Nations, 1972, 1992a, 1992c, 2002). This conclusion represents the long-term trend of legal reform for all levels of water management regime (Dellapenna, 1994a, 1994b).

Economists and others advance private property and markets as the best approach for global, national, or local environmental management processes in general and for problems of local, national, and international water management in particular, describing markets as an automatic and nearly painless means for resolving problems of water allocation, distribution, and preservation (Anderson and Leal, 1991; Anderson and Snyder, 1997; Dinar and Letey, 1991; Pearce and Turner, 1990; Smith, 1988; Wolfrum, 1996). Markets, we are told, will introduce the necessary flexibility into water management while allowing the appropriate integration of water quality and water quantity issues into a single managerial model. Market advocates anticipate that the results will be accorded the strong presumption of validity that market-based allocations are always accorded capitalist societies, a presumption strengthened by the utter failure of classic socialism.

Actual markets for free-flowing water have always been extremely rare (McCormick, 1994; Smith, 1988, at 28-52). For example, in the United States of America such markets as there have been were for the transfer of water among small-scale similar users (Gray, Diver and Wahl, 1991; Thompson, 1993). Around the world, water markets have seldom accomplished significant changes in water usage (O'Brien, 1988; Pigram and Hooper, 1990). When so-called markets have been used to bring about major changes in water usage, the changes came about only through the rather heavy-handed State intervention (National Research Council, 1992). This pattern ought to give rise to an all too obvious question: if markets for water are so good, why are they so seldom used? Supporters of markets seldom address this question except to denigrate their critics as holding cultural, religious, even mystical prejudices about water. Water, however, is not like other resources.

The public nature of water

Water is not only one of our most essential resources, it has also long been considered to be the quintessential "public good." A "public good" has two qualities: indivisibility and publicness (Kaul, Grunberg and Stern, 1999). Because the good is indivisible, one cannot simply divide it up and buy as much as one wants, and because it is public, it is impossible to keep others from accessing and enjoying the good so long as it is accessible and enjoyable by anyone. Public goods generally are free goods as far as markets are concerned because consumers cannot be excluded from enjoying the good. How much can one charge others for viewing the blue sky over one's property? The only costs, if any, associated with a public good are the costs of capture, transportation, and delivery, not payment for the good itself.

This creates an important problem: if one invests in developing or improving a public good, others who pay nothing will enjoy the benefits of the investment. You cannot exclude them from enjoying the good (Coase, 1974). Such "free riders" seriously inhibit investment unless the Government (or some other institution) is able to assure that all (or nearly all) pay for the benefits they receive. Consider air pollution. If many people voluntarily invest in cleaner running cars in order to protect the air we breathe, I will have cleaner air just as much as they will – even if I do not buy a cleaner running car. As more people realize this fact, fewer will voluntarily buy a cleaner running car. The market simply won't work; regulation will.

Economists are so accustomed to considering water a paradigm of a public good that they use water metaphors to discuss public goods generally: "common pool resource," "spill over effects," and so on. Water is, of course, not indivisible and public in the strictest sense, and a few economists therefore have denied that

it is a public good. But few things are strictly indivisible and public. What a culture treats as a public good, however, is not determined just by its physical characteristics, but also by its social and economic characteristics. When the costs to exclude others would be so high that it is impractical to exclude others from access to the good, or when there are other (perhaps cultural) reasons why a society will not exclude some of its members from access to the good, the good is treated as a public good.

The characteristic that most often leads to treating something as a "public good" is because transaction costs are so high that no market can function with even minimal effectiveness (Howe, Boggs and Butler, 1990; Shelanski and Klein, 1995). When transaction costs make markets impossible yet a good is considered essential for the minimum well being of members of society, Governments undertake to provide the good to all without direct charge. Such goods could be termed socially created public goods. Examples of socially created public goods include fire protection or public education. Water is just such a commodity. This is most obvious for the protection of instream flows. Less obvious, but no less true, is the public nature of water when withdrawn for private use. While it is easy enough for someone to own and manage water unilaterally in small amounts (for example, bottled water), a river is an ambient resource that can never be fully controlled or owned. Doing something to water on a large scale necessarily affects many others, making it difficult to procure the contractual assent of all significantly affected persons. Transaction costs on all but the smallest water bodies quickly become prohibitive. This reality underlies the treating of water as a free good – a good available to all at no cost for the water itself, but only for the cost of capturing, transporting, and using the water.

Advocates of markets for allocating and managing water are demanding an end to the treatment of water as a free good. Water should not be a free good. Economic incentives including fees, taxes, and "water banks," should be introduced for those who use water so they will more realistically evaluate the social consequences of their conduct (Wolfrum, 1996). But resort to economic incentives should not obscure the fact that water remains the prime example of a public good for which prices cannot be set in a marketplace. The reality of transaction costs should give even the most free-market oriented economist pause to consider whether true markets could function effectively for water resources (Howe, Boggs and Butler, 1990). Ultimately, true markets must remain marginal to the management of large quantities of water for numerous diverse users.

Patterns of property in water

In thinking about "property" in water, one is likely to have in mind a system of rules that define rights and duties pertaining to water in clear and certain terms, with law serving to protect these entitlements except insofar as changes occur through market transactions. A close model of such an arrangement is the American law of appropriative rights; similar systems are found in other countries as well (Dellapenna, 1991 ch. 8). A rule that permits anyone to use a "common pool resource" so long as the use is "reasonable" hardly seems like a rule of property at all. Such a rule leaves courts to sort out conflicting claims of right to the common resource solely through a rule prohibiting tortious interference with other users (Dellapenna, 1991 ch. 7). This amounts to a rule of common property, rather than a rule of private property. The American law of riparian rights is the prime example of such a legal regime; the Roman law of flowing water was similar. The third possibility is active public management of the common resource. The newest system of American law for the allocation of surface water, "regulated riparianism," corresponds to such a public ownership model; examples are found in a growing number of other countries as well (Dellapenna, 1991 ch. 9).

While actual legal regimes often mix aspects of two or all three of these systems, analysing the "pure types" makes clear the strengths and weaknesses of each approach (Harris, 1995). The correspondence of forms of water law to theoretical models enables us to predict with some certainty whether a form is adaptable to changing circumstances, or whether an entirely new form must be substituted when water demand or supply changes dramatically. Conclusions drawn from the American experience are largely translatable to other societies (Teclaff, 1985). Treating water as common property leads to tragic over exploitation as soon as water begins to be scarce. It seems increasingly clear that a common property system cannot survive (Hardin, 1969; Rose, 1991). Which system should be substituted, however, is less clear.

Private-property market systems – the best mechanism for allocating resources when it works – fail if there are significant barriers to the functioning of a market (Coase, 1960). Markets do not work well for ambient resources like water because when one user attempts to convey a water right to another, particularly to one

seeking to make a completely different use of the water, the problem of "externalities" arises. Theoretically it might be possible for a properly structured market to cope with these concerns. In any hydrologically large and complex system, the difficulty and expense of structuring the necessary transactions (transaction costs) in fact prevent markets from developing unless the law chooses to disregard the externalities. The law, however, protects against such externalities. The law of appropriative rights in the United States of America consistently prohibits even a senior appropriator from changing the time, place, or manner of use if the change would produce a significant injury to another – even junior – appropriator (Gould, 1988). Because of the protection of third-party rights, small-scale transfers of water rights among farmers or ranchers making roughly similar uses at similar locations are the only ones that regularly occur without heavy State intervention (National Research Council, 1992). As a result, treating water as private property tends to freeze patterns of use rather than to create a market.

