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the Built Environment

MANAGING WATER ACCORDING TO RIVER BASINS

Information management, institutional arrangements and strategic policy support
- with focus on the EU Water Framework Directive

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PREFACE AND ACKNOWLEDGEMENTS

It is often said that the solution of environmental problems need multi- or interdisciplinary research approaches. During my time as a PhD student I have sometimes felt that I - myself – may be regarded as an outcome of such an approach. And to be honest, I have had my doubts about the quality of the result... Being a biologist, who turned to information on transboundary water management, which later transformed into evaluation of implementation of EU water policy, I have sometimes felt that "I do not really know anything about anything." However, having more faith in myself, an alternative interpretation of the feeling could be that "I do actually know something about quite a lot of things." Although I cannot say that I am always 100% certain that the latter interpretation holds true, my hope with this thesis is that also a "specialised generalist" could add something of value to – broadly speaking – European water management.

The work on this thesis has been performed between the years 2001-2006, at the Department of Land and Water Resources Engineering at the Royal Institute of Technology in Stockholm, Sweden. Along the way, a number of people have supported my work. Thanks to:

Sindre Langaas, my main supervisor, for support, guidance and enthusiasm throughout the work on this thesis. In particular, I appreciate that you have continued to take time for me, even though you are no longer at KTH but working in the "real world." My co-supervisors Per-Erik Jansson and Jan-Erik Gustafsson for valuable comments and support. Fredrik Hannerz for good cooperation and harsh, but fair, criticism of all my manuscripts. Dorothy Furberg for being a great MSc student and co-author of a paper. Krister Sandberg for being my supervisor during my stay in Austria. Sigrid Hedin, Patrick Lindblom, Riikka Ikonen, Alexandre Dubois and Michael Viehhauser at Nordregio, and Kristina Veidemane at BEF Latvia for good collaboration on issues related to the Water Framework Directive and spatial planning. All informants that have taken their time to answer my questions, either through interviews or by filling out questionnaires. Jos Timmerman at the Institute for Inland Water Management and Waste Water Treatment (RIZA) in the Netherlands for very valuable comments on a draft version of this thesis. Colleagues and friends at KTH. Friends and family – sorry for being such a hermit the last couple of months. Fredrik and Disa♥.

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Susanna Nilsson

Stockholm, November 2006.

LIST OF PAPERS

This thesis is based on the following papers, which will be referred to in the text by their corresponding Roman numerals. The papers are reproduced in full in Appendix 1-5.

I. Nilsson, S. and Langaas, S., 2003. A comparative study of information management in three transboundary water regimes in Europe. In: J. G. Timmerman and Langaas S., (eds.), *Environmental Information in European Transboundary Water Management.* IWA Publishing, London, UK, pp. 224-239.

II. Nilsson, S. and Veidemane, K., 2006. Institutional arrangements for implementing the EU Water Framework Directive – examples from the Baltic Sea Region. *Manuscript.*

III. Nilsson, S., Langaas, S. and Hannerz, F., 2004. International river basin districts under the EU Water Framework Directive: Identification and planned cooperation. *European Water Management Online,* 2004/02.

IV. Nilsson, S. and Langaas, S., 2006. International river basin management under the EU Water Framework Directive: An assessment of cooperation and water quality in the Baltic Sea drainage basin. *Ambio,* 35(6): 304-311.

V. Furberg, D., Nilsson, S., and Langaas, S., 2006. An indicator-based analysis of the river basin districts established under the EU Water Framework Directive. Accepted for publication in *E-WAter.*

TABLE OF CONTENTS

PREFACE AND ACKNOWLEDGEMENTS ..... **III**
LIST OF PAPERS ..... **V**
ACRONYMS AND ABBREVIATIONS ..... **IX**
ABSTRACT **1**
INTRODUCTION **1**
OBJECTIVES **4**
SCIENTIFIC BASIS **5**
Models for river basin management 5
Conceptual frame for the thesis 7
Information for international river basin management 7
River basin management and the WFD 9
METHODS AND MATERIALS **11**
Selection of study objects 11
Data collection and analysis 15
Validity and reliability 20
INFORMATION MANAGEMENT IN TRANSBOUNDARY WATER REGIMES **22**
Differences in information management 22
Similarities in information management 23
IMPLEMENTING INSTITUTIONAL ARRANGEMENTS FOR RIVER BASIN MANAGEMENT ACCORDING TO THE WFD **24**
National considerations: issues related to spatial fit 24
National considerations: issues related to institutional interplay 28
International considerations: ambitions and plans for cooperation 28
SUPPORTING STRATEGIC POLICY MAKING IN RELATION TO WFD IMPLEMENTATION **29**
Assessment of cooperation and water quality in the BSR 29
RBD characterisation and assessment 30
CONCLUSIONS AND RECOMMENDATIONS **35**
Information management 35
Institutional arrangements 35
Strategic policy support 36
FUTURE RESEARCH **37**
REFERENCES **38**
OTHER REFERENCES **41**
APPENDIX A. REFERENCES TO DATA AND MATERIAL USED IN THE STUDIES **42**

ACRONYMS AND ABBREVIATIONS

BSR	Baltic Sea Region
CIS	Common Implementation Strategy
DPSIR	Driving forces-Pressure-Status-Impact-Response framework
EEA	European Environment Agency
EU WFD	European Union Water Framework Directive
EWA	European Water Association
GWP	Global Water Partnership
ICPE	International Commission for the Protection of the River Elbe
ICPOAP	International Commission for the Protection of the Odra River Against Pollution
ICWE	International Conference on Water and the Environment
IGKB	International Commission for the Protection of Lake Constance
IWRM	Integrated Water Resources Management
JRC	Joint Research Centre
MANTRA-East	Integrated Strategies for the Management of Transboundary Waters on the Eastern European Fringe – the Pilot Study of the Lake Peipsi basin
OECD	Organisation for Economic Cooperation and Development
RBD	River Basin District
RBMP	River Basin Management Plan
SIDA	Swedish International Development Agency
TRABANT	Transnational River Basin Districts on the Eastern Side of the Baltic Sea Network
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UN ECE	United Nations Economic Commission for Europe
US TVA	United States Tennessee Valley Authority
WISE	Water Information System for Europe

ABSTRACT

Today, there is a general notion that water resources are best managed according to their river basins. River basin management may be approached from a wide variety of angles. This thesis focuses on information management, institutional arrangements and strategic policy support, with special reference to the EU Water Framework Directive (WFD). The overall objective is to examine strategies, possibilities and hindrances for river basin management, with the ultimate goal of identifying key aspects to be considered - and prioritised - for "successful" European water management and WFD implementation. An assessment of the information management of three transboundary water regimes in Europe showed that a technical/scientific paradigm appears to dominate in river basin accords. This is visible, for example, in the data collection, which is dominated by *state* and environmental *impact* information, and the use of passive channels for communicating with stakeholders and other interest groups. The studies addressing institutional arrangements for river basin management according to the WFD showed that the implementation level of the directive is relatively low – both at national and international levels. For instance, competent authorities have not been established (strictly) according to the borders of the established River Basin District (RBDs). Further, in international RBDs, the ambitions and plans for cooperation vary considerably. Despite the general low implementation level, steps have still been taken in the "direction" of river basin management. At the national level, all examined countries have established RBDs according to river basins, and at the international level, joint river basin management plans will probably be coordinated for a majority of river basins shared by EU Member States. However, the same pattern could not be discerned for river basins extending outside the borders of the EU. In order to support strategic policy making on issues related to the implementation of the WFD, two assessments were made, one addressing international cooperation and water quality in the Baltic Sea Region, and one encompassing rankings of *all* the newly established RBDs based on a number of identical indicators. Although there is a need to refine these assessments, they may be regarded as simple – but yet robust – models for benchmarking.

Key words: River basin management; EU Water Framework Directive (WFD); River Basin Districts (RBDs); International cooperation; Indicators; Baltic Sea Region (BSR)

INTRODUCTION

Population growth, increased economic activity and improved living standards – in combination with social inequity, economic marginalisation and lack of poverty alleviation programmes - place a growing pressure on the world's limited fresh water resources (e.g. GWP 2000; UNEP 2006). For a sustainable use of fresh water resources, integrated management, often referred to as "integrated water management", "integrated water resources management" or "integrated river basin management", has for long been advocated as the solution. The US Tennessee Valley Authority (TVA) is often described as a pioneer in integrated water management. The TVA was established in 1933, and was involved in basin-wide integrated development, including controlling floods, generating and distributing electricity, improving navigation, stimulating industrialisation and employment, extending education and welfare, countering soil erosion, reducing malaria, and improving agricultural output (Downs et al. 1991; Barrow 1998; Gustafsson 1999). Later on, the concept(s) has been addressed at a more strategic level in several official documents and events, such as the UN report on Integrated River Basin Development (United Nations 1970), the Dublin principles agreed at the International Conference on Water and the Environment (ICWE 1992), and the Agenda 21 chapter 18 on freshwater resources adopted at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro 1992 (UNCED 1992). The four Dublin principles state, in

short, that fresh water is a finite resource, that management should be participatory, that women play a central role, and that water has an economic value in all its uses. In chapter 18 of Agenda 21, integrated water resources development and management is one of seven focus areas proposed for the freshwater sector. In the wake of the conferences and policy documents in 1992, the Global Water Partnership (GWP) was established through a joint initiative by the World Bank, the United Nations Development Programme (UNDP) and the Swedish International Development Agency (SIDA) to promote and support Integrated Water Resources Management (IWRM). In addition to this, the concept(s) has been critically reviewed, described and promoted by a large number of researchers (e.g. Lundqvist et al. 1985a; Downs et al. 1991; Barrow 1998; Al Radif 1999; Savenije and van der Zaag 2000). Thus today, despite some recent criticism[1], there is a general acceptance that water management should be "integrated"; there exists a bulk of literature on the topic, and more and more efforts are made to transform theory into practical implementation. However, as there are many definitions, concepts and approaches of integration, the exact implication or meaning of the word is still rather fuzzy.

According to Mitchell (1990), integrated water management may be perceived in at least three ways. First, it may be restricted to encompass various dimensions of water, such as surface water and groundwater, and water quantity and quality. The main idea in this thinking is that water is an ecological system consisting of a number of interdependent components, which need to be managed with regard to their interrelationships. Having this perspective, integration of issues connected to water supply, wastewater treatment and disposal, and water quality may be of concern. Second, integrated water management can mean that, while water is one system, it is at the same time a component which interacts with other systems. With this view, interactions between water, land and the environment in the context of river basins need to be addressed, recognizing that changes in any of the systems may have consequences for the others. Management issues of concern at this level may include, for instance, floodplain management, erosion control, reduction of diffuse pollution and preservation of wetlands and fish habitats. The third and broadest interpretation of integrated water management refers to the interrelationships between water and social and economic development. At this level, the extent to which water is both an opportunity for and a barrier against economic development is of concern. Another issue is to ensure that water is managed and used so that development may be sustained over the long term. Interest at this level may be related to the role of water in producing hydroelectricity, in facilitating transportation of goods and in serving as an input to industrial production.

In some respects, this thesis embraces all Mitchell's (1990) levels of integration. However, the second level of integration, i.e., that comprising integration of water, land and the environment, is somewhat in focus. Special attention is given to the river basin as such, commonly suggested as the most appropriate spatial unit for managing water resources. For referring to this, the term "river basin management" is mostly used throughout the thesis, although the terms "integrated water management" and "integrated water resources management" (IWRM) are used as well.

The European Union Water Framework Directive (EU WFD) (European Parliament and the Council of the European Union 2000), adopted in 2000, is regarded to take an integrated approach to water management

[1] It should be noted that, in the last couple of years, IWRM has been criticised by some studies (e.g. Biswas 2004; Pahl-Wostl et al. 2005) on the grounds that it is a vague concept, which, for instance, misses to consider different types of uncertainty in the management process and the system itself. According to Pahl-Wostl et al. (2005), there is a need for a transition of IWRM into more "adaptive water management", having the capacity of handling uncertainties and extreme events. Although this criticism may be valid, the concept of and means for "adaptive water management" has not been further elaborated in the thesis.

Table 1. Excerpts from Articles 3 and 13 of the WFD.

Article	Exact wording
Article 3	
(1)	Member States shall identify the individual river basins lying within their national territory and, for the purposes of this Directive, shall assign them to individual river basin districts.
(2)	Member States shall ensure the appropriate administrative arrangements, including the identification of the appropriate competent authority, for the application of the rules of this Directive within each river basin district lying within their territory.
(3)	Member States shall ensure that a river basin covering the territory of more than one Member State is assigned to an international river basin district. (…) Each Member State shall ensure the appropriate administrative arrangements, including the identification of the appropriate competent authority, for the application of the rules of this Directive within the portion of any international river basin district lying within its territory.
(4)	Member States shall ensure that the requirements of this Directive for the achievement of the environmental objectives established under Article 4, and in particular all programmes of measures are coordinated for the whole of the river basin district For international river basin districts the Member States concerned shall together ensure this coordination and may, for this purpose, use existing structures stemming from international agreements.
(5)	Where a river basin district extends beyond the territory of the Community, the Member State or Member States concerned shall endeavour to establish appropriate coordination with the relevant non-Member States, with the aim of achieving the objectives of this Directive throughout the river basin district.
(6)	Member States may identify an existing national or international body as competent authority for the purposes of this Directive.
Article 13	
(1)	Member States shall ensure that a river basin management plan is produced for each river basin district lying entirely within their territory.
(2)	In the case of an international river basin district falling entirely within the Community, Member States shall ensure coordination with the aim of producing a single international river basin management plan. Where such an international river basin management plan is not produced, Member States shall produce river basin management plans covering at least those parts of the international river basin district falling within their territory to achieve the objectives of this Directive.
(3)	In the case of an international river basin district extending beyond the boundaries of the Community, Member States shall endeavour to produce a single river basin management plan, and, where this is not possible, the plan shall at least cover the portion of the international river basin district lying within the territory of the Member State concerned.

(Chave 2001; Fairley et al. 2002; Griffiths 2002; Holzwarth 2002). The directive's overall objective is to achieve "good water status" for all waters in Europe by 2015. For reaching this ambitious objective, the WFD introduces, among other things, management according to river basins. Article 3 of the WFD deals with the administrative arrangements of river basin management. According to this article, Member States should, by December 2003, have identified individual river basins and assigned them to River Basin Districts (RBDs). An RBD may be made up of either one single river basin or a combina-

tion of several small river basins, together with associated groundwater and coastal waters. For each district, Member States should ensure that appropriate administrative arrangements are made, including the appointment of a competent authority. The directive is not so specific on the designation of competent authorities. However, the report on Best Practices in River Basin Management Planning (Anonymous 2002), developed under the WFD Common Implementation Strategy (CIS), provides a little more detail. The report states that Member States may identify one or several competent authorities per RBD, and if several authorities are appointed, coordination arrangements should be established. If a river basin extends across international boundaries, the WFD specifically requires it to be assigned to an international RBD, with appropriate administrative arrangements set up. Based on the RBD as spatial management unit, a characterisation in terms of pressures, impacts and economics of water uses should be carried out (Article 5), and a programme of measures for achieving environmental quality standards drawn up (Article 11). This will finally lead to the production and publishing of a River Basin Management Plan (RBMP) for each district, of which the first version is to be ready by 2009 (Article 13). For an international RBD, the WFD specifies that countries should ensure cooperation for producing one single RBMP for an international RBD falling within the territories of the EU; however, somewhat confusingly, the directive at the same time indicates that if not produced, plans must be set up for the part of the basin falling within each country's own territory. If the basin extends beyond the territories of the EU, the directive encourages Member States to establish cooperation with non-Member States and, thus, manage the water resource on a basin level (Article 13). Excerpts, with the exact wording, from Articles 3 and 13 of the WFD are presented in Table 1.

Thus, for managing RBDs, setting up RBMPs and ultimately meeting the objectives of the WFD, *integrated* management is needed. The WFD CIS Guidance Document No. 11 on Planning Processes (Anonymous 2003) also points out, in line with Mitchell's (1990) first and second level of integration, a need for integration: 1) between organizations directly involved with water management, such as water storage and supply, and wastewater treatment; 2) between water management and other sectors, such as spatial planning, agriculture and forestry; and 3) for international river basins, between countries sharing the basins.

OBJECTIVES

The overall objective of this thesis is to examine strategies, possibilities and hindrances for river basin management in line with the intentions of IWRM in general, and the EU WFD in particular, in Member States and Candidate Countries of the EU[2]. By doing this, the ultimate goal is to identify key aspects, which need to be considered - and prioritised - for "successful" European water management and WFD implementation. More specifically, the objectives are to:

- Provide knowledge on and examine differences and similarities of information management in three transboundary water regimes in Europe (paper I);
- Examine institutional arrangements for implementing river basin management according to the WFD, with special reference to spatial planning, in selected countries in the Baltic Sea Region (BSR) (paper II);
- Determine the number and geographical extent of international RBDs established under the WFD (papers III and IV), and examine plans and ambitions for cooperation in these regions (paper III);
- Elucidate possible connections between the degree of cooperation and water quality (primarily with respect to

[2] Including river basins extending beyond the territories of the EU.

eutrophication) in international river basins in the BSR[3] (paper IV);

- Characterise and rank the newly established RBDs using a limited set of identical indicators (paper V).

SCIENTIFIC BASIS

All in all, the papers included in this thesis deal with various aspects of river basin management, drawing upon previous research on, e.g., the role and use of information in decision and policy making, and the implementation of EU environmental policy. In this chapter, a few selected models for river basin management are presented and a broad conceptual frame for the thesis is outlined. Further, brief descriptions and motivations of models, frameworks and theories underlying the specific papers included in the thesis are given as well.

Models for river basin management

There exists quite a lot of literature on models and approaches for river basin management (e.g. Lundqvist et al. 1985b; Barrow 1998; Milich and Varady 1999; Mostert 1999; Jaspers 2003). Some of the literature concerning river basin management is based on theoretical assumptions on how "optimal" river basin management should be designed, while other literature give account of successful approaches used in the "real world". An example of the latter is, for instance, the description and promotion of the French system for river basin management (Gustafsson 1989; Castensson and Gustafsson 1993; Gustafsson 1999).

A more conceptual model describing important principles for river basin management has been outlined by Mostert et al. (1999) (Fig. 1). They distinguish four different levels of river basin management: *institutional structure*, *operational management*, *planning* and *analytical support*. The institutional structure sets the frame for the overall management, under which the three other principles - operational management, planning and analytical support – are present. "Institutions", "institutional arrangements" or "institutional structures" may be defined in different ways (e.g. Ostrom 1990; Eggertsson 1996; Young 2002). Mostert et al. (1999) use ideas from Ostrom (1990), and distinguish between three levels of institutional structures: operational rules, collective choice rules and constitutional rules. Constitutional rules deal with the organisational structure for river basin management and the allocation of tasks and competencies. According to Mostert et al. (1999) there are broadly speaking three different organisational models for river basin management. In the *hydrological model,* the structure is based strictly on river basin boundaries, and the management is more or less the sole responsibility of a single river basin authority. In the *administrative model*, water management is not based on hydrological boundaries, but is in the hands of, e.g., counties and municipalities. Finally, the *coordinated model* is somewhat of a mixture of the hydrological and administrative models.

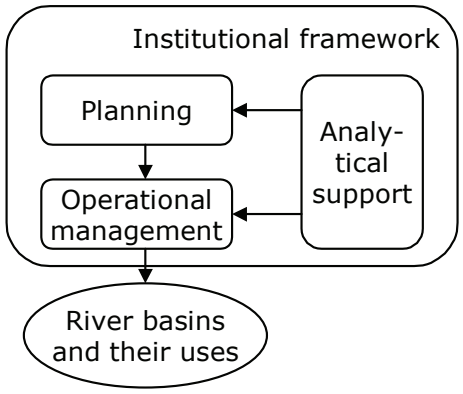

Figure 1. Principles for river basin management (after Mostert et al. 1999).

[3] In paper IV, the term "Baltic Sea Region" is actually not used. Instead the area is referred to as the "Baltic Sea Drainage Basin"; thus, a strict hydrological definition has been used to denote the borders of the region. However, for simplicity and for avoiding confusion, the term "Baltic Sea Region" (used in paper II) has been used exclusively throughout the thesis summary. There is no strict definition of the BSR, but in essence it may be regarded as referring to the Baltic countries (Estonia, Latvia, and Lithuania), the Nordic countries (Denmark, Finland, Norway, and Sweden), northern Germany, Poland, and Russia's Northwestern region.

In this model, there is no river basin authority, but instead river basin commissions have been established, having a coordinating task and functioning as platforms for cooperation between different types of actors in a river basin. Moving on to the other levels of river basin management outlined by Mostert et al. (1999), operational management is the only element that affects river basins directly. It may, for instance, comprise river regulation, construction and operation of water supply infrastructure, monitoring, issuing of permits, collecting charges, providing information to the public, and staff training. The operational management should, in turn, be supported by the planning level. Ideally, the planning process should assess the current situation, the desired situation, the gap between the two, and measures to bridge the gap. There are different kinds of plans, some are more strategic, while others are more operational. In general, the number of plans should be limited to avoid problems related to coordination and reduced transparency. Lastly, there is a need for analytical support. This refers to the development of tools, which may help in assessing the present situation and in developing and evaluating solutions. In general, analytical support can be divided into support for operational management, and support for strategic policy making and planning.

A particular challenge for river basin management is connected to the fact that many river basins are international or transboundary[4] and there is, thus, a need for states to cooperate and manage these basins jointly. In total, there are around 261 international river basins, covering almost half of the world's total land surface, of which 71 are found in Europe (Wolf et al. 1999). Savenije and van der Zaag (2000) have proposed to use the metaphor of a classical temple for the sharing and management of international water resources (Fig. 2). In their model, IWRM is the foundation and the sharing of water resources the roof of the temple. There are three pillars, one political, one technical and one institutional, representing the necessary elements for sharing and management of international water resources. The political pillar is needed to provide an enabling environment, creating opportunities for international cooperation and planning. The legal-institutional pillar comprises institutions and legal instruments developed at the national and international level. Within the frames of this pillar, the establishment of river basin organisations is of key concern. The authors argue that there is a need to establish two types of organisations, one *regulatory* (at the policy level) and one *developmental* (at the implementation level). For instance, a joint water commission may be established as the main policy body, and a river basin authority may be formed with responsibilities to execute, operate, and manage specific issues. Finally, the technical or operational pillar must be present, allowing the broader concepts to be translated into operational measures and actions. This pillar is regarded as central for the success of the management of international river basins; if any of the outer pillars is weak or damaged, the technical pillar may bear most of the load.

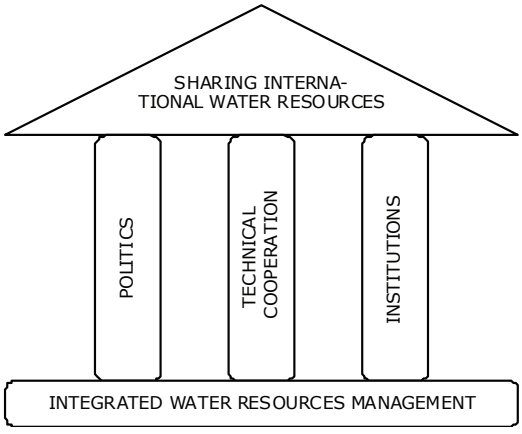

Figure 2. The classical temple as a model for the sharing of international water resources (from Savenije and van der Zaag 2000).

[4] In this thesis, the word "international" has been used interchangeably with the word "transboundary". Thus, "international river basin" means the same thing as "transboundary river basin".

Conceptual frame for the thesis

To sketch a broad conceptual frame for the thesis, Mostert et al.'s (1999) four principles for river basin management and Savenije and van der Zaag's (2000) classical temple have been used as a basis.

By listing Mostert et al.'s (1999) four principles for river basin management for structuring the content of the thesis, it can be seen that all principles are covered, although to a varying degree (Table 2). In Figure 3, an attempt has been made to visualise the conceptual frame, describing the main elements of the thesis. The two largest boxes represent the very outer boundaries for the thesis, IWRM and river basin management. As can be seen in the figure, river basin management is for all papers except one (paper I), considered within the context of the EU WFD. All papers deal in some respect with institutional arrangements for river basin management. In fact, in some of the papers (II-IV) a main objective was to specifically examine and evaluate institutional arrangements for river basin management as such. The three other principles for river basin management presented by Mostert et al. (1999) are also present in the figure. Below the principles, the specific focus has been indicated, and models, frameworks or theories applied to conduct the studies are listed in parentheses.

Table 2. Principles for river basin management (adopted from Mostert et al. 1999) included in the thesis. An attempt has been made to reflect to which degree each principle is covered.* "X" *means that the principle is covered to some extent, while* "XXX" *means that the principle is quite extensively covered.

Aspects of river basin management	Covered in thesis	Paper
Institutional arrangements	**XXX**	Papers (I), II-IV, (V)
Operational management	**X**	Paper I
Planning	**XX**	Papers I-IV
Analytical support	**XX**	Papers IV-V

Finally, the lines connecting the different principles with the papers show the thematic content of each paper and the papers' relation to each other.

Short accounts, explaining the rationale behind the specific papers included in the thesis, along with brief descriptions of applied models, frameworks and theories are given below.

Information for international river basin management

River basin management, or for that matter, all planning and policy-making, require adequate and understandable information (Dinar 1998; Naff 1999). While this statement is valid for all types of water resources, it might be of special importance for river basins shared by several countries. As stressed by Savenije and van der Zaag (2000), a common way for states to cooperate around international water resources is to establish river basin institutions or transboundary water regimes[5], where the formal cooperating body often is some sort of joint water commission. In many cases, one of the most important functions of such commissions are information related activities, such as monitoring of water quality and quantity, standardisation of data collection and sharing of relevant data (Savenije and van der Zaag 2000; Enderlein 2001). Closely related to these functions are the development of information needs and strategies for information collection, storage, analysis and use (information management). Few studies have, however, critically examined such needs and strategies.

[5] There are various definitions of transboundary or international regimes. In a broad sense an international regime may be defined as "sets of implicit or explicit principles, norms, rules and decision-making procedures around which actors' expectations converge in a given area of international relations (Krasner 1983). In this thesis, however, the conception of an international regime is narrower, and may be described as "a specific form of international institution, in which states actively and consciously bend their behaviour toward the attainment of a collective purpose" (Conca 1996).

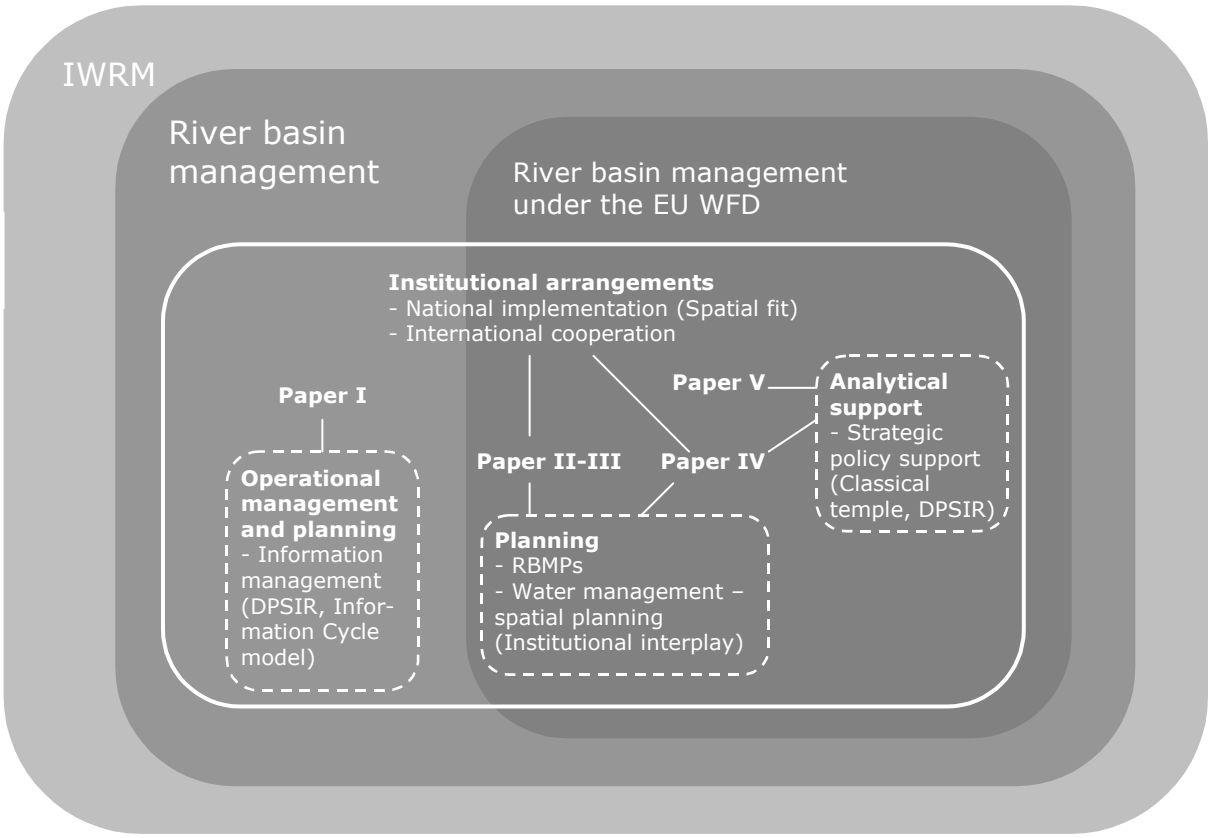

Figure 3. Conceptual frame of the thesis, depicting the included papers' thematic focus as well as their relations to each other.

Models for understanding the collection and use of information in international river basin management

For understanding the collection and use of information in international river basin management, a wide array of frameworks or models may be used. Somewhat simplified, one can say that there is one type of model which focuses upon the management of and connections between different types of information. An example of such a model is the DPSIR (*D*riving forces, *P*ressure, *S*tatus, *I*mpact, *R*esponse) framework. The DPSIR framework builds originally upon a state of environment reporting model developed by the Organisation for Economic Cooperation and Development (OECD), which in the last decade has become increasingly popular to use for the management and assessment of environmental information (UNEP/CEU 1997; EEA 1999; Harremoës and Turner 2001; Lorenz et al. 2001). The framework assumes that there are interrelated links between social, economic and environmental systems, such as (EEA 1999):

- Driving forces (D) of environmental change (e.g. economic activity, transport);
- Pressures (P) on the environment (e.g. discharges of waste water);
- State (S) of the environment (e.g. water quality in rivers and lakes);
- Impacts (I) on population, economy, ecosystems (e.g. water unsuitable for drinking, biodiversity loss); and
- Responses (R) of the society (e.g. river basin protection).

Another type of model focuses primarily upon the transformation of data into information, which may be used by policy and decision makers. These models are, hence, concerned with producing and communicating the "right" information to information users. An example of such a model is the Information Cycle model, suggested by

Timmerman et al. (2000) and the United Nations Economic Commission for Europe (UN ECE 1996) for facilitating policy and decision making on water issues. The model describes the essential steps in the continuously ongoing process of information production (and use), starting with definition of information needs and strategies, followed by data collection and analysis, which finally leads to information utilisation for water policy and decision making. One main objective of the Information Cycle model is to facilitate the dialogue between information producers, such as experts and scientists, and users, such as policy and decision makers. Based on experience, Timmerman et al. (2000) claim that defining the information needs is often the most difficult, but yet, most important step in the cycle. Ideally, information users should identify information needs in cooperation with information producers.

River basin management and the WFD

To quite a large degree, this thesis deals with examining the implementation level of the WFD with regard to the establishment and management of RBDs. By doing this, the thesis places itself, at least partly, in a tradition of implementation research (e.g. Werner 2004). Earlier research on implementation of EU environmental policy has shown that the implementation of EU environmental policy in Member States varies quite substantially (Hanf and Jansen 1998; Jordan 2005). According to Knill & Lenschow (2000), a widening "implementation gap" has been observed in the implementation of EU environmental policy. In response to this, the European Community has tried to improve the implementation record by changing its policy making, from technocratic, interventionist and top-down into more self-regulating, participatory and voluntary. The idea is that a more flexible system may facilitate the decision making process, as well as the subsequent implementation. Additionally, by encouraging the involvement of the public, the European Commission hopes that a stronger societal support and awareness will increase the pressure on domestic administrations to properly implement EU policy. So far, the chosen strategy appears not to have been as successful as hoped for (Knill and Lenschow 2000). A possible explanation for this, suggested by Knill and Lenschow (2000), is that the traditional policy style in many Member States is quite distinct from this new bottom-up approach advocated by the European Commission; thus complicating implementation.

According to Moss (2004), the policy style of the WFD can be characterised as a combination of the "old" command-and-control and the "new" more interactive, negotiative approach. By using this combined policy approach, along with the development of the CIS in close cooperation with Member States, the European Commission and others instrumental behind the WFD hope for successful implementation of the directive in Member States (Moss 2004).