The California Water Bank is often presented as an example of a successful market for water rights (Gray, 1994; Israel and Lund, 1995; O'Brien and Gunning, 1994; Wahl, 1995). The California Water Bank, however, was a most unusual "market." For the 350 persons selling water rights, the State was the only buyer; for the 20 institutions buying water rights, the State was the only seller. California simply decreed that when the State buys or sells it need not concern itself with the effects of its transactions on third parties, even if they held valid water rights. The State sold at a standard price to buyers selected on the basis of criteria other than willingness to pay the price a market would set. The California water bank system was simply a set of economic incentives to encourage other actors to comply with the State's policy choices that disregarded the effects of the State's actions on yet other actors whose claims, if recognized, would preclude accomplishment of the State's goals (Gray, 1994; Wahl, 1994). Flexibility was introduced to enable fundamental transformation of water uses within the State, and (incidentally) wealth was transferred from those who formerly used water to those who thereafter would use water – from small (and relatively poor) users to large (and relative rich) users (Easter and Hearne, 1995; Gray, 1994; O'Brien and Gunning, 1994). In short, the California Water Bank is State management hiding behind the facade of a market – management that exacerbated social inequities.

The public property option

Because markets fail when one attempts to treat the right to use water as private property, private property systems like appropriative rights are experiencing increasing stress as demands surge and unappropriated water becomes rare. What works best (albeit imperfectly) is treating water as public property for which basic allocation decisions are made by public agencies. Today, both eastern and western States in the United States of America are increasingly turning to active public management for water management (Abrams, 1989, 1990; Dellapenna, 1991 ch. 9; Dellapenna, 1997b). State Governments have concluded that, despite the considerable difficulties in defining what are the proper public goals or in making the right decisions to achieve those goals, a transition to public property offers significant advantages over common and private property in terms of efficiency and distributive justice.

The core concept of public property in water as found in regulated riparian statutes is that all uses qualifying for a permit must be "reasonable" (Dellapenna, 1991, § 9.03(b)). The decision whether a proposed use is reasonable is made before investment in the use through issuance or denial of a permit. The administering agency includes an analysis of generalized interests widely diffused among the public that were only theoretically recognized, if at all, in the other property systems. Such a programme of public management might very well fall short of its goals. It undoubtedly could be improved by introducing economic incentives into the public management scheme (Cummings and Nercissiantz, 1992). One should not, however, confuse economic incentives with markets.

Administration of a public property system will be less than perfect. Whether such a permit process is superior to traditional riparian rights, appropriative rights, a pure market system (if such were possible), or some other regulatory system is hotly debated (Abrams, 1989, 1990; Dellapenna, 1991 ch. 9; Dempsey, 1989; Komesar, 1994; Rose, 1990; Trelease, 1974). Still, one cannot have much confidence in a private property/market system given the scarcity of actual empirical evidence that such a system can work and the transaction costs and externalities as barriers to the successful operation of a market for water rights.

The international dimension

Water has another quality that, combined with water's unusual importance, gives rise to a considerable risk of conflict among neighbouring communities. Water is an ambient resource that largely ignores human boundaries. Some 264 river basins in the world – including all the larger rivers and home to about 40 percent of the world's population – are shared by more than one nation. Cordial and cooperative neighbouring States have found it difficult to achieve acceptable arrangements for governing transboundary surface waters even in relatively humid regions (Teclaff, 1967; Zacklin and Caflisch, 1981). No wonder English derives the word "rival" from the Latin word "rivalis," meaning persons living on opposite banks of a river. Considerable evidence, however, suggests that cooperative solutions to water scarcity problems are more likely than prolonged conflict (Dellapenna, 1997a; Wolf, 1998). Historian Robert Collins summarized this same reality in a comment on the rivalries in the Nile basin: "[M]an will always need water; and in the end this may drive him to drink with his enemies" (Collins, 1990, at 300).

A well-developed body of international law addresses transboundary water problems. A growing body of international law also regulates the activities driving global climate change – mostly relating to activities that impact on the air and not directly on water (Churchill and Freestone, 1991; Goldenman, 1990; Jurgielwicz, 1996; United Nations, 1985, 1987). Water's status as a public good is central here as well (Kaul, Grunberg, and Stern, 1999; Merrett, 1997). As such, it usually cannot simply be parcelled out among competing users. The international community must cooperate to increase trust and eliminate water as a possible reason for going to war. International law (particularly customary international law) by itself cannot solve this problem, yet international law is an essential element of any solution.

Customary international law

The international legal system lacks the specialized institutions – executive, legislative, and judicial – of modern national legal systems. Customary international law consists of practices of States undertaken out of a sense of legal obligation – a sense that the practice is required by law (Wolfke, 1993). Despite the obvious difficulties in determining the precise content of customary international law, the system has been remarkably successful. This should hardly surprise. No form of international life could exist without shared norms that are largely self-effectuating in the conduct of that life (Henkin, 1979; Koh, 1997). Focusing exclusively on a relatively few highly dramatic instances of international legal failure creates an impression of entire ineffectiveness. Focusing on similar failures in national legal systems would lead to a similar reaction to those systems as well.

Successful areas of customary law have tended to be codified under United Nations auspices. A rich body of customary law regarding internationally shared freshwater has emerged, largely in the last century or so (Dellapenna 2001; International Law Association, 1966; McCaffrey, 1986; Schwebel, 1982). That law was codified in the UN Convention on the Law of Non-Navigational Uses of International Watercourses, approved by the General Assembly on May 21, 1997, by a vote of 103-3 (United Nations, 1997). The Convention will come into effect if 35 States ratify it, a process that has been going on very slowly. The Convention, however, has been already recognized as the best statement of the customary international law (Danube River Case, 1997, paras. 78, 85).

Under customary law, only riparian States – States across which, or along the border of which, a river flows – have any legal right, absent agreement, to use the water of a surface water source (United Nations, 1997 arts. 2(c), 4). Riparian States in turn are bound by the rule of "equitable utilization" (United Nations, 1997 art. 5(a)). Equitable utilization requires each State to use water in such a way as not to injure unreasonably other riparian States. Reliance on customary international law, however, to allocate surface water or groundwaters among States is too cumbersome and uncertain to resolve disputes over interstate sources of water satisfactorily and too primitive to solve the continuing management problems in a timely fashion (Benvenisti, 1996; Dellapenna 2001). Furthermore, relying upon an informal legal system alone to legitimate and limit claims to use shared water resources is inherently unstable.