Assessments so far indicate, however, a rather low transposition and implementation level of the WFD in Member States (Moss 2004; EEB and WWF 2005; EEB and WWF 2006). EEB and WWF (2005) note in their survey, comprising around 16 EU Member States, that the "quality of WFD transposition and implementation is low, giving a poor basis for achieving [the WFD's] environmental objectives."

Spatial fit and institutional interplay

There may be various reasons for the relatively low implementation level of the WFD in EU Member States. One possible explanation, put forward by Moss (2004), may be connected to problems of "spatial fit" and "institutional interplay". In short, spatial fit refers to the overlap between the territorial borders of political and management institutions, and the biogeophysical resource to be managed (e.g, Cano 1985; Folke et al. 1998; Young 2002). The idea is that creating better fit between responsible institutions and the resource to be managed reduces spatial externalities, which otherwise may benefit free riders and harm others beyond the spatial extent of the management institution. Institutional interplay, on the other hand, refers to the idea that the success or effectiveness

of institutions is dependent not only on their own performance, but also to a large degree on their interactions with other institutions (for a more thorough description of fit and interplay see, e.g., Young 2002). The intentions and ambitions of river basin management according to the WFD are well correlated with thoughts and ideas of spatial fit and institutional interplay. The WFD requires that water resources should be managed according to river basins (Article 3, WFD). Further, although coordination and cooperation between water management and other sectors are not explicitly required by the directive, it is still regarded as crucial for, e.g., achieving the environmental objectives (e.g. Anonymous 2003). However, few European countries (with some exceptions such as France, and England and Wales) have experiences of organising river basin management in such a manner. Instead, water management has traditionally often been arranged according to political or administrative units, and often with a strong sectoral division between different types of water management institutions, as well as between water management and other sectoral management systems, such as spatial planning and agriculture. Hence, implementing an *integrated* river basin management model based on hydrological boundaries may entail substantial changes to countries' administrative systems for water management, and it may thus be questioned if countries will actually be able and willing to adapt and fully implement the "requirements" of the WFD.

International cooperation

Another aspect related to the implementation of institutional arrangements for the establishment and management of RBDs, which may deserve special attention, is the way the "requirements" of the WFD are applied and implemented in international river basins. This is of importance as there are around 70 international river basins in Europe (Wolf et al. 1999); thus, the number of international RBDs identified under the WFD is probably significant. However, as the WFD is even more unspecific and ambiguous in its formulations concerning management of international RBDs compared to national RBDs (cf. Table 1), there is a risk of different interpretations by Member States in the implementation of the international aspects of the directive (Grimeaud 2001). This has also been stressed by Macrory and Turner (2002) who point out that although the international dimensions are more explicit in the WFD than in other EU directives, potentially requiring Member States to move towards close cooperation in managing shared river basins, the strict legal requirements to actually achieve joint management are weak.

Assessments of river basins and RBDs

A potential problem, although different in character from that described above but nevertheless related to the implementation of the WFD, is the lack of comprehensive assessments of river basins in general, and RBDs in particular. The European Environment Agency (EEA) has pioneered work on indicators in Europe and continually uses indicators to assess the state of the environment (e.g. EEA 2005a;b). However, for freshwater issues, indicators are normally presented per country, sometimes for selected major European river basins but so far not for RBDs (EEA 2000; Nixon et al. 2003). Initiatives to overcome these problems have however been initiated. The most ambitious one is the Water Information System for Europe (WISE), currently under development by the European Commission in collaboration with the EEA, Eurostat and the Joint Research Centre (JRC) (EC and EEA 2003; EC 2006). In the short term, WISE is intended to serve as a publicly accessible portal for information on the WFD. In the long term, i.e., by 2010, the aim is to develop an information system that contains most of the relevant information for water resources and management on a European scale. However, since there are relatively few harmonised and easily comparable data and information currently available for the RBDs - although it is hoped that these will emerge under the WISE initiative - there may be a need for making initial indicator-based assessments, supporting strategic policy and decision making.

METHODS AND MATERIALS

For conducting the studies in this thesis, a variety of research methods have been applied, combining both quantitative and qualitative data.

Social science, and qualitative research in particular, have often been criticised for being subjective and unscientific (Kvale 1997). This criticism has its roots in the views on science. One school of thought, commonly referred to as "positivism", traditionally rejects qualitative research as science. According to a positivistic view, there is a value-free objective reality, in which objects and phenomena occur even without human knowledge about them. Scientific facts should be objective, quantified and the research arriving at the facts should be freed from human influence (Patel and Davidsson 1994). Thus, acknowledgment of this view makes it practically impossible to consider, for example, qualitative interviews as science. However, positivism has been criticized for not being able to keep to its own requirements on objectivity. Closer examination of the ways in which "objective facts" are reached often reveals a range of theoretical assumptions, of intersubjective character, built-in to the observation procedures. An opposite view to positivism is often referred to as "hermeneutics" or "relativism". According to this school of thought, there is no such thing as objective reality; instead, all knowledge is subjective. Knowledge is gained through interpretation and understanding of the human reality. These interpretations are highly influenced by the environments, such as the society and the culture, in which they are perceived. Thus, the researcher is a part of the reality being studied (Kvale 1997).

In this thesis, environmental or water related issues are seen mainly as subjective problems, to a large degree social constructs, shaped by peoples' perceptions about what a problem is. Thus, the studies are inevitably coloured by the investigator's views and perceptions. Consequently, there are often no absolutely "true" answers to the questions posed. This does not mean, however, that aspects related to the scientific quality of the studies have been ignored. On the contrary, the methods for data collection and analysis were carefully chosen and the validity and reliability of the studies were seriously dealt with.

One common feature of many of the studies included in the thesis (in particular papers I and II) is that they apply case study methodology or elements thereof (see e.g. Yin 1994; Stake 1995). According to Yin (1994), a case study is an empirical inquiry that:

- Investigates a contemporary phenomenon within its real-life context, especially when
- The boundaries between phenomenon and context are not clearly evident

Another typical characteristic of a case study is that it normally relies on multiple sources of evidence, quantitative as well as qualitative (Yin 1994).

In general, data for the studies included in the thesis were collected through semi-structured interviews; documents, such as treaties, legislation, planning documents and reports; questionnaires; and publicly available spatial and statistical databases. The collected material was analysed and interpreted by the use of *ad hoc* meaning generation (Kvale 1997) through, e.g., coding and qualitative interpretation; pattern-matching (Yin 1994); Geographical Information Systems (GIS); and summary statistics. An overview of the methods used for data collection and analysis is presented in Table 3. Full references to the data and material used in the studies can be found in Appendix A.

Selection of study objects

The geographical boundary of this thesis is Europe, or more specifically, Member States and Candidate Countries of the EU, including river basins extending beyond the borders of the EU (Fig. 4). Norway is included as well, as the country aims to implement the WFD. Thus, the whole territory of the EU (including Candidate Countries and Norway) was covered with the following exceptions: 1) Turkey was not included because the dataset on river basins used in the analysis did not cover Turkey, and 2) Italy, Greece and Croatia were not included as neither RBDs

Table 3. Overview of methods used for data collection and analysis.

Paper	Aim	Study objects	Method for data collection / collected data	Main method for data analysis
I	Provide knowledge on and examine differences and similarities of information management in transboundary water regimes	Water commissions for Lake Neusiedl, Lake Constance and Elbe River	Semi-structured interviews, documents (treaties, reports and Internet material)	Ad hoc meaning generation (coding into categories and qualitative interpretation)
II	Examine institutional arrangements for implementing river basin management according to the WFD, with special reference to spatial planning	Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden	Presentations held at TRABANT workshop 13-14 February 2006, documents (legislation, planning documents, reports, Internet material, scientific articles), semi-structured interviews	Pattern-matching (empirical evidence is compared to theories of spatial fit and institutional interplay, Article 3 of WFD and the French water management model). Ad hoc meaning generation (mainly qualitative interpretation).
III and IV	Determine the number and geographical extent of international RBDs established under the WFD	RBDs in EU Member States, Candidate Countries and Norway	Questionnaire, documents (official reports and web pages presenting established RBDs), spatial datasets of river basins and international boundaries	Use of GIS to combine data to delineate RBD borders and create a RBD dataset. Summary statistics.
III	Examine plans and ambitions for cooperation in international RBDs	RBDs in EU Member States, Candidate Countries and Norway	Questionnaire, documents (treaties, official reports)	Use of GIS to derive summary statistics.
IV	Elucidate possible connections between cooperation and water quality (primarily with respect to eutrophication) in international river basins	International river basins larger than 6000 km² in the BSR	Documents (treaties, reports, Internet material); questionnaire; spatial datasets of RBDs, river basins, population and land cover; water quality monitoring data	Derivation and quantitative assessment of indicators. Linking cooperation and water quality indicators by simple plotting.
V	Characterise and rank the newly established RBDs using a limited set of identical indicators	RBDs in EU Member States, Candidate Countries and Norway	Spatial datasets of RBDs, river basins, population and land cover; water quantity and quality monitoring data	Derivation and quantitative assessment of characteristics and indicators. Relative rankings of the RBDs.

nor competent authorities had been established as of 30 June 2005. This wide geographical perspective is either fully or partly in focus in papers III-V.

The other studies in the thesis are, at least geographically, more restricted. However, when these study objects are compared to each other it becomes evident that the geographic and thematic focuses vary, although there is a slight geographical focus on the BSR. The explanation for this variation is that the thesis has been formed under the scope of different projects, with slightly different geographic and thematic focuses. In general, the author of the thesis had limited opportunity to influence the initial selection of study objects; however, within the "given frames", there has been considerable scope for shaping each study. When the specific study objects are described below, the main

Figure 4. Geographical coverage of the thesis.

selection criteria will be explained. It should however be stressed that sometimes these criteria have been set by the author and sometimes by the projects under which the studies were carried out.

For examining the information management of formal transboundary water regimes (paper I), three case study regions were selected; namely the basins for Lake Neusiedl (shared between Austria (85%) and Hungary (15%)), Lake Constance (shared between Switzerland incl. Liechtenstein (50%), Germany (28%), Austria (21%) and Italy (0,4%)) and Elbe River (shared between Germany (65%), Czech Republic (34%), Austria (0,6%) and Poland (0,2%)). The study focused on the

agreements set up by countries to cooperate in water management issues, and – in particular - the information related activities of the water commissions, established to fulfil the agreements. The selection[6] of case regions was made in year 2000, under the preparation of the application for the research project "Integrated Strategies for the Management of Transboundary Waters on the Eastern European Fringe – the Pilot Study of the Lake Peipsi basin" (MANTRA-East). One initial aim in the selection of case regions was to choose lakes before rivers, as the main study object of the MANTRA-East project was Lake Peipsi, shared between Estonia and Russia. However, this idea was partly abandoned when it was realised that there were not enough lakes in Europe that: 1) had significant environmental problems, and 2) were at the same time transboundary. Consequently, also rivers were included in the selection. Another selection criterion was that the transboundary water resource should be shared by at least one EU Member State and one Candidate Country and/or country outside the EU.

Paper II examined institutional arrangements for implementing river basin management according to the WFD by comparing the situation in Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden. A deepened analysis, for more specifically examining the institutional interplay between water management and other sectors, not traditionally involved in water management, was also included in the paper. This analysis was restricted to deal with connections between river basin management, as introduced by the WFD, on the one hand, and land use/spatial planning[7] on the other hand. Although coordination and cooperation between these two sectors are not specifically "required" by the WFD, it is implicitly needed for, e.g., reducing nutrient leakage from agriculture and rehabilitating physically exploited rivers and floodplains. This "interplay" is, thus, considered as being of vital importance for achieving the objectives of the WFD (Anonymous 2003; Moss 2004; Pahl-Wostl et al. 2005). For this purpose, Latvia and Lithuania were taken as examples. In the same way as for paper I, the selection of study objects (in this case, countries) included in the study was steered by an outside project, the Interreg IIIB project "Transnational River Basin Districts on the Eastern Side of the Baltic Sea Network" (TRABANT), which has the BSR as geographic focus. As the study deals with evaluating the implementation of Article 3 of the WFD, the study was restricted to only encompass EU Member States in the BSR with the exception of Denmark.

Paper III (and IV) had the aim to determine the number and geographical extent of international RBDs established under the WFD and to examine plans and ambitions for cooperation, and paper V characterised and ranked the newly established RBDs using a limited set of identical indicators. For performing these studies *all* RBDs in EU Member States and Candidate Countries, and Norway, were targeted and included in the analyses.

In paper IV, possible connections between the degree of international cooperation and water quality - primarily with respect to eutrophication - were elucidated by assessing a number of indicators, related both to cooperation and water quality, in the main 14 international river basins in the BSR. The BSR was chosen because it is an interesting het-

[6] In total, eight case study regions were selected for examining the role and use of information in transboundary river basin management. The results from all eight case studies have been reported in Langaas (2002).

[7] In Europe, there exist no real ambiguous understanding of "spatial planning". In fact, in some European countries the term does not exist, but instead this type of planning is referred to as "land use planning", "regional planning" or "physical planning". Instead of using a range of concepts, which may be confusing, the term "spatial planning" has mainly been used throughout this thesis. According to the European Commission "spatial planning" refers to "the methods used largely by the public sector to influence the future distribution of activities in space. It is undertaken with the aims of creating a more rational territorial organisation of land uses and the linkages between them, to balance demands for development with the need to protect the environment, and to achieve social and economic objectives" (EC 1997).

erogeneous region, characterized by different political, socio-economic, and environmental situations of both countries and river basins. All international river basins larger than 6000 km^2 within the region were included in the study.

Data collection and analysis

Qualitative studies

The material for paper I was collected using several data collection techniques. A large part of the material was collected through semi-structured interviews, performed in October 2001 – January 2002. In total, 19 persons involved in the work of the water commissions for Lake Neusiedl, Lake Constance and Elbe River were interviewed. These persons can be roughly divided into two groups. The first group of interviewees was commission delegates, i.e., decision makers in the commissions. The other group of interviewees were consulting experts, i.e., information providers, often members of commissions' working groups. Representatives from all countries involved in the cooperations were interviewed. Before the interviews, the interviewees received a document briefly describing the outline of the study and the main questions to be discussed during the interview. The interviews, which could be classified as focused interviews allowing open-ended questions (Yin 1994), were either performed as face-to-face interviews with one or two persons at a time or as questionnaires sent to persons concerned, followed by phone interviews. Each interview, lasting between 30 to 90 minutes, was recorded and transcribed. Because of the semi-structured nature of the interviews, the questions discussed on each occasion were not identical. However, some major questions were brought up at each interview. Besides the material from the interviews, other sources of information, such as treaty texts, reports, meeting minutes and Internet material were also collected. For guiding the data collection and analysis, the Information Cycle model (see Scientific basis) was used for understanding *how* information is managed in transboundary water regimes, while the DPSIR framework (see Scientific basis) was used to address questions related to *what* type of data and information is needed and *what* type of data and information is collected. In practice, the collected data was analysed *ad hoc* (Kvale 1997), i.e., different analysing techniques were used, and the material was related to the following categories:

- Information needs and strategies;
- Data collection and analysis;
- Information use.

The data was coded according to specific classes when applicable, while in other cases; the transcribed interview material was condensed into shorter sentences (qualitative interpretation). For each case, a case study report was written (Nilsson 2002a; Nilsson 2002b; Nilsson 2002c). With the case study reports as a basis, the material was analysed further. The results of the case study reports were compared, and analytical generalisations of the information management in transboundary water regimes were made, on the basis of the observed similarities of the regimes.

For examining institutional arrangements for implementing river basin management according to the WFD (paper II), material presented at a workshop[8] with the theme "Current spatial planning and river basin management planning according to the EU Water Framework Directive: Conflict or synergy? State-of-the-art around the Baltic Sea", held within the Interreg IIIB project TRABANT on 13-14 February 2006 was used. When needed, the material from the workshop was complemented with other sources of information, such as official documents collected from the web pages of Ministries of Environments and national authorities. For a more thorough investigation of the institutional interplay between water management institutions responsible for river basin management according to the intentions of the WFD, and spatial planning, information was collected through a review of, e.g., legislation, planning documents and reports, as well as through semi-structured interviews with experts in water management and spatial plan-

[8] Attended by the author.

ning at the national level. In total, six interviews[9] were performed in May – June 2006, either face-to-face or as sent-out questionnaires. Each interview was recorded and transcribed. The collection of information for this part of the study followed specific guidelines, developed within the Interreg IIIB project TRABANT, and for each country a case study report was written (Nilsson 2006a; Veidemane and Nilsson 2006). During the data analysis, the empirical material was compared to Moss' (2004) proposed theories regarding spatial fit and institutional interplay (see Scientific basis). Furthermore, the French system for river basin management was used as a reference point for comparing and discussing various institutional arrangements established under Article 3 of the WFD. A "pattern-matching logic" (Yin 1994) was thus applied for analysing the data.