Despite the evident failings of customary international law for managing internationally shared waters, no solution is possible without the creation of the necessary law. If a cooperative management system is to be put in place for internationally shared freshwaters, that system must entail some sort of a legal mechanism for the orderly investigation and resolution of the disputes characteristic of that theory (Dellapenna, 1994b;

Kliot, Shmueli, and Shamir, 1998). Recurring bitter disputes even overt military conflict would inevitably continue in the absence of an alternative mechanism for resolving disputes. While stress on water resources itself creates real pressures for cooperative solutions to the problems confronting communities sharing the resource, the creation of a formal legal system is a necessary prerequisite to preventing conflict over water in any set of communities where water resources are under stress. Cooperative management has taken many forms around the world, ranging from continuing consultations, to active cooperative management that remains in the hands of the participating States, to the creation of regional institutions capable of making and enforcing their decisions directly (Dellapenna, 1994b).

Groundwater internationally

In contrast to the considerable state practice regarding the sharing of surface water sources, remarkably little state practice exists regarding the sharing of underground sources of water. Before the spread of vertical turbine pumps after World War II, groundwater was a strictly local resource that could not be pumped in large enough volumes to affect users at any considerable distance away. With the newer technologies, and with the exponential growth in the demand for water of the last several decades, groundwater has emerged as a critical transnational resource that has increasingly become the focus of disputes between Nations yet for which no consistent body of state practice has emerged. All too typical examples are the several treaties dealing with waters shared between the United States of America and Mexico; despite the growing importance of groundwater in the border regions, the treaties are silent on groundwater with potentially disastrous results (Rodgers and Utton, 1985).

Most legal scholars have concluded groundwater must be subject to the same rule of equitable utilization as applies to surface waters (Barberis, 1991; Donauversinkung Case, 1927; Hayton and Utton, 1989; Rodgers and Utton, 1985). As the hydrologic, economic, and engineering variables involved are basically the same for surface and subsurface water sources, the law must also be the same for both sources. Groundwater and surface water are not merely similar, they are in fact the same thing. Groundwater and surface water are simply water moving in differing stages of the hydrologic cycle. The UN Convention did not, however, include groundwater except to the extent that they are tributary to an international watercourse (United Nations, 1997 Art. 1).

Foremost among the problems in applying equitable utilization to an aquifer is the lack of firm knowledge of the characteristics of the resource (Tsur, 1995). We know quite a lot about surface water sources, having made accurate and ongoing measurements of these sources for a century or more, observing where surface water flows and what variables affect its behaviour. Groundwater, like surface waters, responds to gravity, seeking its lowest level, yet it does not flow as freely as surface waters. Groundwater's movement is determined by the structure, porosity, and slope of the rocks or soil through which it seeps or percolates. With highly variable subsurface conditions, often we do not know a great deal about the characteristics of particular aquifers. Acquiring more knowledge is expensive. We are only able to make tentative allocations that informal processes such as customary regimes are ill adapted to revise or supplement.

Does customary law provide a suitable mechanism for responding to global climate change?

The most significant developments not directly reflected in the customary rules relating to international waters are the emergence of environmental concerns, integrated management, and sustainable development as central principles of international resource and environmental law (Carley, 1998; Commission on Sustainable Development, 1997; Kirkby, O'Keefe, and Timberlake, 1995; Magraw, 1991; Nollkaemper, 1993; Sand, 1992; Sands, 1994; United Nations 2002; Weiss, 1988). This new body of international environmental law is compatible with the rule of equitable utilization. Yet equitable utilization is sufficiently uncertain that some critics argue that the principle focuses too strongly on the procedures for resolving disputes over water and presupposes that water is to be consumed even if consumption is not sustainable (Rahman, 1995). The political processes within the International Law Commission and the Sixth Committee virtually assured that their results would be a compromise that elides serious problems where the various competing legal principles conflict most directly. If the law governing the allocation of internationally shared waters is to be a positive contribution to the solution of the looming global water crisis rather than an

expression of obsolete formulas reflecting a vanished time of plentiful water, that law must be revised to incorporate these new concerns.

The Water Resources Committee of the International Law Association, the body responsible for the highly influential Helsinki Rules (International Law Association, 1966), has now undertaken to revise those rules to reflect these concerns (International Law Association, 2002). These revision synthesizes the emerging new paradigm of the customary international law of water management that focuses on joint, basin-wide management of water resources. This paradigm is sometimes called "equitable participation" (United Nations, 1997 Art. 5(b)). The paradigm of participation implies that all affected States be included in a management regime, and that persons or communities affected by management decisions have a voice in the decision process. As developed in the International Law Association project, the new paradigm is based upon the following principles that derive from the traditional customary international law of water management, or from international environmental law, or from international humanitarian law:

- The duty to cooperate regarding water, allowing all affected States, communities, or persons to have a voice in the decisions affecting them;
- The duty to manage related waters conjunctively;
- The duty to integrate the management of waters with the management of other related resources;
- The duty to utilize waters equitably and reasonably;
- The duty to use waters in a sustainable manner; and
- The duty to minimize environmental harm, respecting the ecological integrity of waters, assessing impacts before making decisions, and applying the precautionary principle, while compensating for injuries caused by such environmental harm as occurs, and including the duty to harmonize or coordinate national policies designed to achieve this goal.

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A transboundary approach to mitigating total dissolved gas in the Columbia River basin

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Introduction

Significant declines in salmon stocks have occurred in the Pacific Northwest and Northern California. There is risk of extinction for 214 wild spawning salmon stocks and 17 stocks have already become extinct (Washington Department of Fish and Wildlife, 1999). Total Dissolved Gas (TDG) supersaturation is one of many stresses facing the salmon stocks. TDG supersaturation can cause gas bubble disease to both resident and anadromous fish and other aquatic biota. These conditions are the result of both involuntary (for example under flood conditions) and voluntary spills (such as intentional spill for downstream fish migration) over dams as opposed to passage of water through hydroelectric turbines. High levels of TDG result in violations of United States Federal, State and Tribal water-quality standards and fail to meet Canadian environmental guidelines. These conditions can persist for several miles downstream and have a cumulative effect. This paper focuses on the situation in the Columbia basin and in particular on the main-stem of the Columbia River and outlines steps being taken by the Transboundary Gas Group to foment a binational approach to dealing with the issue of TDG supersaturation.

The Columbia River basin

The Columbia River drainage area measures 669,000 square kilometres including 169,000 square kilometres in British Columbia, Canada. The river originates in the Columbia Lake, located in the Selkirk Mountains and flows about 750 kilometres before crossing the international border between Canada and the United States of America near Newport, Washington. It flows an additional 1,250 kilometres before discharging into the Pacific Ocean near Cape Disappointment. The Columbia River is the largest source of hydroelectric energy in the United States of America and provides important benefits to irrigated agriculture and supports barge traffic all the way to Lewiston, Idaho on the Columbia's largest tributary, the Snake River. It discharges an average of 6,650 cubic meters per second. A series of Federal and utility owned dams as shown in Figure 1 are located throughout the basin. The installed hydroelectric capacity of the United States projects in the Columbia watershed exceeds 30,000 MW and average annual generation is in excess of 137,000 GWh.