RBD dataset

For conducting the analyses in papers III-V there was a need for a digital dataset of the RBDs established under the WFD. At the time when these studies were performed, a digital copy of the map of RBDs published by the European Commission in December 2005 was not available. Instead, an own geographical dataset of RBDs was set up specifically for the analyses. This dataset is based on official maps of RBDs from countries implementing the WFD; that is, EU Member States, Candidate Countries and Norway. In the first round (paper III), information on RBDs was collected through a questionnaire sent out in February 2003 to representatives of national authorities or ministries in charge of the WFD implementation. Twelve countries replied to the questionnaire (AT, BE: Flanders, FI, HU, LT, LV, PL, PT, RO, SE, SI, and SK[10]), while eight instead provided other information material, such as consultation papers or official proposals of RBDs (CZ, ES, IE, NL, NO, UK: Northern Ireland, UK: England and Wales, and UK: Scotland[11]). Five countries did not reply at all; however, information was instead collected through other contacts, e.g., other researchers, or official web pages (DE, DK, EE, FR, IT[12]). In six cases neither a reply nor any other information was obtained (BE: Brussels and Wallonia, BG, CY, GR, LU, MT[13]).

Since determining the number and geographical extent of international RBDs was a major aim of papers III-IV, the delineation of international districts was given considerable attention in the creation of the RBD dataset. As mentioned in the introduction, the WFD requires that international river basins are assigned to international RBDs. However, the WFD does not define an international district, but instead this is up to each Member State to decide. Rather than using Member States' own definitions of international RBDs, which may vary due to different interpretations of the WFD text, an own definition was drawn up. An "international RBD" was defined as "an RBD where at least one river basin in the district covers the territory of more than one country". In practice, all districts with at least one river basin where more than 500 km^2 or 3% of the basin area covered the territory of more than one country were considered as international districts.

The RBD dataset, in the form of a GIS data layer, was created by combining a dataset in the scale 1:1 million on catchments draining into the sea, provided by the EU scientific and technical research laboratory the JRC (JRC 2003), with a dataset on international boundaries (ESRI 2005). By using the collected analogue map material on official RBDs from each country as reference mate-

[9] It should be pointed out that the author only performed the three interviews with Lithuanian officials. The interviews with the three Latvian officials were performed by Kristina Veidemane.

[10] AT – Austria, BE – Belgium, CH – Switzerland, FI – Finland, HU – Hungary, LT – Lithuania, LV – Latvia, PL – Poland, PT – Portugal, RO – Romania, SE – Sweden, SI – Slovenia and SK – Slovak Republic.

[11] CZ – Czech Republic, ES – Spain, IE – Ireland, NL – The Netherlands, NO – Norway and UK – United Kingdom.

[12] DE – Germany, DK – Denmark, EE – Estonia, FR – France and IT – Italy.

[13] BE – Belgium, BG – Bulgaria, CY – Cyprus, GR – Greece, LU – Luxemburg and MT – Malta.

rial, river basins belonging to one district were selected and unified into one polygon. Although the WFD requires that groundwater and coastal waters also should be identified and assigned to RBDs, this information was not incorporated in the dataset due to lack of data. For international RBDs shared between Member States and/or Candidate Countries information from the countries concerned was combined for delineating the borders of the district. When an RBD contained one or more river basins extending outside the territories of the EU, the borders of the river basin(s) were used as borders for the RBD. Thus, in the creation of the RBD dataset, river basin borders - rather than country boundaries - were used as borders for the RBDs. By using this logic, some RBD borders may deviate from officially designated borders.

As the first data collection effort took place in February – June 2003, before the final establishment of RBDs, much of the provided information was preliminary. Therefore, it was decided to update the input data for the RBD dataset with new information as of June 2005 (paper IV). This updated information consisted of official maps of RBDs collected from web pages or provided by informants well acquainted with the country's implementation of the WFD.

Studies based on the RBD dataset

When ready, the RBD dataset could be used for analyses. In papers III and IV, the dataset was used to determine the number and geographical extent of international RBDs.

In paper III, the dataset was also used to derive summary statistics for examining plans and ambitions for cooperation on international RBDs. This information was collected through the questionnaire sent out in February 2003 and the information from the replies was attached to the RBD dataset as attribute information. Countries were asked to provide information about the presence of international water commissions and plans or ambitions for the RBMPs, which are to be produced under the WFD. In asking for this information, it was assumed that an international RBD (or, rather, river basin) with an established international water commission and/or plans for coordinating a joint RBMP for the whole basin/district is more positively inclined towards cooperation for implementing the WFD than an RBD without a commission and/or plans for coordinating a joint RBMP. Thus, the information was considered as an indicator on the plans and ambitions for cooperation on international RBDs. When no answers to the questionnaires were obtained, information about the presence of water commissions was collected through other channels, such as the International Freshwater Treaties Database (Oregon State University 2002) and web pages of ministries and national authorities.

In paper IV, the RBD dataset was used to identify international RBDs and river basins larger than 6000 km^2 in the BSR. The 14 identified river basins were then used for exploring international river basin management under the WFD more thoroughly. In view of the dynamics and the continuous developments in connection with the implementation of the WFD, 1 July 2005 was used a benchmark for the study. For performing the study, a framework of analysis was developed (Fig. 5). This framework tries to connect degree of cooperation with water quality - in this study mainly restricted to eutrophication - in international river basins in the BSR. The adopted approach can be regarded as a simpler successor to Wolf et al.'s (2003) empirical work on identifying international river basins at risk; the use of water quality indexes by, e.g., Canadian authorities (CCME 2001), as a means of effective communication of water quality information to policy makers and the public; and the development of a Water Institution Health Index (Dinar and Saleth 2005). The analysis was performed in a two-step process; focusing firstly, on indicators of relevance for international cooperation, and, secondly, on indicators influencing or describing water quality. The selection of indicators of cooperation was based on Savenije and van der Zaag's (2000) classical temple (Fig. 2), literature on water conflict and cooperation, the text of the WFD and guidance documents on the implementation of the directive. The selection of water quality indi-

cators was restricted so as to primarily relate to eutrophication. All the selected indicators are listed and described in Table 4. After selecting the indicators of cooperation, each indicator was assessed for each river basin according to a dichotomous scoring system, i.e., if a river basin fulfilled all conditions of the indicator at hand, the basin received the score 1 and if the river basin did not fulfil the conditions of the indicator at hand, the basin received the score 0. Lastly, the scores for each basin were summarised to receive an overall score for each basin, thus reflecting its degree of cooperation. For the selected indicators influencing or describing water quality, statistics for each indicator and basin were extracted using a GIS. The actual, real values for each indicator were then normalised using "the percentage of range approach" (Yoe 2002), i.e. a normalised value or score for each river basin was obtained by first calculating the range for an indicator and then dividing each indicator value less the minimum by its range. To facilitate the further analysis, all scores were multiplied by 100. With regard to the indicator at hand, the score 0 represents the basin with "best" water quality and the score 100 represents the basin with "worst" water quality among those included. Based on the normalised scores for the selected indicators, two water-quality ranking scales were constructed; one for *pressure* indicators and one for *state* indicators. These ranking scales were derived by taking the mean score for the pressure and state indicators, respectively. Thus, the ranking scores calculated for each basin reflect – relative to the other basins in the study – the pressure on, or the state of, water quality within the basin.

After completing the first two steps of the analysis, the last step was to link the indicators of cooperation with the indicators influencing or describing water quality. This was done by plotting the scores of cooperation against the water quality ranking scores.

In paper V, the RBD dataset was used to characterise and rank the RBDs. In total, four characteristics and four indicators were used for this (Table 5). More specifically, two *pressure* and two *state* indicators, related to water quality (primarily restricted to eutrophication) and water quantity were included in the analysis. Spatial and statistical data was collected from public domain spatial data web pages, information centres and statistical bureaus. GIS was used to harmonise, re-project and display all digital geographic data, and extract statistics and summaries per RBD. Two basic relative rankings were carried out for assessing the RBDs: one in terms of *pressure* placed on the water resources and one based on the current *state* of the water

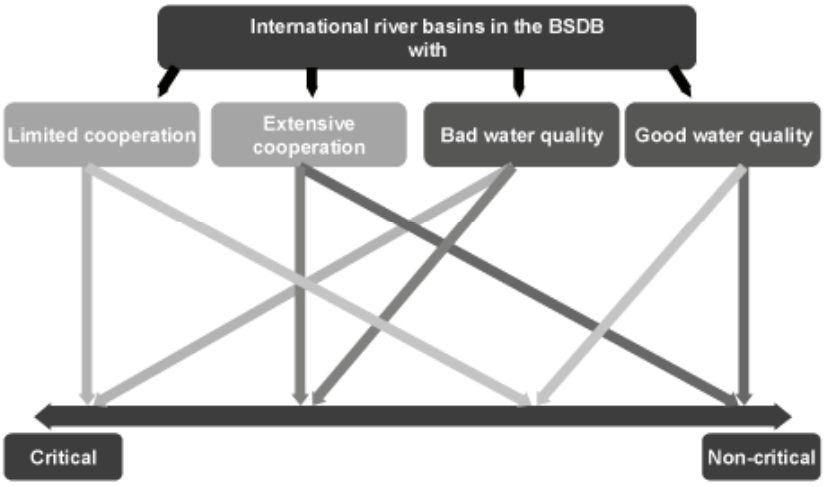

Figure 5. Framework of analysis used in paper IV for exploring international river basin management in the BSR. The framework tries to connect the "degree of cooperation" (limited to extensive cooperation) with "water quality" (bad to good water quality).

Table 4. Description of indicators used in paper IV.

Description of cooperation indicator	**Assessment**
Water treaty indicator (all river basins have treaties)	
Commission	Yes/no (0,33/0)
All countries signatories	Yes/no (0,33/0)
Water quality/WFD as specific task	Yes/no (0,33/0)
Shared by EU Member States	Yes/no (1/0)
Belonging to an RBD officially appointed as an international district	Yes/no (1/0)
Ambitions for producing a joint RBMP according to Article 13 WFD	Yes/no (1/0)
Joint characterization according to Article 5 WFD by the publication of joint report	Yes/no (1/0)
Regional/basin cooperation on water management issues	Yes/no (1/0)
Description of water quality indicator	**Units**
Pressure indicator	
Population density in the basin (from 2003)	People/km^2
Cultivated (arable) land in the basin (from 2000)	Per cent
State indicator	
Median of annual mean concentrations (for the years 2000-2004) of total nitrogen from all water quality monitoring stations within the basin	Mg/l
Median of annual mean concentrations (for the years 2000-2004) of total phosphorus from all water quality monitoring stations within the basin	Mg/l

resources within the RBDs. The procedures for obtaining the rankings are illustrated in Table 6. For each indicator, the average of all the RBD scores[14] was calculated and each individual RBD score was then divided by the average. This provided a number that revealed the deviation of the individual RBD score from the category average, and it is this number that gives the RBD its rank. This series of operations was performed to obtain a number of indexes, namely a population density index, a water availability index and a cultivated land index (index referring to the fact that the ranking is based on the scores' relationship to the average). Since a higher score means worse ranking in each of the categories, scores for water availability were converted from m^3 per person per year to persons per billion m^3 per year. With a few extra calculations, a nutrient concentration index was also produced. Given that there are four nutrient categories (Ammonium, Nitrogen, Phosphorus and Orthophosphate) and that a relative score could be calculated in each category for almost all RBDs, it was possible to take the average of these per district to obtain a relative overall "nutrient concentration" score for each RBD. The same method was used to combine the water availability and nutrient concentration indexes and thereby obtain an aggregated status index. Thus, the scores from the water availability and nutrient concentration indexes for a given RBD were averaged to provide its score in the aggregated status index. The same applied when the population density index and cultivated land index were combined in order to obtain an aggregated pressure index. Dividing an RBD's score from the aggregated pressure index by its score in the aggregated status index gives an idea of how much greater or smaller the pressures within the RBD are compared to the status of its water resources. Although admittedly highly speculative, this also gives an indication of how well an RBD is managing the pressures that are being placed on its water resources. The calculation was named Pressure Management index and

[14] Please note that "score" here is referring to real values.

Table 5. RBD characteristics and indicators used in paper V.

Characteristic / indicator	Type of indicator	Units
Area	-	km^2
Population	-	People
Population density	Pressure	People/km^2
Average annual discharge	-	m^3
Water availability	State	m^3/person · year
Nutrient (nitrogen and phosphorus) concentrations	State	Mg/l
Land cover	-	Per cent
Cultivated (arable) land	Pressure	Per cent

Table 6. Definitions of the procedures for obtaining the indicator and aggregated indexes used in paper V.

$$\text{Population Density Index for RBD}_n = \frac{\text{Population Density (pers/km}^2\text{) for RBD}_n}{\text{AVG (Population Density for all RBDs)}}$$

$$\text{Cultivated Land Index for RBD}_n = \frac{\text{Cultivated Land (\%) for RBD}_n}{\text{AVG (Cultivated Land for all RBDs)}}$$

$$\text{Water Availability Index for RBD}_n = \frac{\text{Water Availability (pers/m}^3\text{ yr) for RBD}_n}{\text{AVG (Water Availability for all RBDs)}}$$

$$\text{Nutrient concentration Index for RBD}_n = \frac{\left(\frac{\text{Nit. (mg/l) for RBD}_n}{\text{AVG (Nit. for all RBDs)}} + \frac{\text{Phos. (mg/l) for RBD}_n}{\text{AVG (Phos. for all RBDs)}} + \frac{\text{Orthophos. (mg/l) for RBD}_n}{\text{AVG (Orthophos. for all RBDs)}} + \frac{\text{Ammonium (mg/l) for RBD}_n}{\text{AVG (Ammon. for all RBDs)}}\right)}{4^*}$$

*This number depends on the available data for each RBD. For instance, for several districts in Ireland, no total nitrogen or phosphorus data was available, so the average of only their orthophosphate and ammonium indexes is taken.

$$\text{Aggregated Status Index for RBD}_n = (\text{Water Availability Index for RBD}_n + \text{Water Quality Index for RBD}_n) \div 2$$

$$\text{Aggregated Pressure Index for RBD}_n = (\text{Population Density Index for RBD}_n + \text{Cultivated Land Index for RBD}_n) \div 2$$

$$\text{Pressure Management Index for RBD}_n = \text{Aggregated Pressure Index for RBD}_n \div \text{Aggregated Status Index for RBD}_n$$

may be considered an attempt to suggest an approach to benchmark management effectiveness.

Validity and reliability

Validity

Validity is related to the truth and the correctness of a statement. According to a positivistic view on validity, this is related to quantifiable measurements. However, in a wider perspective validity relates to the issue of whether a method examines what it is supposed to examine (Kvale 1997). Yin (1994) describes three types of validity in relation to case study research. "Construct validity" is connected to establishing correct operational measures for the concepts being studied, i.e., an investigator must be able to demonstrate that the selected measures of an event really manage to correctly describe that

specific event. This type of validity may be increased by the use of multiple sources of evidence, by establishing a chain of evidence and by having key informants review case study reports. "Internal validity" is considered in explanatory or causal studies, where an investigator wants to prove that certain conditions lead to some other conditions. Internal validity may be addressed by doing pattern-matching, explanation-building and time-series analysis. Lastly, "external validity" deals with generalisations of the findings of a study. For external validity of case studies, it is relevant to talk about *analytical* generalisations (in contrast to *statistical* generalisation), which means that an investigator strives to generalise a particular set of results to some broader theory. This type of validity may be increased if findings may be replicated in multiple cases.

Considering the more qualitative studies, specifically applying case study methodology (papers I and II), construct validity was increased through the use of multiple sources of information, combining interviews with the collection of, e.g., treaties, legislation, reports and meeting minutes. Collecting information from multiple sources aimed at corroborating the same fact or phenomenon, through so called triangulation of data (Yin 1994; Stake 1995). One possible flaw with these studies was that much of the written material was only available in national languages, which in most cases were not understood by the investigator. Although some of the material was translated, the language barrier was still somewhat of a limitation to the studies. Another tactic, reducing the risk of incorrect reporting and thus increasing construct validity, was to have the interviewees review the case study reports. This was done for the reports for Lake Neusiedl, Lake Constance, and Elbe River (paper I), and the reports for Latvia and Lithuania (paper II). For paper I, there is no real point in discussing internal validity as this study can be regarded as being primarily descriptive and explorative. In paper II, however, theories regarding spatial fit and institutional interplay in combination with the French system for river basin management were used for comparing and interpreting the empirical material collected. Thus, a "pattern-matching logic" (Yin 1994) was applied, trying to compare the situations in different countries with anticipated problems of spatial fit and institutional interplay; thereby strengthening the internal validity. Regarding external validity or the ability to generalise the results of papers I and II, this is a quite tricky issue. On one hand, there has been a clear aim to increase the external validity by, e.g., including multiple cases (three transboundary water regimes for paper I and seven countries for paper II), and using the same frameworks and methods for data collection and analysis. On the other hand, each case is unique, regardless of whatever measures have been taken to make them as comparable as possible, and the generalisations made should thus be handled with care. In paper II, it would have been possible, at least theoretically, to examine the spatial fit between RBDs established under the WFD and the administrative structures set up for managing these spatial units in *all* EU Member States; thereby being able to say something general about the implementation level of the WFD in the *whole* EU. However, in practice, resources for doing this were not available.

For the more quantitative studies (papers III-IV), the same "formalised" procedures as the ones used in papers I and II for increasing the validity of the studies have not been applied. Nevertheless, a number of measures were taken to ensure the validity of the performed studies. For instance, collected data and information were compared with other data sources to ensure that the data used were similar to other types of data reporting on the same phenomenon. Further, in paper IV, two water quality ranking schemes were produced to give two alternative descriptions of water quality in river basins, and in paper V, data limitations and uncertainty analysis are specifically dealt with in the discussion part of the paper.

A general problem in examining and evaluating the implementation of the WFD (especially for papers II-IV) is that it is an ongoing process, which is constantly changing and evolving. Thus, what is "true" today may be incorrect tomorrow. This "durability prob-

lem" of the findings is, clearly, a weakness of the studies. However, it is still argued that there is a value in performing these kinds of studies; the results may highlight and reveal weak or problematic issues in the implementation, which then may have a good chance to feed into and support and improve the further implementation process.

Reliability

The aim of reliability is to assure that, if repeated by another person, the study would generate the same results as the first time (Patel and Davidsson 1994). Hence, the goal is to minimise the errors and biases in a study.

For increasing the reliability, especially of papers I and II, standardised procedures for data collection and analysis were used. For instance, a question scheme was used to guide the interviews in paper I, and the more deepened studies on institutional interplay in Latvia and Lithuania in paper II followed specific guidelines. The reliability of the data analysis could possibly have been enhanced by, for instance, letting two persons code the data in parallel and then compare the results. Due to lack of resources this was, however, not done. Additionally, a general aim of all studies has been to keep descriptions of the methods applied and the logic behind results and conclusions as clear and transparent as possible. In some cases, detailed descriptions of the studies can be found in background reports (Nilsson 2002a; Nilsson 2002b; Nilsson 2002c; Nilsson 2006a; Nilsson 2006b; Veidemane and Nilsson 2006), while in other cases enough details have hopefully been given in the papers as such.

INFORMATION MANAGEMENT IN TRANSBOUNDARY WATER REGIMES

Paper I examined differences and similarities in the information management of the formal transboundary water regimes set up for Lake Neusiedl, Lake Constance and Elbe River.

In all the case regions, legal agreements about cooperation in transboundary water issues have been concluded and joint commissions have been established. The Hungarian-Austrian water commission was established in 1956, the International Commission for the Protection of Lake Constance (IGKB) in 1960 and the International Commission for the Protection of the River Elbe (ICPE) has been in existence since 1990. There are both similarities and differences between the regimes. The contracting parties are national or regional governments and there is in general little representation of stakeholders or other similar groups in the commissions. The commission delegates are not politically elected, but are civil servants, mainly highly qualified engineers. The resolutions of the delegates are made by the principle of unanimity and are later to be approved by the member governments. The mandates of the commissions differ somewhat. In the Constance and Elbe regimes, the focus is on protection of the water resource and improvement of the water quality, while in the Neusiedl regime the main focus is cooperation on technical and economic water management issues.

Differences in information management

The study revealed differences in information management between the transboundary water regimes. The results indicate that of the transboundary commissions examined, the Elbe Commission has the most comprehensive information management, followed by the Constance Commission and, lastly, the Commission for Neusiedl. This statement is based on the following observations. In the identification of information needs, Elbe was the only commission that recognised a need for information to stakeholders and the public (Table 7). Further, when relating the actual data collection performed within the frames of the commissions to the DPSIR framework, it was shown that the Elbe Commission had the most regular and systematic collection of (D,) P, S, I and R information (Table 8). The Elbe Commission can also be considered to be the one, which most actively communicates information to the public by, e.g., regular meetings with the NGO community (Table 9). The least extensive information management was found in the commission for Neusiedl, where only S and I in-

formation is collected regularly and few channels are used to actively communicate information to the public. The information management in the Constance commission appears to be neither as extensive as in the Elbe commission, nor as moderate as in the commission for Neusiedl.

There may be several reasons for the differences in information management between the commissions. For instance, it may be that the differences are related to factors such as the diversity and perceived significance of environmental issues in the basin, indirectly influenced by, e.g., the number of inhabitants, number and type of industries, and proportion of agricultural land in the basin. Considering the relatively high number of users of water in the Elbe river basin, causing pressures on the ecosystem, it may be argued that Elbe faces a higher diversity of environmental problems than Neusiedl, where the number of uses and users is smaller. If the range of environmental problems is large it may be assumed that this poses higher demands on management of different types of information. Further, the many water users in the Elbe basin may put a higher pressure on governments, to act for providing reliable information for decisions, compared to basins where the number of users is few. Another explanation for the differences may lie in the history and mandates of the regimes. The Elbe regime is the youngest, concluded in 1990 in response to the severe pollution of the river. The mandates for the commission are the most extensive among the three cases, comprising tasks, such as identification of major pollution sources, coordination of monitoring programmes, and suggestion of remediation measures. The Constance regime was set up in 1960 as a response to the increasing phosphorus levels in the lake, and subsequently the main task was to halt the eutrophication of the lake. The regime for Neusiedl, set up after World War II, is actually not specifically committed to protect the water of the lake. The main focus is rather to make decisions on the practical solution of technical and economic water management issues, all along the Austrian-Hungarian border.

Similarities in information management

Although there are differences in information management between the studied regimes, similarities can also be distinguished. One common feature of the commissions is that they all are expert/technical commissions. This has been referred to as the "technical/scientific paradigm in river basin accords" (Milich and Varady 1999). In this paradigm, experts, often hydrologists and engineers, are given broad authority to prioritise issues to be addressed, choose tools and targets, and determine the extent of public involvement. According to Milich and Varady (1999), the weakness of this paradigm is that decisions on critical social/environmental policy are allocated to engineers, who are often incapable of assessing the potential adverse effects of their decisions. The technical/scientific paradigm is similar to ideas put forward by other authors. For instance, Mostert (1999) has described the "natural science and engineering perspectives on river basin management" as two out of six possible perspectives on international river basin management.

The technical domination of the studied commissions is reflected in several ways. It is shown in the information needs, which are mainly defined with the commissions' own needs in mind, and in the regular data collection, which is dominated by state and impact information, collected through monitoring of physical, chemical and biological parameters. Further, the paradigm is also visible in the means for communicating information to the public, which is mainly done through passive channels.

Table 7. Information needs (and uses).

Information needs (and uses)	Category according to DPSIR framework	Basin
Observe and agree upon the current status of the lake/river	S, I	Constance, Elbe, Neusiedl
Examine to what extent problems are still present and if measures have had the intended effect	S, I, R	Constance, Elbe, Neusiedl
Identify causes of pollution	D, P	Constance, Elbe, Neusiedl (?)
Recommend preventive measures	R	Constance, Elbe
Discuss planned utilisation of the water resource	D, P, S, I, R	Constance
Communicate information to the public about status and improvements	D, P, S, I, R	Elbe

Table 8. Types of data collected according to the DPSIR framework. "+" indicates that data is regularly collected while "-" indicates that data is not regularly collected.

Basin	D	P	S	I	R
Neusiedl	-	-	+	+	-
Constance	-	+	+	+	-
Elbe	?	+	+	+	+

Table 9. Means for communicating information to interest groups and the public. "+" indicates use of the information channel while "-" indicates no use of the information channel.

Basin	Press conference	Technical reports	Internet	Newsletter	Workshops/meetings
Neusiedl	+	-	-	-	-
Constance	+	+	+	+	-
Elbe	+	+	+	-	+

IMPLEMENTING INSTITUTIONAL ARRANGEMENTS FOR RIVER BASIN MANAGEMENT ACCORDING TO THE WFD

Papers II and III, and to some extent paper IV, examined institutional arrangements for implementing river basin management according to the intentions of the WFD. Paper II focused on institutional arrangements, and integration between water management and spatial planning in selected countries in the BSR, while papers III and IV addressed issues related to the implementation of the WFD in international river basins.

National considerations: issues related to spatial fit

An overview of the institutional arrangements set up to meet the intentions of Article 3 of the WFD in the examined countries in the BSR is presented in Table 10. As can be seen, RBDs based on river basin boundaries have been established in all countries. Further, some countries have chosen to break up the RBDs into smaller units, sub-basins.

In none of the countries are the geographical borders of the established RBDs exactly the same as the geographical borders of the competent authorities appointed as responsible for the management of the districts. Only in Estonia and Sweden can the competent authorities be regarded as – at least partly – coincident with RBD/sub-basin borders. In these countries, one county environmental department (Estonia) and one county administrative board (Sweden) have been specifically designated as competent authority for a RBD/sub-basin, taking an overall responsibility for the whole district/basin. These competent authorities are however still part of "old" administrative water management structures, and a main task for them is actually to cooperate and coordinate with

other environmental departments/administrative boards within the district/basin. In Finland, the 13 regional environmental centres have all been appointed as competent authorities; and thus do not match the borders of the eight established RBDs. If there is more than one regional environmental centre in an RBD, the work should be coordinated among the centres. Germany has quite a complex organisation for managing their ten RBDs and 28 sub-basins. On the federal level, the Ministry for the Environment, Nature Conservation and Nuclear Safety has been appointed as competent authority; but, because of Germany's federal structure the Ministry is only acting as a "framework" organisation. The Environment Ministries of the States (Länder) have been appointed as competent authorities on the state level. In each sub-basin, one state is mainly responsible for coordinating the work among all the states sharing the sub-basin. For coordinating the work on the RBD level, a coordination group for all states sharing an RBD has been set up. Small countries, i.e., Estonia[15], Latvia and Lithuania appear to have chosen the strategy of only having one competent authority, such as the Ministry of Environment (Estonia), the Environment, Geology and Meteorology Agency (Latvia) and the Environmental Protection Agency (Lithuania), – on the national level – for all their RBDs. In Poland, the National Water Management Board under the Ministry of Environment has been appointed as competent authority together with the seven regional water management boards, established already in 1991 and arranged partly according to river basins. However, despite being (partly) organised according to river basins, the geographical borders of the Polish regional water management boards still do not correspond to the borders of the established RBDs. Fig. 6 provides an attempt to illustrate the geographical match (or mismatch) between the borders of the RBDs and the organisations formally appointed as responsible for their management.

In general, the implementation of Article 3 of the WFD appears so far to have implied quite limited changes to the administrative structure of water management institutions in the examined countries. However, some new structures have been set up based on RBD borders. The primary function of these new structures appears to be to either meet the need for coordination among water management organisations or to improve the active involvement of stakeholders and the public. An example of the former is the coordination groups in Germany for states sharing RBDs, which are new administrative structures based on RBD borders. Examples of the latter are the cooperation groups or coordination committees/boards in Finland, Latvia and Lithuania, which have or will be established based on RBD borders. It appears that it is only in Sweden that a new administrative structure has been established, both based on RBD borders and with some real decision-making powers. In Sweden, one water delegation has been established per RBD. Each delegation has a maximum of eleven members - mainly restricted to representatives from county administrative boards and experts from universities – and its main tasks are to make decisions about water quality standards, programmes of measures and RBMPs.

At a general level, the results from this study confirm the findings of other studies which examine the implementation of the WFD (Moss 2004; EEB and WWF 2005; EEB and WWF 2006), that the implementation level of the directive is rather low. Countries appear to have chosen a somewhat "minimal implementation strategy"; establishing RBDs, but not really making any substantial changes to "old" administrative water management structures. Thus, for managing RBDs considerable resources will probably be spent on coordinating the work among "old" water management institutions. In this sense, the chosen strategy for river basin management may be compared to the coordinated model, described by Mostert et al. (1999) (see Scientific basis). However, it should be pointed

[15] In fact, Estonia has appointed the Ministry of Environment as competent authority for their three RBDs, while county environmental departments have been appointed as competent authorities for the eight sub-basins.

Table 10. Overview of institutional arrangements set up to meet the intentions of Article 3 of the WFD.

Country	RBDs established acc to article 3, WFD (Yes/No)	Geographical borders of competent authorities coinciding with geographical borders of RBDs (Yes/Partially/No)	Concrete changes of the administrative structure (No changes/Slight changes/Substantial changes)
Estonia	**Yes** - Three RBDs and eight sub-basins	**Partially** - The Ministry of Environment has been appointed as competent authority for all three RBDs. One county environmental department has been appointed as competent authority for each sub-basin. The Environment Information Centre (working on the national level) and other county environmental departments should support the competent authorities.	**Slight changes** - The county environmental departments appointed as competent authorities can be regarded as partly new administrative structures based on river basin borders.
Finland	**Yes** - Eight RBDs	**No** - Finland's 13 regional environmental centres have been appointed as competent authorities. If there is more than one regional environmental centre in a RBD, the work should be coordinated among the centres. Cooperation groups, with representatives from municipalities, industry, agriculture and other interest groups, should be established, preferably, for each RBD. The groups will have an advisory role.	**Slight changes** - The cooperation groups are new administrative structures – in most cases, but not necessarily - based on RBD borders.
Germany	**Yes** - Ten RBDs and 28 sub-basins	**No** - The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety has been appointed as competent authority on the national level; however, because of Germany's federal structure the Ministry is only acting as a "framework" organisation. The Environment Ministries of the States have been appointed as competent authorities on the state level. A coordination body for the states (Joint Water Commission of the States), LAWA, develops guidance documents and coordinates the work. The RBDs have been divided into 28 sub-basins. In each sub-basin, one state is mainly responsible for coordinating the work among all the states sharing the sub-basin. To coordinate the work on the RBD level, all states sharing one RBD have established a coordination group.	**Slight changes** - The coordination groups for states sharing RBDs are new administrative structures based on RBD borders.
Latvia	**Yes** - Four RBDs	**No** - The Latvian Environment, Geology and Meteorology Agency has been appointed as competent authority for all four RBDs. Coordination committees, with representatives from public authorities, district and local governments, and NGOs should be established for each RBD. The committees will have an advisory role. District and local governments should support the competent authority with information.	**Slight changes** - The coordination committees are new administrative structures based on RBD borders.
Lithuania	**Yes** - Four RBDs	**No** - The Lithuanian Environmental Protection Agency (EPA) has been appointed as competent authority for all four RBDs. Various functions have been subordinated from the EPA to the Ministry of Environment, Lithuanian Geological Survey, Marine Research Centre, State Service of Protected Areas, Lithuanian Hydrometeorological Survey and Regional Environmental Protection Departments. Coordination boards, with representatives from municipalities, counties, governmental institutions, NGOs and other interest groups, have been established for each RBD. The boards will have an advisory role.	**Slight changes** - The coordination boards are new administrative structures based on RBD borders.
Poland	**Yes** - Ten RBDs (two "main" and eight small RBDs)	**No** - The Ministry of Environment (the National Water Management Board) has been appointed as competent authority on the national level. Seven regional water management boards (established already in 1991) have been appointed as competent authorities for sub-basins. Regional and local governments are also considered as competent authorities.	**No changes** - No new administrative structures have been established based on RBD borders. Poland had already before the WFD implementation an administrative water management structure based partly on river basins.
Sweden	**Yes** - Five RBDs	**Partially** - One county administrative board in each RBD has been appointed as competent authority, forming a "water authority". The other county administrative boards should support the county administrative board appointed as water authority. Water delegations, with representatives from county administrative boards and universities, have been established for each RBD. The delegations formally decide about programmes of measures and river basin management plans.	**Slight (- some) changes** - The county administrative boards appointed as competent authorities can be regarded as partly new administrative structures based on RBD borders. - The water delegations are new administrative structures based on RBD borders.