Water-quality standards for total dissolved gas

In the United States of America, the States generally set water-quality standards. In Washington State, the standard for total dissolved gas is that TDG shall not exceed 110 percent of saturation at any point of sample collection (WAC, 2002). A special exception is made when the stream flow exceeds the seven-day, ten-year frequency flood. An additional modification to the criteria is made when spilling at dams occurs to aid fish passage. Under such conditions, TDG cannot exceed 115 percent below Bonneville Dam (the most downstream dam). Tailrace TDG is limited to 120 percent at each dam. These values are determined based on the twelve highest hourly readings in any one-day. Additionally, a one-hour maximum of 125 percent applies. These standards are enforceable and Federal dam owners, regulators and utilities are taking a variety of steps to meet these standards. Standards in the nearby Oregon are similar and when two or more standards are given for the same waterbody, the stricter standard applies.

In British Columbia, enforceable standards do not exist. Instead provisional water-quality objectives are set to protect a variety of designated water uses. The objective for TDG is a level less than 110 percent of saturation (Butcher, 1992). British Columbia is also developing "Water Use Plans" that will address TDG.

Figure 1. Columbia River watershed *(source: US Army Corps of Engineers, 2002)*

History of the Transboundary Gas Group

The United States of America and Canada signed the Columbia River Treaty [1] in 1961 to construct three new dams in British Columbia and one new dam in Montana. The Treaty became effective in 1964 and by the mid-1970s the new dams were built. The new projects significantly increased hydropower production and provide considerable flood control benefits, since over one third of the system storage capacity lies within the Canadian Treaty reservoirs alone. The Treaty showed that the United States of America and Canada could work together to address common water resource needs on a large scale in the Pacific Northwest. The two countries actually have a long history of working together on transboundary water issues dating back to the creation of the International Joint Commission (IJC) in 1909.

The Transboundary Gas Group grew out of a desire by agencies to develop a system-wide approach to managing dissolved gas and furthering its abatement throughout the Columbia basin. Regulators recognized that a piecemeal approach dealing with each dam along the river in an isolated fashion could be considerably more costly than a holistic approach. In 1998, the System Configuration Team and Dissolved Gas Team (later merged to form the Water Quality Team) were tasked to develop such an approach. The first step would be the characterization of location and extent of TDG levels produced by dams on the Columbia River and its tributaries, including four States in the United States of America and British Columbia. An April 1998 international conference titled *Towards Ecosystem-Based Management in the Upper Columbia River* brought scientists, planners, regulators and policy makers from both Canada and the United States of America together in Castlegar, British Columbia. Several of the attendees met to discuss transboundary water-quality issues and TDG management and abatement. An outgrowth of these meetings was the creation of the Columbia River Transboundary Gas Group (TGG). The TGG first met in June 1998 in Spokane, Washington, to focus on the development of a system-wide TDG management approach and to form technical working groups to specifically address important issues. The TGG appointed officials from Environment Canada and the United States National Marine Fisheries Service as coordinators.

[1] Treaty between Canada and the United States of America relating to cooperative development of the water resources of the Columbia River basin, done in Washington on 17 January 1961. The Treaty entered into force on 16 September 1964.

Working groups

Several working groups were formed to deal with specific TDG issues and each working group has a United States and Canadian co-chair. In addition to a Sytemwide Dissolved Gas Abatement Steering Committee, there are four additional working groups on:

- Biological Effects and Research;
- Monitoring and Information Sharing;
- Modelling;
- Operational and Structural Abatement.

Goals and objectives

The TGG has defined its primary goal as: "Reduce system-wide TDG to levels safe for all aquatic life in the most cost-effective manner possible". The members have set the following objectives:

- Define the geographic scope of the effort;
- Identify the status of current TDG biological and physical studies, additional TDG monitoring needs, and data management and availability;
- Identify physical and biological models that can be used to analyse system-wide TDG operational and structural alternatives;
- Identify and analyse potential operational and structural options to abate TDG in a system-wide context;
- Identify additional research needs related to biological and physical effects of operational and/or structural alternatives;
- Develop and recommend an action plan for system-wide TDG abatement;
- Define major elements of the Systemwide Dissolved Gas Abatement Study Plan.

The Framework Plan for Coordinating Activities

An important step was taken with the issuance of the Framework Plan for Coordinating Activities of the TGG. The framework plan was developed to coordinate investigations and TDG management activities throughout the Columbia basin. It defines cooperative mechanisms, updates the technical working group activities and provides an updated status report on transboundary gas management. The immediate focus of the framework plan will be short-term activities to characterize existing conditions and develop an information base as well as appropriate tools. More detailed investigations may occur in the future including implementation studies and integration of the TGG's work with several other efforts to address water quality in the Columbia basin. Information will be refined on transboundary conditions and methods will be determined to improve system-wide coordination. Figure 2 illustrates how the framework authors believe short-term and long-term activities will interact under the plan.