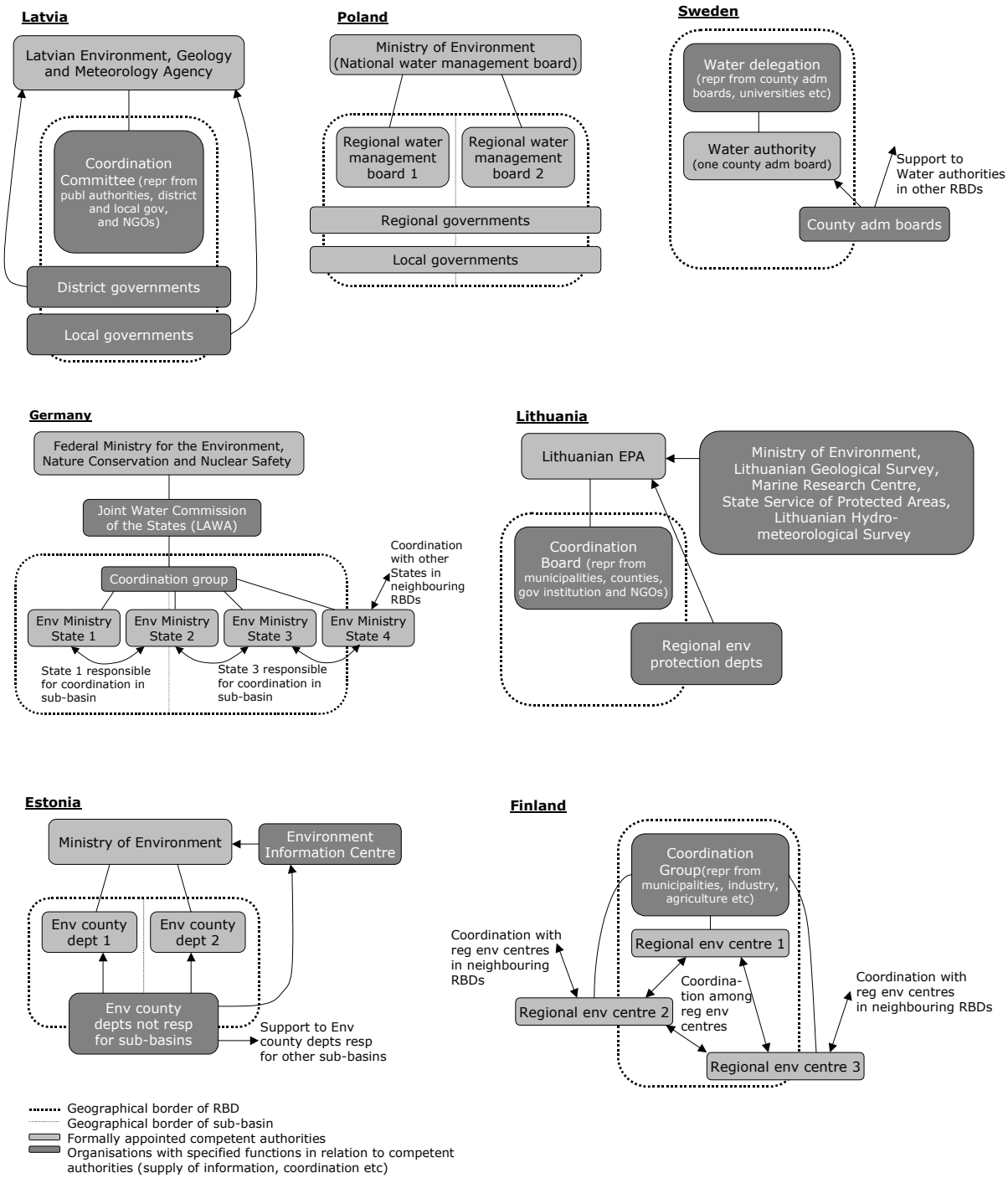

Figure 6. Geographical match (or mismatch) between the RBD borders and organisations responsible for their management.

out that these findings might not hold on closer examination. As the WFD implementation is an ongoing process it is too early to judge the results of the adopted approaches, and it is therefore difficult to say something about the "success" or "failure" of the implementation of river basin management according to the WFD. It may be, as has also been suggested by Moss (2004), that the WFD actually *has* initiated a process of change to the "old" water administrations by, e.g., the establishment of coordination groups and water delegations.

National considerations: issues related to institutional interplay

Latvia and Lithuania were chosen as case study objects for examining the institutional interplay between water management institutions responsible for river basin management according to the WFD, and spatial planning. The results show that Latvia and Lithuania may to some extent be regarded as each other's opposites regarding their handling of the WFD implementation and connections to spatial planning. In Latvia, concrete steps have been taken to integrate the two systems. According to two governmental regulations, adopted in 2004 and 2005, spatial planning at the local and district level must incorporate and take into consideration river basin management related issues, such as characterisation of water resources, identification of pressures and impacts of human activities, and listing of protected areas, in the development of spatial plans. Thus, water management can be said to partly steer spatial planning. How the institutional interplay will work in practice, and which problems may arise in the future, remain to be seen. In Lithuania, on the other hand, no concrete actions have yet been taken to bring the two systems closer together. The general opinion appears to be that such steps are not of high priority, although the water management side (Lithuanian EPA) sees a need for involving municipalities for, e.g., implementing programmes of measures. Thus, so far, the implementation of the WFD in Lithuania has generated neither conflicts nor synergies between water management and spatial planning. Whether connections between the two systems will develop more in the future is difficult to say; this is probably dependent upon both the choice of strategies for development of RBMPs and implementation of programmes of measures, as well as on the willingness to participate and the interest of spatial planning.

International considerations: ambitions and plans for cooperation

Fig. 7 shows a map of national and international RBDs in Europe. According to the created RBD dataset, the total number of RBDs is 105. Thirty-five or 33% of these are classified as international districts[16]. Area-wise, the international districts constitute 70% of the total area of the districts. Twenty-two or 63% of the international districts are shared between Member States and/or Candidate Countries, while 13 or 37% of the districts are shared with countries outside the EU or outside Candidate Countries. A majority of the international districts is shared by two countries (63%), but there are also districts shared by three (14%), four (14%), or five or more countries (9%). Based on these findings, it is thereby quite clear that for fulfilling the intentions of the WFD regarding management according to river basins, this should imply some sort of *international* management. Savenije and van der Zaag (2000) argue that management of international or transboundary river basins requires a common legal framework and one may, thus, discuss whether or not the WFD alone will be able to serve as this common framework and enforce joint international management. The directive addresses international river basins in, e.g., the designation of RBDs, where it requires international river basins to be assigned to international RBDs (cf. Table 1). On the other hand, the directive is less strict and more ambiguous in its demands for international RBDs compared to its demands for national districts (Macrory and Turner 2002). Rather than strictly enforcing international management, the directive serves as an incentive for joint management. However, how extensive this joint manage-

[16] It should however be stressed that the figures on total number of RBDs and portion of international districts presented here probably not are the same as the official figures today. There are several reasons for this. Firstly, some countries had not finally settled on their RBDs by June 2005, which was used as a benchmark for the creation of the dataset. Secondly, some countries have continued to reorganise their water management institutions, changing also the borders of RBDs. Thirdly, the number of international RBDs is dependent upon how international RBDs are defined and accounted for. As there is no legal/official definition of international RBDs, EU Member States and the European Commission sometimes use other definitions than the one used in this thesis.

ment ultimately will be depends upon the willingness and resources of the countries involved.

As regards the actual plans and ambitions for cooperation on international RBDs the situation is quite complex. In international RBDs shared between Member States and/or Candidate Countries, there exist international water commissions in little more than half of the districts (Fig. 8). In RBDs shared with countries outside the EU (or outside Candidate Countries) there exist international water commissions in nearly 40% of the districts. In international RBDs shared between Member States and/or Candidate Countries, there are plans or ambitions for coordinating a joint RBMP[17] in little more than half of the cases, whereas in the remaining districts the strategies for the RBMPs have not yet been settled. This is quite opposite to the RBDs shared with countries outside the EU, where RBMPs, only for their own part of the district, will be produced in nearly 50% of the districts. Only in two of the RBDs shared with countries outside the EU (Danube and Rhine) are there plans for coordinating joint RBMPs; however, in five of the districts no decisions have yet been taken about RBMPs. In general, large RBDs in western and central Europe appear to be "most cooperative". In these cases there exist water commissions that intend to coordinate joint RBMPs for the districts. RBDs located on the eastern border of the EU appear to be "least cooperative". Although joint commissions exist in some of these districts, little effort will probably be placed upon coordinating joint RBMPs. Based on these results; the intention of the WFD, that all waters in the community should be managed according to (strictly) hydrological rather than political borders, appears a bit unrealistic.

[17] It should be pointed out that producing or coordinating a joint RBMP (probably) not will replace the production of a national plan for the part of the district falling within the specific country's territory. Thus, in essence, national RBMPs will be produced, and then, in some cases, there are also decisions or plans for coordinating and publishing a joint RBMP for the whole international district.

SUPPORTING STRATEGIC POLICY MAKING IN RELATION TO WFD IMPLEMENTATION

In papers IV and V quite a substantial amount of empirical material was collected on cooperation and water quality in international river basins in the BSR (paper IV), and water quantity and quality, and pressures in all the established RBDs (paper V). Based on the compiled information, a few general assessments were made. The aim of the assessments was both to come up with possible suggestions and approaches for simple - but yet robust - models for benchmarking, and to directly assist and support strategic policy making on issues related to the implementation of the WFD.

Assessment of cooperation and water quality in the BSR

Table 11 shows the results of the assessment of the indicators of cooperation in the 14 international river basins in the BSR. In this assessment, river basins could obtain a score between 0 and 6. As can be seen from Table 11, the actual overall scores obtained range from 0.66 to 5. In all river basins water treaties exist and in a majority of these basins a commission has been established. When this is compared with the global situation, where only 117 of the world's 263 international river basins have treaties (Wolf et al. 2003), the BSR can be regarded as a region with a solid base for international cooperation. Five of the river basins are shared by two or more countries; however, only in one case, the Oder, are all countries signatories to the treaty. In the rest of the cases only bilateral agreements exist. A little more than half the treaties deal specifically with water quality or WFD issues. In the cases of Gauja, Lielupe and Venta, the WFD was actually the main reason for setting up treaties. The treaties not specifically devoted to water quality issues are generally quite old, and may focus on issues related to, e.g., hydropower or navigation. However, there are examples of treaties, such as the one for Torne River originally set up in 1971 to deal with issues connected with hydraulic engineering and fishing, that are now updated because of, among other things, the

WFD. Nine or 64% of the river basins are shared with countries outside the EU. This figure is substantially higher if compared with the figures reported in the RBD register for the whole of Europe where 37% of the international RBDs are shared with countries outside the EU. Several of the basins, in total twelve, have been officially designated as international districts/basins according to the requirements of the WFD. It is actually only Kemijoki and Vuoksi, shared between Finland and Russia, which have not been officially designated as international RBDs. In five river basins, all shared by EU Member States, there are officially stated plans to produce or coordinate joint RBMPs. However, from the results of the assessment of the indicator regarding joint characterization, it can be seen that - in practice - very few joint actions have been taken so far. Only in one case, the Oder, has joint characterization according to Article 5 of the WFD been carried out. The International Commission for the Protection of the Odra River Against Pollution (ICPOAP) has coordinated the work and has published characterization reports in German, Polish and Czech on their homepage. As regards the indicator describing more informal transboundary cooperation initiatives, it can be seen that such initiatives are present in at least nine of the river basins.

The water quality ranking scores – with regard to pressure and state indicators - for the 14 international river basins in the BSR are presented in Table 12. Although not identical, the two alternative rankings show a similar pattern; basins with high pressure scores generally have high state scores as well. For instance, Oder is ranked as "worst" with regard to both pressure and state.

The results from the plotting of cooperation scores against water quality ranking scores are presented in Fig. 9. To facilitate the interpretation of the figure, two lines have been drawn in each chart, in the middle of each scale. The drawing of the lines resulted in four boxes. According to this suggested division, the lower left box is characterized by basins with moderate-low or very low water quality ranking scores (<50), and at the same time relatively low cooperation scores (<3). Thus, these basins may not have very well developed cooperation. On the other hand, at least for the basins with very low water quality ranking scores, there may not have been a need for such cooperation to develop since the water related problems, at least with regard to water quality (eutrophication), are relatively small. The lower right box encompasses river basins with moderate-low or very low water quality ranking scores (<50), but high cooperation scores (>4). It may be interesting to note that the Torne River has high cooperation score and, at the same time, very low water quality scores. One explanation for this may be that the trigger for cooperation in Torne River was originally related to other water issues, e.g. fishing, than water quality, but that this may also have actually facilitated cooperation around the implementation of the WFD. The upper right box depicts river basins with both high water quality scores (>50) and high cooperation scores (5). The last box, in the upper left corner, encompass the international basins in strongest need of intensified cooperation (scores<3) with regard to water quality (scores>50). These basins are: Vistula, Pregola and, at least according to the pressure water quality ranking, Nemunas. Characteristic for these basins is that there is no water commission established and no multilateral agreement on cooperation in existence. Further, the basins are shared by EU Member States and countries outside the EU, which may complicate WFD implementation.

RBD characterisation and assessment

Characterisation maps – containing information corresponding to Table 5, along with a map of each district – have been produced for all RBDs. The intention is that these maps could provide general information about RBDs to water managers, stakeholder groups and others interested parties.

The results from the RBD rankings are presented as a number of graduated colour maps (Fig. 10-11). From the pressure and status maps (Fig. 10), it is clear that there are significant differences among Europe's RBDs when it comes to water quantity and quality and pressures on water resources, and that

Table 11. Overall assessment of cooperation in the 14 international river basins in the BSR based on six indicators.

Int river basin	Water treaty indicator			Shared by EU Member States	Int RBD	Ambitions for joint RBMP	Joint characterisation	Informal cooperation initiatives	Overall score (0-6)
	Commission (0/0.33)	All countries signatories (0/0.33)	Water quality / WFD as specific task (0/0.33)						
Klarälven-Trysilelva/ Göta River	0	0.33	0	0	1	0	0	0	1.33
Indalsälven	0	0.33	0	0	1	0	0	0	1.33
Torne River	0.33	0.33	0.33	1	1	1	0	1	5
Kemijoki	0.33	0.33	0	0	0	0	0	0	0.66
Vuoksi/ Lake Ladoga-Neva River	0.33	0.33	0	0	0	0	0	1	1.66
Narva River/Lake Peipsi	0.33	0	0.33	0	1	0	0	1	2.66
Gauja	0.33	0.33	0.33	1	1	1	0	0	4
Daugava	0	0	0	0	1	0	0	1	2
Lielupe	0.33	0.33	0.33	1	1	1	0	1	5
Venta	0.33	0.33	0.33	1	1	1	0	1	5
Nemunas	0	0	0.33	0	1	0	0	1	2.33
Vistula	0.33	0	0.33	0	1	0	0	1	2.66
Pregola	0	0.33	0	0	1	0	0	1	2.33
Oder	0.33	0.33	0.33	1	1	1	1	0	5

the RBDs with lower status and higher pressure, and the inverse, appear to be grouped geographically. In general, the RBDs in the Nordic countries (except Denmark) do well when compared to the rest of the RBDs, while the toughest water-related challenges appear in Great Britain, Denmark and Spain. As might be expected given the information contained in the maps in Figure 10, Western Europe dominates the list of RBDs with the greatest percentage of cultivated land and highest population density, which often translates into regional hotspots for high nutrient concentrations in rivers and periodic water stress.

A more nuanced picture emerges if one looks at the Pressure Management index map (Fig. 11). It indicates that some RBDs with high pressure on water resources are actually handling these pressures rather well. This is the case for the Rhine RBD and for some RBDs in Denmark, for example. On the other hand, the Pressure Management index map also reveals where pressure management effectiveness is either low because it is not needed or low where it is badly needed. The results suggest that several RBDs in southern Spain appear not to handle their pressures well, since these are not as extreme as elsewhere in Europe, but still lead to some of the poorest water quality and quantity conditions. In addition, it is clear that pressure management is minimal because pressures are low to begin with in some northern European RBDs. This is the case for several districts in Sweden and Finland.

While the north-south gradient evident in the ranking of the RBDs comes as no real surprise, it is interesting to note that the repeatedly lowest ranked RBDs are located exclusively in Western Europe. One might have expected the major problem areas to appear in Eastern Europe in the new Member States due to the previous lack of environmental protection for water resources, particularly during the Soviet era. One caution in this regard, however, is that almost no quality information for Russia and Belarus was pub-

Table 12. Water quality ranking scores for the 14 international river basins in the BSR.