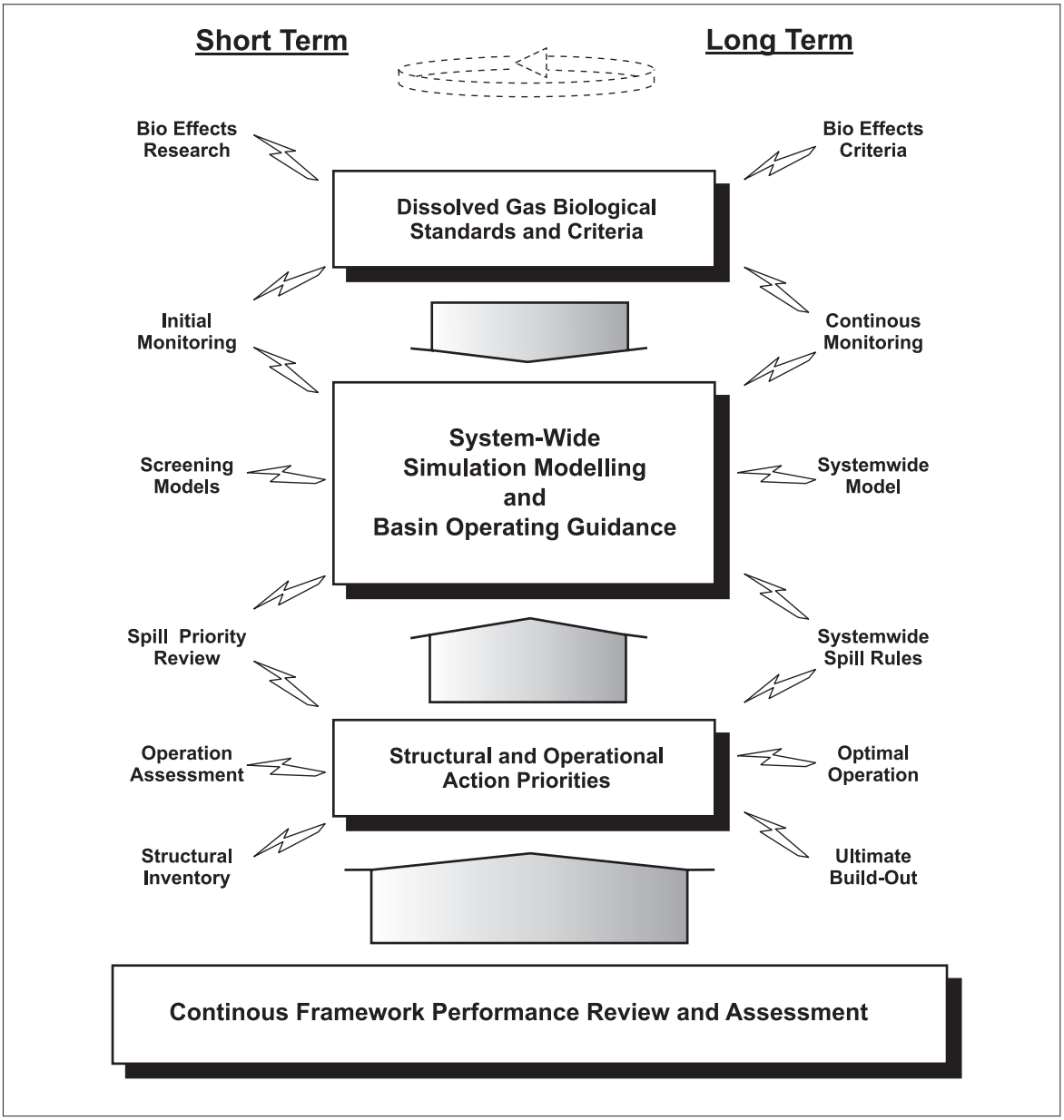

Figure 2. Flow Diagram of Framework Plan *(source: Columbia Transboundary Gas Group, 2000)*

More recent developments

Meetings of the TGG have been occurring on a regular basis, generally once in the spring and once in the fall, with locations alternating between the United States of America and Canada. The most recent meeting was held on 23-24 October 2001 in Castlegar, British Columbia. The TGG has made considerable progress in characterizing the existing TDG conditions and how it relates to fish distribution. Results of a mass-balance type model were presented and favourably compared against monitoring data. TDG status reports were presented on a number of United States and Canadian projects and included monitoring reports, and TDG mitigation studies. A review of treaties was presented in the context of implications for TDG management in the basin. The group has functioned essentially on an ad-hoc basis up till now, but there was more discussion on more formal memoranda of agreement. To ultimately formalize actions by the TGG would involve the United States Department of State and the Canadian counterpart. Activities of the TGG would need to be carefully coordinated by activities already underway by Federal dam operators, utilities and regulatory agencies. The Oregon and Washington State environmental departments, for example, have issued a preliminary draft total maximum daily load on TDG for the lower Columbia River that will ultimately result in an implementation plan to move towards compliance in that reach.

Conclusions

The ultimate cost of bringing the Columbia River into TDG compliance (or meeting Canadian TDG objectives) will likely be tremendously expensive. The benefits to restored salmon runs will have positive effects on the environmental well-being of the region and potentially have positive effects on the economy via improved salmon harvests. Tribal plans have set goals for restoring harvestable levels of fish as opposed to simply deleting the wild salmon species from the threatened and endangered species list. A multitude of other problems must also be addressed in parallel to the TDG actions including upstream and downstream fish passage, mortality through hydroelectric turbines, total maximum daily load (TMDL) for other water-quality parameters, competition with hatchery fish and problems associated with the ocean environment both in terms of harvest and ambient environment. A collaborative approach between the United States of America and Canada is being implemented to address the issue of TDG supersaturation on a basin-wide basis. This methodology may also be applicable to many of the other factors influencing the restoration of the salmon stocks. Work is continuing on this effort and it bears monitoring as an example of transboundary cooperation on a major water quality issue.

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The present structure and development scenarios of Lake Peipsi fish resource use – an Estonian perspective

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Lake Peipsi is the fourth largest lake in Europe and consists of three parts: the northern Lake Peipsi (2,611 km^2, mean depth 8.4 m), the southern Lake Pihkva (708 km^2, mean depth 3.8 m) and the narrow river-shaped Lake Lämmijärv (236 km^2, mean depth 2.6 m), which connects the northern and southern lakes. The fish resources of this transboundary lake are very important both for the Russian Federation and Estonia. The documented annual catches have varied between 3,000 and 17,000 tons during the last 70 years (Figure 1). Most likely the catches were even bigger at the beginning of 20th century (Tjurin, 1974). In 2000, the value of the commercial catch from the fishery of this lake was 84% of the total inland catch and 15% of the total Estonian fisheries catch (high seas fishery not included).

Due to the increased inflow of nutrients, the trophic status of the lake has changed considerably during the last century and essential changes have taken place in the relative abundance of species (Saat, Vaino, Afanasjev and Koncevaja, 2002). The total annual catches in the 1990s have decreased more than twofold, compared to the catches a century ago. The changes in commercial catches from 1931 to 1999 are presented in Figure 1. Whereas the role of the species favoured by oligo- and mesotrophic conditions (smelt, vendace) has decreased, the catch of predators such as perch and pikeperch favoured by eutrophic conditions has remained the same or has even grown.

However, fishery is not an activity depending only on natural resources. The structure and performance of a fishery is also deeply affected by society and its development. Changes in social and economic life of a country are usually followed by a dramatic change in fisheries. For example, at the beginning of the 20th century, most of the big inland water bodies of Western Europe served flourishing commercial fisheries, now fish is mainly harvested by recreational fishermen. The reasons are often much more related to changes in income and lifestyle of people than to alterations in the resource base.

In the last decade, changes in the political, economic and social life have taken place in the Estonian and Russian societies. The paper aims to analyse and evaluate the present structure of the fishery and the management system, and compare it with other European inland fisheries.

The catch data and the number of recreational licenses issued were provided by the Department of Fisheries, Estonian Ministry of the Environment. Data on first-buyer prices originate from the Estonian Environmental Inspection. The data on recreational fishermen presented in this paper were obtained through interviews carried out during winter 2000-2001. Altogether, 231 recreational fishermen were interviewed.

Fishing rights and the gear allocation system

In the lake, there are three main groups of fish resource users: commercial fishermen, household fishermen and recreational fishermen. These different user groups have different access to the fish resource.

For commercial fishing, the total number of allowed gears (TACs) and technical measures (Vetemaa, Vaino, Saat and Kuldin, 2001) are used. The number of gears is adjusted each year by a decree of the Minister of Environment based on scientific advice. Fishing rights are allocated according to the "historical usage principle". However, from 2001 onwards a special fishing rights auctions system is also in force (Vetemaa, Eero and Hannesson, 2002). According to this system, 10% will be deducted each year from the "historical fishing rights". This part is subject to open auctions. Thus, whereas enterprises that are not willing or able to buy additional rights will eventually disappear from the fishery, a rapid growth in terms of fishing effort is also possible.

The household fishing rights, which entered into force in 1995, enable coastal inhabitants to fish for their own use. According to the Fishing Act, all inhabitants of the municipalities bordering the lake have the right to apply for up to three gill nets (≤70 m in length) to be used in the 1 km wide coastal zone. Applications of owners of coastal properties have to be satisfied first. However, due to the high number of applications, only one gill net has been allocated to the majority of applicants during the last years. Since the Fishing Act does not provide any practical recommendations for the case that the number of applications surpasses the maximum number of gill nets allowed by the Minister, a decision has to be made by the local fisheries administration based mainly on the historical use principle. Initially in 1995, the number of household fishing gill nets was 1,000 and decreased to 895 in 2002.

Recreational fishing is allowed for everybody, including foreigners. Whereas the use of an angling rod is free, a special license is needed for the use of spinning rods or under-ice fishing equipment. The fee is low and the number of licenses is not limited. Thus, this system can not be regarded as a measure to limit the total fishing effort.

Resource users and their share in catch

The number of fishermen has varied a lot over the last centuries. Even if the number of fishermen at the 19th century is not known, von Baer, who studied the fisheries on the lake at that time, concluded that the stocks of some species were already overexploited at that time (von Baer, 1860). Between World War I and World War II, the total number of users of the fish resources was almost ten times higher than nowadays, up to 9,000 on the Estonian side. However, most of them were part-time fishermen fishing mainly for their own households. The number of gears per fisherman was small and their efficiency was low.

The importance of commercial and household fishery in the present utilization of the fish stocks varies between the species. Whereas in the harvest of commercial fishermen several species play an important role, the bulk of the catches by household and recreational fishermen are made up of one species: roach and perch, respectively (see Table 1).

Commercial and household fishermen are obliged to report their catches on a monthly base. Whereas the data on commercial catches are reasonably good (all commercial fishermen submit fishing data), the reliability of the household fishery statistics is low. During the last few years only around 75% of household fishermen have submitted their catch data. There are no official data whatsoever that show the catches by recreational fishermen.

The annual dynamics of fishing in the commercial and the household segments is rather similar (see Figure 2). In recreational fishing, the most important season is winter.

Species	Volume of the catch (t)		Value of the catch (Euro*10^3)	
	Commercial	Household	Commercial	Household
Smelt	623.3	0	208.1	0
Pikeperch	449.5	0.5	848.3	0.9
Perch	275.2	6.0	406.3	8.9
Bream	230.2	1.1	121.4	0.6
Roach and silver bream	182.8	26.9	44.4	6.9
Pike	120.9	1.6	112.7	1.3
Burbot	32.0	0.3	18.8	0.2
Whitefish	8.8	< 0.1	11.4	0.1
Ide	2.2	0.9	1.3	0.5
Eel	0.3	0	1.6	0
others	12.0	0.8	1.5	< 0.1
Total	1,937.2	37.4	1,775.9	19.5

Table 1. The structure of the Lake Peipsi / Lake Pihkva fish resource use (excluding recreational fishery) by species in 2001

Commercial fishery

During the Soviet period, all commercial fishing was performed by collective enterprises. At present, commercial fishing is totally privatised. The total number of commercial fishermen on the Estonian and Russian side of the lake is approximately 400 and 700, respectively (Estonian side in 2002 by counties: Tartu – 138; Jõgeva – 102; Põlva – 62; and Ida-Viru – 114).

The aggregated revenue based on the registered catches in 2001 (Table 1) divided by the number of fishermen corresponds to the Estonian average yearly salary. However, the fishing costs and taxes reduce the income per fishermen to around a half of the Estonian average. Still, according to the interviews with fishermen, the majority of them do not want to leave fishery. This attitude can partly be explained by rather few alternative sources of income that exist in the region, but also by the real income of fishermen that substantially exceeds "official" salaries. Nevertheless, whereas fishing was mainly a full-time activity during the Soviet period, the number of part-time fishermen is now permanently increasing.

In 2001, the number of owners of commercial fishing rights on the Estonian side was 65. Altogether, 36 of them were fishing enterprises (employing more than one fisherman) and 29 private entrepreneurs (i.e. in principle one-man enterprises). However, some of the private entrepreneurs employ also additional labour force.

Household fishery

There was no essential difference between commercial and household fishing before World War II. During the Soviet period, however, only commercial and recreational fisheries were allowed. In 2001, the total number of Estonian household fishermen was 589 (by counties: Tartu – 210; Jõgeva – 82; Põlva – 148; Ida-Viru – 149). This number has been rather stable since 1995. Most of the people received the right to fish with only one gill net.

By volume, the most important species in the household fishery is roach. According to the official data in 2001, 13% of its catch was taken by household fishery. However, since the catch data from the household fishery is poor, most likely the real share is significantly bigger. In the value of the catch, perch is also important (see Table 1).

Recreational fishery

Unlike in most European countries, where recreational fishery is important, recreational fishermen in Estonia do not play a very important role in the use of fish resources of inland waters. Nevertheless, the recreational fishery has increased over the last few years to such a level that it might already impact the stock of perch in the lake.

There are no official data on the number of recreational fishermen and the total number of days spent on the lake. In the present study, the evaluation of the importance of recreational fishery is based on two different scenarios.

In the first scenario, the number of fishing licenses issued by the authorities in the four counties bordering the lake can serve as a basis for an estimate of the importance of fishing (Table 2). However, as fishing in other waters of the four counties is also possible (and the licenses allow for fishing in all water bodies), most likely not all licenses were purchased for fishing on Lake Peipsi.

Duration of validity	1998	1999	2000	2001
12 months	2,900	4,508	3,403	4,207
6 months	2,237	4,073	4,395	3,921
1 month	979	1,751	2,374	1,203
3 days	130	1,599	1,314	269
1 days	315	4,143	2,476	
whitefish, under-ice fishing, whole winter	256	182	127	
whitefish, under-ice fishing, 1 day	65		0	401

Table 2. Total number of recreational fishing licenses issued by the counties bordering Lake Peipsi

In the second scenario, an estimate of the recreational fishing effort was obtained by counting the number of fishermen on ice from six border guard stations (only on the Estonian territory) during one week-long period, 4 - 10 February 2002 (see Table 3). Since Lake Peipsi is a transboundary lake, its territory is permanently observed by the boarder guard. Fishermen were counted on late mornings, when their number is usually the highest. (Still, the total daily number of fishermen may be underestimated, as some fishermen may come to the ice later.)

	4 Feb	5 Feb	6 Feb	7 Feb	8 Feb	9 Feb	10 Feb	Total
Alajõe	60	110	130	90	110	320	340	1,160
Omedu	26	35	81	102	154	1,500	712	2,610
Ninasi (near Kolkja)	28	47	25	34	52	160	71	417
Varnja	17	29	36	98	102	450	170	902
Piirissaare		20		11		77	75	183
Mehikoorma	25	20	9	4	50	88	37	233
Total	156	261	281	339	468	2,595	1,405	5,505

Table 3. Number of fishermen on ice counted by the border guard on 4-10 February 2002 (Monday-Sunday)

In general, the number of recreational fishermen is much bigger in the northern areas of the lake system and during weekends (Table 3). The duration of the under-ice fishing season is usually at least 10 weeks per year. Thus, according to the very rough estimate based on the number of fishermen counted, the total number of man-days in recreational fishery in winter 2001-2002 surpassed 50,000. The most important species targeted by the group is perch. If the average daily catch of perch is 2 kg (according to the interviews it was 2-3 kg), then the total catch of perch by recreational fishermen was at least 100 tons in winter 2001-2002. However, it can not be excluded that the total catch surpassed 150 tons.