Int river basin	Pressure indicators		Pressure wq ranking score (mean of pressure scores)	State indicators		State wq ranking score (mean of state scores)
	Population density (0-100)	Cultivated land (0-100)		N-tot con-centration (0-100)	P-tot con-centration (0-100)	
Klarälven-Try-silelva/ Göta River	14	12	**13**	14	5	**9**
Indalsälven	2	1	**1**	0	0	**0**
Torne River	0	0	**0**	1	5	**3**
Kemijoki	0	0	**0**	1	5	**3**
Vuoksi/Lake Ladoga-Neva River	14	2	**8**	6	7	**6**
Narva River/Lake Peipsi	11	35	**23**	35	23	**29**
Gauja	12	42	**27**	31	28	**29**
Daugava	22	29	**26**	36	31	**34**
Lielupe	26	92	**59**	91	50	**71**
Venta	21	80	**50**	52	26	**39**
Nemunas	38	71	**54**	46	45	**45**
Vistula	89	79	**84**	68	87	**78**
Pregola	63	100	**81**	64	77	**70**
Oder	100	83	**91**	100	100	**100**

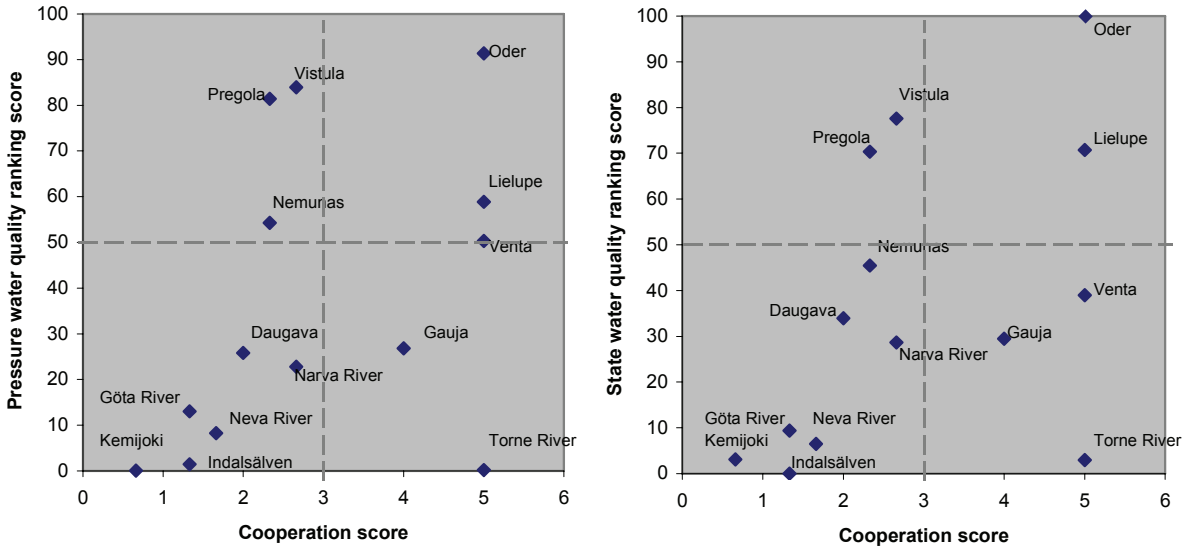

Figure 9. Plotting of cooperation scores with water quality ranking scores (both for pressure and state rankings) for the 14 international river basins in the BSR.

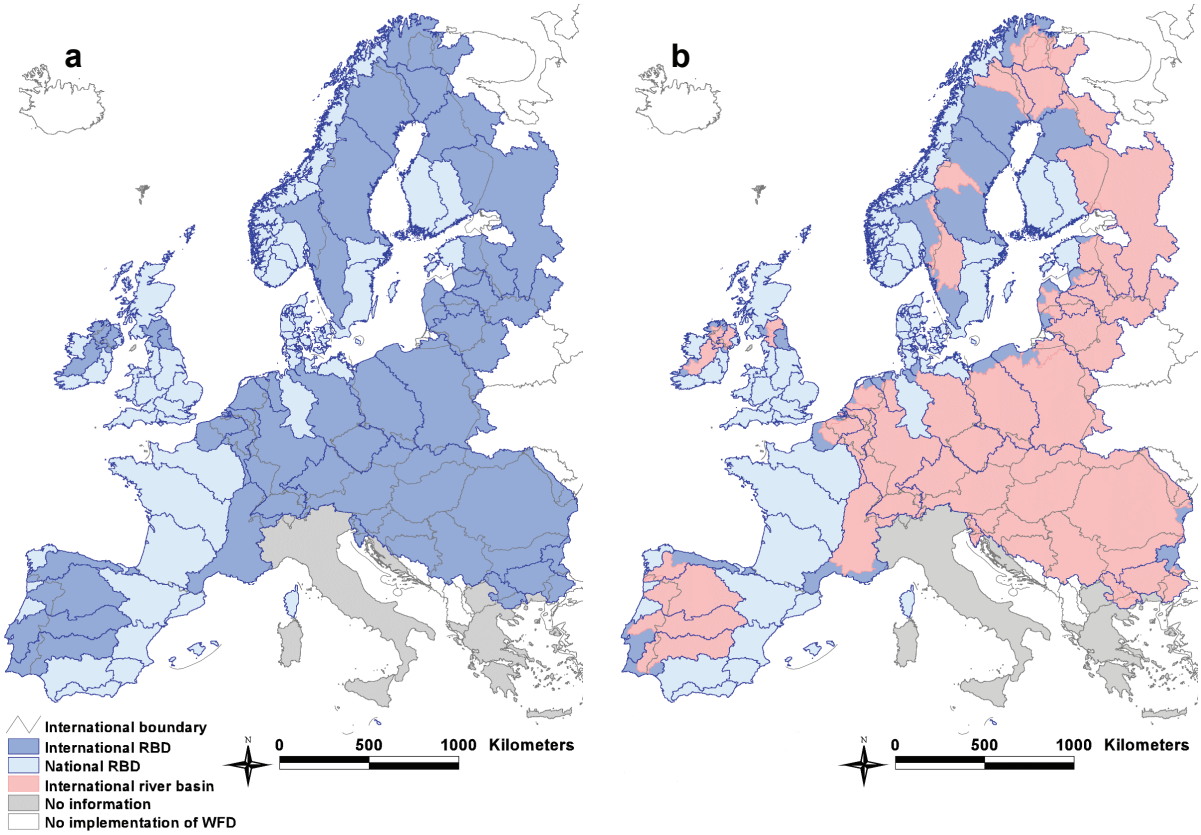

Figure 7. RBDs in Europe with (a) international RBDs (dark blue) and (b) international river basin within the RBDs (pink).

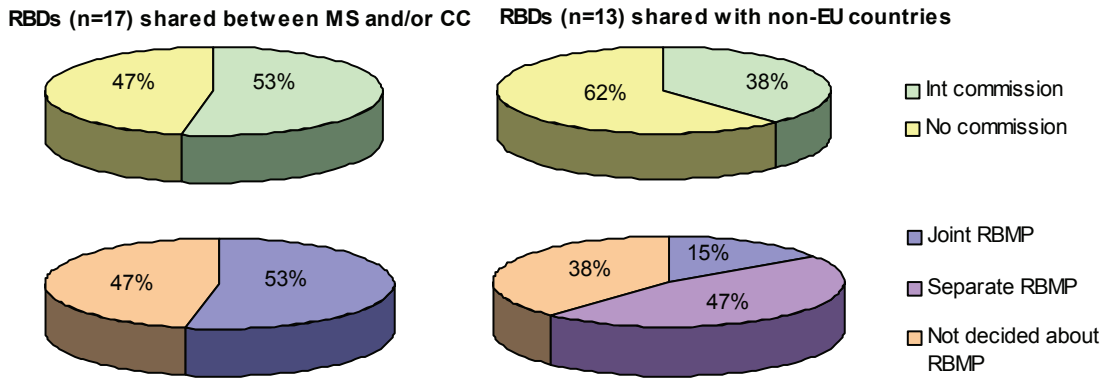

Figure 8. Summary statistics regarding international water commissions and RBMPs. The two uppermost diagrams show presence of international water commissions in prospective international RBDs. The two diagrams below show plans or ambitions for RBMPs in prospective international RBDs. It should be noted that the statistics are based on the first version of the RBD dataset (presented in paper III), and therefore the international districts do not correspond exactly with the international districts reported in Fig. 7.

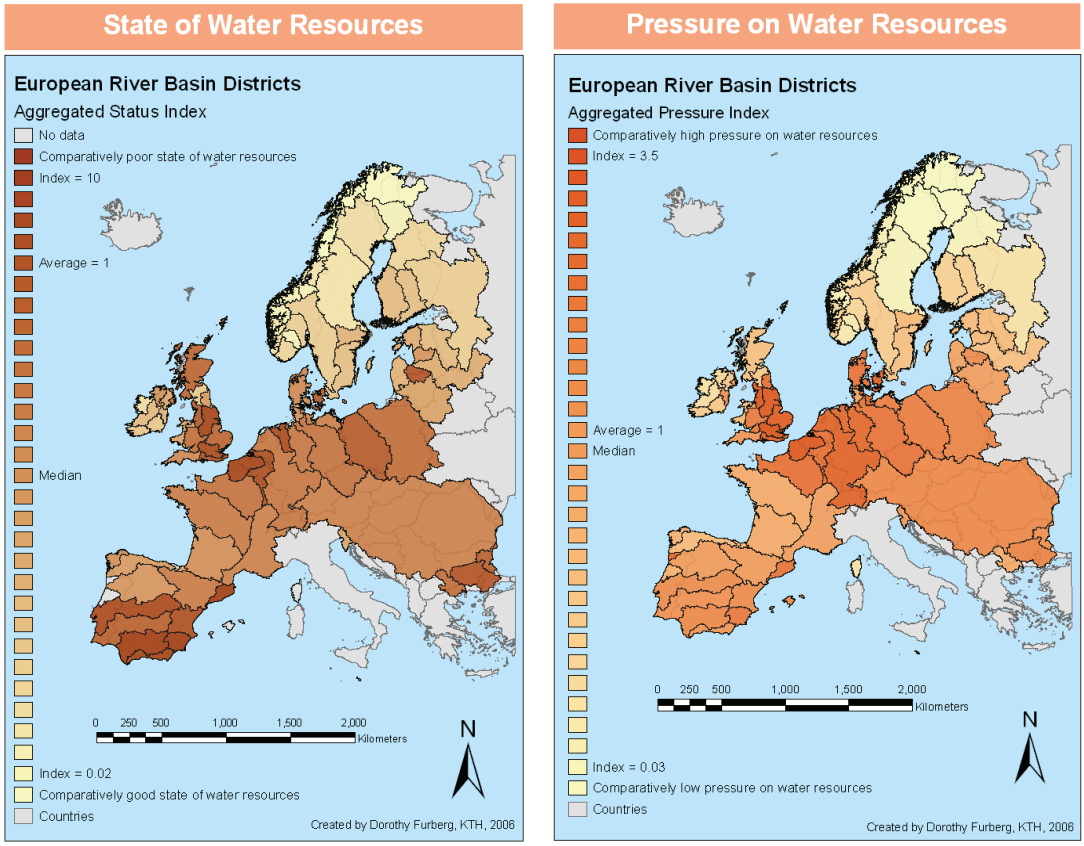

Figure 10. Pressure on and state of water resources in the European RBDs.

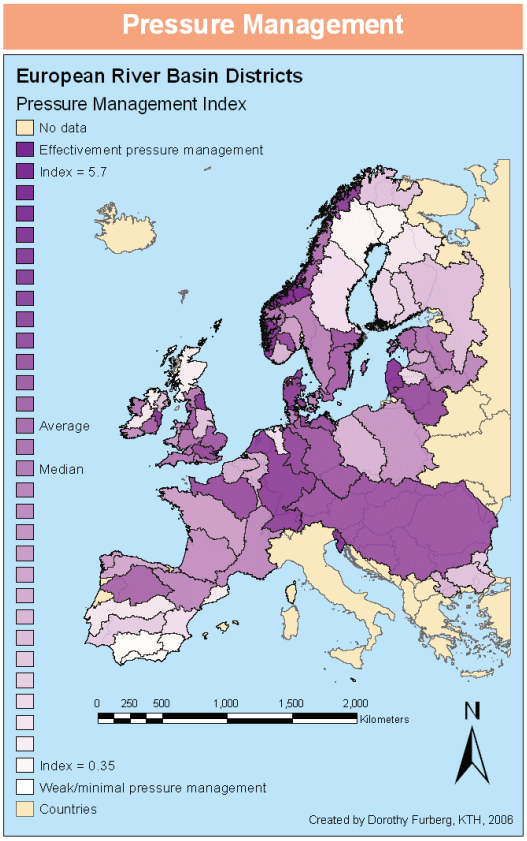

Figure 11. Pressure management per RBD.

licly available, and thus districts that share parts of these countries may not be accurately ranked.

CONCLUSIONS AND RECOMMENDATIONS

Broadly speaking, this thesis has dealt with IWRM and river basin management, in particular in the context of the WFD. Within these frames, the thesis has addressed issues according to three broad themes, namely information management, institutional arrangements and strategic policy support. The ultimate aim of the work has been to identify key issues which need to be considered - and prioritised - for "successful" European water management and WFD implementation. By structuring this chapter according to the three themes mentioned above, main conclusions will be drawn, and recommendations will be given.

Information management

The case studies of the transboundary water regimes for Lake Neusiedl, Lake Constance and Elbe River, showed – not so surprisingly - that there are differences in the information needs, data collection and information use between different transboundary regimes in Europe. However, despite the differences in information management between the regimes, there are also similarities. A technical/scientific paradigm appears to dominate in transboundary water regimes. This is visible in several ways. Information needs tend to be defined by experts without direct involvement of policy and decision maker from member governments, stakeholders or other interest groups. Further, the regular data collection is dominated by state and environmental impact information. Finally, the commissions mainly use passive channels for communicating with stakeholder groups and the public, and these groups are, thus, not actively involved in the management of the water resource through the activities of the commissions.

If information management in transboundary water regimes in the future is to meet the "requirements" of information implied by IWRM (and the WFD) more fully, a change of mind might be needed. This may comprise various things. Firstly, new information needs should be defined, taking into account the needs of stakeholders and other interest groups. Recognising information needs of other groups will probably require an involvement of these groups already in the definition process. This involvement will contribute to a more participatory management of water resources, which is emphasised by an integrated approach (and the WFD). Secondly, the data collection could be more balanced, collecting not only state and environmental impact information, but also driving forces/pressures and response information originating from the basin. Thirdly, there is a need to develop more participatory forums and mechanisms, such as workshops and scenario planning models, for communication with stakeholder groups and the public.

Institutional arrangements

By examining institutional arrangements for river basin management according to the WFD in selected countries in the BSR, a number of important conclusions may be drawn. The study showed that all countries have established RBDs according to Article 3 of the WFD. However, no country has radically changed their administrative water management structures to better fit these new spatial management units. Instead all countries have – to a greater or lesser extent – chosen to manage the districts by coordinating the work among "old" administrative water management organisations. This strategy is understandable given that almost no country has any practical experience of (strictly hydrological) river basin management. Thus, the implementation level with regard to institutional arrangements according to the WFD appears - so far – to be rather low. However, despite the perceived low implementation level, concrete steps have still been taken in the "direction" of river basin management, by, e.g., the establishment of coordination groups and water delegations. It is possible that the timetable of the WFD is too tight and ambitious, and that changing institutional arrangements to-

wards river basin management is a process that needs considerably more time to evolve. Further, although the WFD sets the framework for river basin management in Europe, there exists no universal blueprint of a river basin management organisation. Thus, only the future will tell if the institutional arrangements set up in different countries will *work* for drawing up programmes of measures, compiling RBMPs, and ultimately, reaching the WFD objective of "good water status". The study examining the institutional interplay between river basin management according to the WFD, and spatial planning in Latvia and Lithuania, supports the perception that countries are interpreting and implementing the WFD in quite different ways.

In view of the above, it may be important to devote specific attention to the following issues in the further implementation process. Although the perceived low implementation level by no means implies a failure of river basin management according to the WFD, the results may still serve as an "alarm clock" or indication to the European Commission to carefully follow and monitor the further implementation process. It may be necessary to continue to take and develop initiatives under the CIS, or elsewhere, for further supporting the establishment and development of river basin management organisations. Platforms, such as the conferences arranged by, e.g., the European Commission and the European Water Association (EWA) and meetings of the Water Directors, may be valuable for exchanging experiences and knowledge on "best practices". Finally, individual countries should ideally, after some years evaluate how the institutional arrangements for river basin management according to the WFD are working, and – if needed – revise and improve the systems.