From the 242 interviewed under-ice anglers, 30% declared that sale of catch is their main reason for fishing. Additional 6% from the respondents told that they sell at least part of their catch. The interviews were anonymous, because a sale of recreational catch is illegal (if the person is not registered as a private entrepreneur and fulfils all usual administrative formalities). Still, it is possible that at least some people who stated that they never sell fish do it in reality, and gave a negative response just because they know that sale of catch is prohibited. First of all, this concerns the group of fishermen who fish very often. If one assumes that all fishermen who fish at least 30-60 days per winter sell at least part of their catch, then the share of "fish-sellers" may surpass even 50% of all under-ice-fishers on the lake.

The share of local inhabitants in recreational fishery is high. Altogether 36% of the interviewed fishermen live closer than 5 km to their fishing place. A second distinct group (some 10% of the total) was made up of "catch-sellers" who live far away and came to the region in order to stay for a longer time (5-30 days) and earn money. The rest of the people came for 1-3 days, usually for weekends. Around 30% of all respondents came from Latvia. Latvians came on average for 4 days and 55% of them said that at least part of their catch is going for sale. Around one third of all respondents had to pay for accommodation. However, average hotel accommodation is only 1.70 euros per night.

Evaluation of the present use structure and development scenarios

Recreational fishery

In most developed countries, inland commercial fisheries are decreasing, while the importance of recreational fishery as a user of the fish resource has been steadily growing over the last decades. In Poland, for example, the recreational catches make up 2/3 of the total volume and value of the inland fisheries catches (Bninska and Wolos, 2001). In Finland, this figure is more than 90% and in the case of pike, pikeperch and perch surpasses 96% (Nylander, 2000). In Lake Vänern (Sweden), a lake rather comparable by size to Lake Peipsi, the recreational catches of pikeperch and perch correspond to 3/4 of the total (Anonymous, 2001). In Lake Peipsi, however, the commercial fishery is still by far the most important player (responsible for more than 95% of the catch value), whereas recreational fishery is targeting almost only perch and is mainly carried out during winter in form of under-ice angling.

In developed countries, recreational fishermen fish almost exclusively for pleasure. According to the data from the Swedish National Board of Fisheries, around 10% of the total and 2% of perch and pikeperch recreational and household catches are going for sale in Sweden. From the catch harvested by angling and spinning rods only a small part is sold (Anonymous, 2001). In the study of inland recreational fisheries of Germany (Wedekind, Hilge and Steffens, 2001), a sell of catch is even not listed in the motives of fishing.

In developing countries, however, this type of fishery is important also as a source of food. For example, Campos and Munoz-Roure (1989) report that marine recreational fisheries activities are an important component of the day-to-day activities of a large part of the population of the Caribbean for whom the caught fish supplements the home supply of protein food. McLachlan, Dugan, Defeo, Ansell, Hubbard, Jaramillo and Penchaszadeh (1996) report that many beach clam species in South Africa support recreational, artisan and commercial fisheries, but recreational fishery is also mostly commercial. The authors recognize the role of recreational fishery as a resource user and conclude that recreational fisheries are notoriously difficult to manage, as the number of harvesters usually cannot be controlled and the exploitation must be limited by bag size, season or area restrictions.

There are two different ways to evaluate the present situation. Growth of recreational fisheries has is many countries been favoured by both central Governments and local authorities, because it is believed that in general the benefit to a coastal region is bigger, if the fish resource is used for recreational fishery. For example in Lake Vänern, the average yearly catch per fishermen in 2002 was 18 kg, while average expenses (fishing equipment, accommodation, transport etc.) amounted to 225 euros (65 million euros in total). At the same time, the total revenue was only around 1.5 million euros in commercial fisheries (Anonymous, 2001). Based on these figures, the growing share of recreational fishermen in the resource use of Lake Peipsi could be rated as a positive sign.

However, the Lake Peipsi case is different. According to the interviews, a remarkable part of the recreational fishermen are local citizens, which means that they are not providing extra income to the region in form of usual “tourist business”. In respect of the high share of “catch sellers” in the group of recreational fishermen, the fishery of the lake is fairly unique, at least at the European scale. From another point of view, the profit-oriented recreational fishery of Lake Peipsi could also be evaluated as wasteful, because the catch taken now by thousands of “artisan” fishermen could be harvested by a significantly smaller number of people using more efficient equipment. But as the employment possibilities in the region are poor, a decrease in importance of fishery can be expected only if growing employment possibilities in the region compete fishery out. In conclusion, the recreational fishery of Lake Peipsi is currently more “an employment of the last resort” than a leisure-time activity.

In general, the importance of recreational fisheries in everyday life of people in the more developed neighbouring countries is much higher than in Estonia. In Sweden, 14% of the population declares that fishing is the most important or one of its most important free-time activities (Anonymous, 2001). In Finland, half of the population fished at least once per year in 1998 (Nylander, 2000). In Estonia, the number of recreational fishing licenses issued corresponded to less than 3% of the total population in the last few years. However, the total number of recreational fishermen fishing in Lake Peipsi is rather high, even compared to the Nordic “standard”. If most of licenses issued in the counties, bordering the lake, during the last few years (8,000-10,000 yearly) were purchased in order to fish on that particular lake system, then it is rather comparable to the recreational fishing effort in Lake Vänern, 27,000 recreational fishermen in 2000 (Anonymous, 2000).

In the world’s fisheries, several attempts were made to limit recreational catches. Those range from daily bag limits to the permission of recreational fishery on weekends and public holidays, only (Tarr and Mackenzie, 2002). Today, the recreational fishery is unlimited in Lake Peipsi, but there is growing concern that some measures will be introduced by the fisheries administration soon to limit the catches.

At the same time, the use of fish resource by local inhabitants in means of household fishery using limited number of commercial fishing gears could be evaluated as a positive element. For one thing, fishing for own use is a traditional part of the life-style of the region. Secondly, the right to fish with a commercial gear gives additional value to the whole region, increasing for example the market value of coastal property.

Commercial fishery

Due to the periphery status of the Lake Peipsi region, the commercial fishery and fish processing are still very important contributors to the general economic activity. In many coastal villages, they are the main employers. However, the scenario of decreasing importance of the commercial segment can also be predicted for the Lake Peipsi fishery. Whereas the incomes of fishermen have remained comparatively stable, the salaries in other sectors of the national economy have grown year by year. If in 1996 the total value of Lake Peipsi official catches (1,539,000 euros) corresponded to 672 Estonian average yearly salaries (2,290 euros in 1996), this ratio has decreased significantly over the last five years. The value of 2001 catches (1,795,000 euros) corresponded only to 398 average yearly salaries (4,511 euros in 2001). Further, the fishing costs such as fuel and the prices of services needed by commercial fishermen have increased significantly.

Most likely this development continues. The first-sell prices of fish in Estonia are already quite close to west-European levels. Calculated on the basis of average Finnish prices for the year 2000 (Nylander, 2000), the value of Lake Peipsi registered catch in 2001 (2.4 million euros) is only around 1.3 times bigger than its value in Estonian prices (1.8 million euros). At the same time, the average income in Finland is still roughly 5 times higher than in Estonia. Thus, under the Finnish conditions the fish resource of Lake Peipsi could employ certainly not more than 100 commercial fishermen on a full-time basis if higher fishing costs were also taken into consideration.

However, the decreasing importance of fishing is evident, not only due to the dramatic fall in the total number of the Lake Peipsi commercial fishermen, but also due to the decreasing share of fishermen revenues in the income of the households of fishermen.

For example, the fishermen of the Swedish big lakes earn only 1/3 of their income from fisheries. Still their total number in Sweden is 220, and 87 in Lake Vänern fisheries (Anonymous, 2001). A fall in the number of commercial fishermen has also taken place in Finland. In 1980, the total number of inland commercial fishermen was around 2,800, but decreased to only 995 in 1998 (Nylander, 2000). Even if the total value of Lake Peipsi catch can be somewhat increased through a better management, the decline in the number of full-time commercial fishermen as well as in the general importance of the fishery in the region is unavoidable in the long run.

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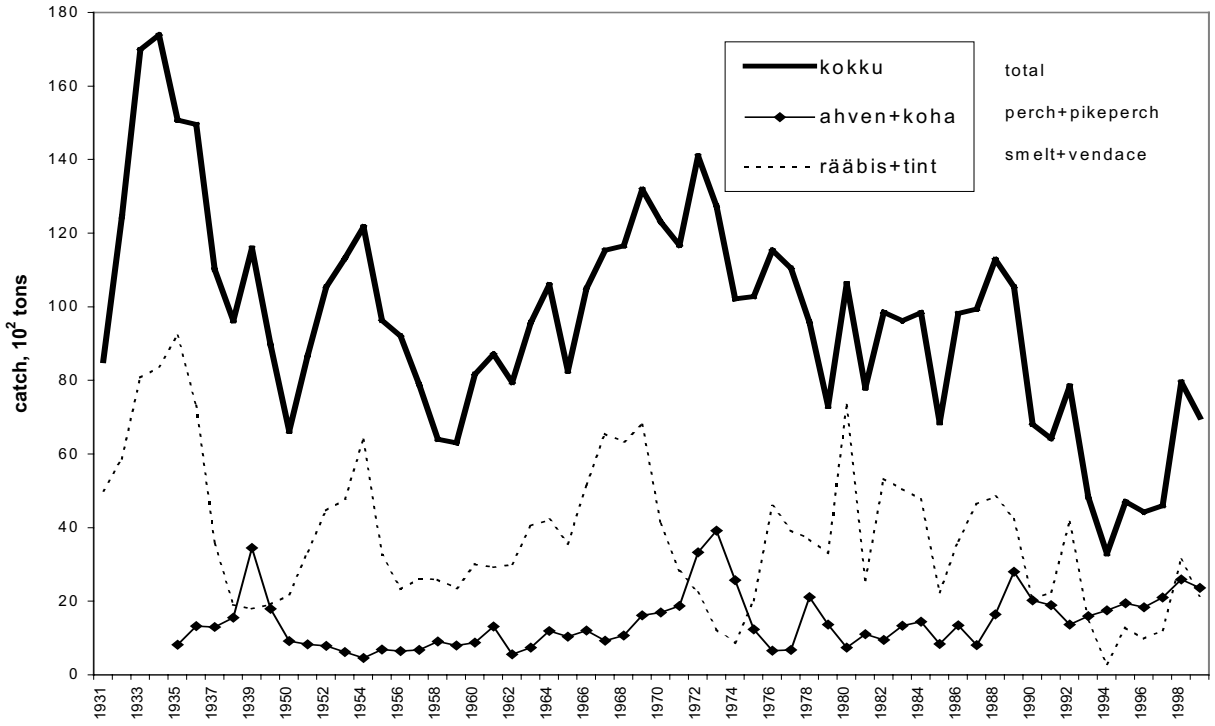

Figure 1. The catches of Lake Peipsi fish (both Estonian and Russian catch included) in 1931-1999

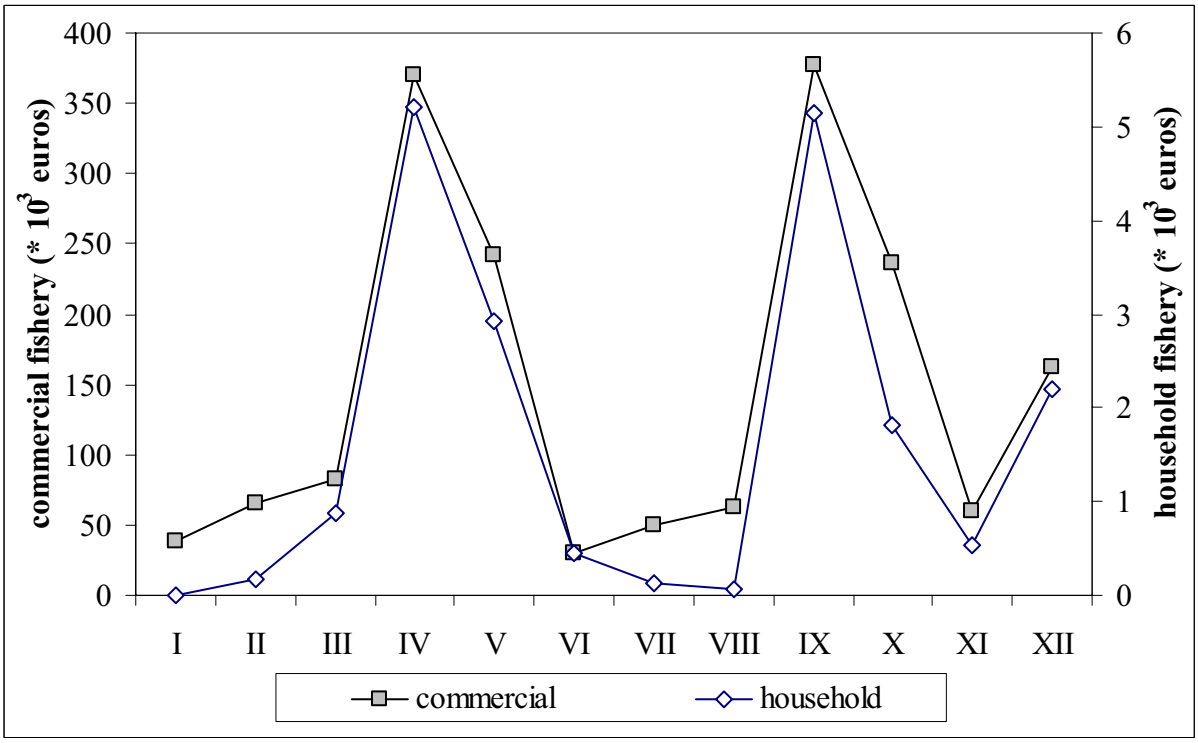

Figure 2. The annual dynamics of the catch value in commercial and household fishery (2001)

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