As regards international RBDs it can be concluded that the number and area of international RBDs identified under the WFD are significant; about 1/3 of the districts are international and they cover about 2/3 of the total area of RBDs. The studies also showed that the ambitions for cooperation on international RBDs vary considerably. It appears that river basins shared by countries within the EU have moved towards joint management of international river basins by, e.g., signing water treaties and having ambitions to coordinate joint RBMPs. However, the same pattern cannot be discerned for river basins shared between EU Member States and countries outside the EU.

For the future it will be of the utmost importance to give priority to the issue of coordination and cooperation in international RBDs, as such a large proportion of the established RBDs is international. Special attention and support should be given to international river basins/RBDs shared by EU Member States and countries outside the EU. In particular, focus should be directed towards international basins on the eastern border of the EU, since these basins appear to have the weakest and least developed cooperations. Activities may be concentrated to supporting the development of multilateral agreements and the establishment of water commissions; however, the exact forms of this support need to be further investigated.

Strategic policy support

The assessment of cooperation and water quality in international river basins in the BSR, and the rankings of the RBDs can – despite their limitations – provide important support for strategic policy making. The assessment of international river basins in the BSR identified "critical" basins with regard to cooperation and water quality (eutrophication). These basins are, besides having a relatively "bad" water quality, characterised by being shared by EU Member States and countries outside the EU and by having no multilateral agreements and water commissions (cf. previous section). The rankings of the RBDs provided an initial comparative overview of the newly established RBDs, possibly assisting policy making in identifying regions that are most in need of support in terms of reaching the WFD goal of "good water status". The results reveal clear patterns in that, on the whole, northern districts fair well in a Europe-wide comparison while southern districts fair poorly in terms of pressure on and state of water resources. The comparison and rankings also highlight some

regional hot spots. The identification of these hot spots could be helpful in promoting co-operation between RBDs that, while geographically distant, may have common water problems and information to exchange concerning the solutions.

Parallel independent assessments, such as the linking of cooperation and water quality in international river basins in the BSR and the rankings of the RBDs, can assist with environmental benchmarking, complementing activities of the WISE and EEA. If further developed, updated and refined, such initiatives could lead to increased effectiveness in the management of water resources.

FUTURE RESEARCH

While this thesis has, it is hoped, generated valuable knowledge and insight on information management, institutional arrangements and strategic policy support for river basin management, the results have also pointed out needs for future research.

Starting with information management, the general conclusion regarding the domination of a technical/scientific paradigm in transboundary water regimes may be tested for its validity by examining the information management in a larger number of transboundary water regimes in Europe. There may also be a need to more thoroughly examine information management in transboundary river basins through, e.g., extending the scope of the study and identifying *all* key actors involved in the management of the water resource, and investigating the exchange and communication of information between them. It would also be interesting to explore more deeply the role which data and information may have for transboundary cooperation. For instance, the question of whether data and information is a source of conflict or cooperation may be interesting to address in greater detail. In fact, both the latter suggestions could be interesting to perform for national river basins as well, where the transboundary dimensions would refer to, e.g., municipal and regional borders.

With regard to institutional arrangements, there are several options for future research. For instance, more studies at greater depth, which examine not only the formal institutional changes implied by the WFD implementation, but also capture more informal changes in practices, norms and values which may be taking place at regional and local levels, would be of interest. There is also a need to address the effectiveness of the institutional arrangements established because of the WFD implementation. This may be a tricky issue; however, it is in fact not the institutional changes as such that are interesting, but the results or effects caused by the changes. For instance, interesting and pertinent questions to address may comprise: Has the WFD resulted in the implementation of "effective" organisations for river basin management, both at the national and international level?, and What characterises an "effective" organisation?

The assessment of cooperation and water quality in international river basins in the BSR, and the rankings of the RBDs, provided simple models for benchmarking. Although the results from these assessments may be valuable for strategic policy making as they are, there is certainly room for vast improvements and further developments of the assessments. For instance, the water quality ranking scales used in paper IV, which was mainly restricted to indicators related to eutrophication, could be extended to encompass other important water quality indicators, such as hazardous substances. Another rather weak point of the assessments is that they are "snapshots", providing only a static picture of the current situation. It would, thus, be very valuable if the assessments could be developed to show trends over time.

REFERENCES

Al Radif, A., (1999) Integrated water resources management (IWRM): an approach to face the challenges of the next century and to avert future crises. *Desalination,* 124(1-3): 145-153.

Anonymous, (2002) *Best Practices in River Basin Management Planning*. Common Strategy on the Implementation of the Water Framework Directive Project 2.9, European Commission, Brussels, 108 pp.

Anonymous, (2003) *Planning Processes*. Common Implementation Strategy for the Water Framework Directive Guidance Document No 11, European Commission, Luxembourg, 78 pp.

Barrow, C.J., (1998) River basin development planning and management: A critical review. *World Development,* 26(1): 171-186.

Biswas, A.K., (2004) Integrated Water Resources Management: A reassment. *Water International,* 29(2): 248-256.

Bradshaw, G.A. and Borchers, J.G., (2000) Uncertainty as information: narrowing the science-policy gap. *Conservation Ecology,* 4(1): 7 (online).

Cano, G.J., (1985) Legal and administrative tools for river basin development. In: J. Lundqvist, Lohm, U. and Falkenmark, M., (eds.), *Strategies for River Basin Management*. D. Reidel, Dordrecht, 189-200 pp.

Castensson, R. and Gustafsson, J.-E., (1993) Hur skapa ett vattenmedvetande i samhällsplaneringen? In: B. Kullinger and Strömberg, U.-B., (eds.), *Planera för en bärkraftig utveckling*. Byggforskningsrådet, Stockholm, 73-84 pp.

CCME, (2001) *Canadian water quality guidelines for the protection of aquatic life: CCME Water Quality Index 1.0*. Technical Report, Canadian Council of Ministers of the Environment, 13 pp.

Chave, P., (2001) *The EU Water Framework Directive*. IWA Publishing, London, 208 pp.

Conca, K., (1996) *International Regimes, State Authority, and Environmental Transformation: The Case of National Parks and Protected Areas*. Occasional Paper No. 15, Harrison Program on the Future Global Agenda, Tydings Hall College Park, MD, 19 pp.

Dinar, A., (1998) Water policy reforms: information needs and implementation obstacles. *Water Policy,* 1(4): 367-382.

Dinar, A. and Saleth, R.M., (2005) Can water institution be cured: A Water Institution Health Index. In: K.P. Tsagarakis, (ed.), *International Conference on Water Economics, Statistics and Finance*, IWA Publishing, Rethymno, Greece, 3-21 pp.

Downs, P.W., Gregory, K.J. and Brookers, A., (1991) How integrated is river basin management. *Environmental Management,* 15(3): 299-309.

EC, (1997) *The EU compendium of spatial planning systems and policies*. Directorate-General for Regional Policy and Cohesion of the European Commission, Brussels, 191 pp.

EC and EEA, (2003) *Reporting for Water - Concept document: Towards a Shared Water Information System for Europe (WISE)*. Common Implementation Strategy for the Water Framework Directive Technical report, European Commission and European Environment Agency, Rome/Brussels, 32 pp.

EEA, (1999) *Environment in the European Union at the turn of the century*. Environmental assessment report No 2, European Environment Agency, Copenhagen, 446 pp.

EEA, (2000) *Sustainable use of Europe's water? State prospects and issues*. Environmental assessment report No 7, European Environment Agency, Copenhagen 36 pp.

EEA, (2005a) *The European Environment: State and Outlook 2005*. European Environment Agency. European Environment Agency, Copenhagen, 572 pp.

EEA, (2005b) *Source Apportionment of Nitrogen and Phosphorus Inputs into the Aquatic Environment.* EEA report No 7/2005, European Environment Agency, Copenhagen, 48 pp.

EEB and WWF, (2005) *EU Water Policy: Making the Water Framework Directive work*. European Environmental Bureau and WWF European Policy Office, Brussels, 40 pp.

EEB and WWF, (2006) *EU water Policy: Making economics work for the environment*. European Environmental Bureau and WWF European Policy Office, Brussels, 64 pp.

Eggertsson, (1996) The economics of control and the cost of property rights. In: S.S. Hanna, Folke, C. and Mäler, K.-G., (eds.), *Right to Nature* Washington, D.C., 157-175 pp.

Enderlein, R.E., (2001) Bilateral and multilateral cooperation under the water convention. Presentation at the workshop Environmental Status and Assessment of 10 Transboundary Rivers in Europe, 9-10 April 2001, Prague, Czech Republic.

European Parliament and the Council of the European Union, (2000) 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. *Official Journal of the European Communities,* (L 327): 1-72.

Fairley, R., Smith, C., van Geen, H., Hoedl-Adick, M., van Thuyne, G. and De Roover, D., (2002) Riding the new wave of European water law: How Member States are tackling the Water Framework Directive. *European Environmental Law Review,* 11(8-9): 232-239.

Folke, C., Pritchard, L., Berkes, F., Colding, J. and Svedin, U., (1998) *The Problem of Fit between Ecosystems and Institutions*. IHDP Working Paper No 2, International Human Dimensions Programme on Global Environmental Change, Bonn (online).

Griffiths, M., (2002) The European Water Framework Directive: An approach to integrated river basin management. *European Water Management Online* (2002/05): 1-14.

Grimeaud, D., (2001) Reforming EU water law: Towards sustainability? *European Environmental Law Review,* 10(4): 125-135.

Gustafsson, J.-E., (1989) *Vattenförvaltning i Frankrike*. R21:1989, Statens råd för byggnadsforskning, Stockholm, 232 pp.

Gustafsson, J.-E., (1999) Vattenförvaltning i avrinningsområden: möjligheter och lösningar i olika länder. *Vatten,* (55): 251-257.

GWP, (2000) *Integrated Water Resources Management*. TAC Background Papers No. 4, Global Water Partnership, Stockholm, 67 pp.

Hanf, K. and Jansen, A.-I., (1998) Environmental policy - the outcome of strategic action and institutional characteristics. In: K. Hanf and Jansen, A.-I., (eds.), *Governance and Environment in Western Europe*. Longman, Harlow, 1-15 pp.

Harremoës, P. and Turner, R.K., (2001) Methods for integrated assessment. *Regional Environmental Change,* 2(2): 57-65.

Holzwarth, F., (2002) The EU Water Framework Directive - A key to catchment-based governance. *Water Science & Technology,* 45(8): 105-112.

ICWE, (1992) The Dublin statement on water and sustainable development. *International Conference on Water and the Environment*, World Meteorological Organization, Dublin.

Jaspers, F.G.W., (2003) Institutional arrangements for integrated river basin management. *Water Policy,* 5(1): 77-90.

Jordan, A., (2005) Introduction: Europen Union Environmental Policy - Actors, Institutions and Policy Processes. In: A. Jordan, (ed.), *Environmental Policy in the European Union*. Earthscan, London, 1-15 pp.

Knill, C. and Lenschow, A., (2000) Do new brooms really sweep cleaner? Implementation of new instruments in EU environmental policy. In: C. Knill and Lenschow, A., (eds.), *Imple-*

menting EU environmental policy New directions and old problems. Manchester University Press, Manchester, 251-286 pp.

Krasner, S.D.,(ed.) (1983) *International regimes*. Cornell University Press, Ithaca, NY, 372 pp.

Kvale, S., (1997) *Den kvalitativa forskningsintervjun*. Studentlitteratur, Lund, 306 pp.

Langaas, S.,(ed.) (2002) *Environmental information in transboundary river basin policy-making and management: Selected European case studies*. MANTRA-East working report, Stockholm, 110 pp.

Lorenz, C.M., Gilbert, A.J. and Cofino, W.P., (2001) Indicators for Transboundary River Management. *Environmental Management,* 28(1): 115-129.

Lundqvist, J., Lohm, U. and Falkenmark, M., (1985a) River basin strategy for coordinated land and water conservation. In: J. Lundqvist, Lohm, U. and Falkenmark, M., (eds.), *Strategies for River Basin Management*. D. Reidel, Dordrecht, 5-17 pp.

Lundqvist, J., Lohm, U. and Falkenmark, M.,(eds.) (1985b) *Strategies for River Basin Management*. D. Reidel, Dordrecht, 346 pp.

Macrory, R. and Turner, S., (2002) Participatory rights, transboundary environmental governance and EC law. *Common Market Law Review,* 39(3): 489-522.

Milich, L. and Varady, R.G., (1999) Openess, sustainability, and public participation: New designs for transboundary river basin institutions. *Journal of Environment & Development,* 8(3): 258-306.

Mitchell, B., (1990) Integrated water management. In: B. Mitchell, (ed.), *Integrated Water Management: International Experiences and Perspectives*. Belhaven Press, London, 1-21 pp.

Moss, T., (2004) The governance of land use in river basins: prospects for overcoming problems of institutional interplay with the EU Water Framework Directive. *Land Use Policy,* 21(1): 85-94.

Mostert, E., (1999) Perspectives on river basin management. *Physics and Chemistry of the Earth,* 24(6): 563-569.

Mostert, E., van Beek, E., Bouman, N.W.M., Hey, E., Savenije, H.H.G. and Thissen, W.A.H., (1999) River basin management and planning. Keynote paper for International workshop on River Basin Management, The Hague 27-29 October.

Naff, T.,(ed.) (1999) *Data Sharing for International Water Resource Management: Eastern Europe, Russia, and the Cis*. Kluwer Academic Publishers, Dordrecht, 268 pp.

Nilsson, S., (2002a) Role and use of environmental information: The case of Elbe River. In: S. Langaas, (ed.), *Environmental information in transboundary river basin policy-making and management*. MANTRA-East working report, Stockholm, 49-60 pp.

Nilsson, S., (2002b) Role and use of environmental information: The case of Lake Constance. In: S. Langaas, (ed.), *Environmental information in transboundary river basin policy-making and management*. MANTRA-East working report, Stockholm, 20-37 pp.

Nilsson, S., (2002c) Role and use of environmental information: The case of Lake Neusiedl. In: S. Langaas, (ed.), *Environmental information in transboundary river basin policy-making and management*. MANTRA-East working report, Stockholm, 38-48 pp.

Nilsson, S., (2006a) *TRABANT WP2 working report Lithuania*. 20 pp.

Nilsson, S., (2006b) *International river basin management under the EU Water Framework Directive: An assessment of cooperation and water quality in the Baltic Sea Drainage Basin*. IIASA Interim Report IR-06-009 International Institute for Applied Systems Analysis, Laxenburg, 31 pp.

Nixon, S., Trent, Z., Marcuello, C., Lallana, C., (2003) *Europe's water: An indicator based assessment*. Topic report No 1/2003. European Environment Agency, Copenhagen, 97 pp.

Ostrom, E., (1990) *Governing the commons: the evolution of institutions for collective action*. Cambridge University Press, Cambridge, 280 pp.

Pahl-Wostl, C., Möltgen, J., Sendzimir, J. and Kabat, P., (2005) New methods for adaptive water management under uncertainty - The NeWater project. *Paper accepted for the EWRA 2005 conference*.

Patel, R. and Davidsson, B., (1994) *Forskningsmetodikens grunder*. Studentlitteratur, Lund, 127 pp.

Savenije, H.H.G. and van der Zaag, P., (2000) Conceptual framework for the management of shared river basins; with special reference to the SADC and EU. *Water Policy,* 2(1-2): 9-45.

Stake, R.E., (1995) *The art of case study research*. SAGE publications, Thousand Oaks, 175 pp.

Timmerman, J.G., Ottens, J.J. and Ward, R.C., (2000) The information cycle as a framework for defining information goals for water-quality monitoring. *Environmental Management,* 25(3): 229-239.

UN ECE, (1996) *Protection of Transboundary Waters*. Water Series No. 3, United Nations, Geneva, 36 pp.

UNCED, (1992) Agenda 21. *United Nations Conference on Environment and Development* United Nations, Rio de Janerio.

UNEP, (2006) *Challanges to International Waters - Regional Assessments in a Global Perspective*. United Nations Environmental Programme, Nairobi, 123 pp.

UNEP/CEU, (1997) *Denisov, N. B., Mnatsakanian, R. A., and A. V. Semichaevsky. Environmental Reporting in Central and Eastern Europe: A Review of Selected Publications and Frameworks*. UNEP/DEIA/TR.97-6, GA/205031-97/1, and CEU/50-97.1, 123 pp.

United Nations, (1970) *Integrated River Basin Development: Report of a Panel of Experts*. UN Department of Economic and Social Affairs, New York, 44 pp.

Veidemane, K. and Nilsson, S., (2006) *TRABANT WP2 working report Latvia*. 19 pp.

Werner, A., (2004) *A Guide to Implementation Research*. Urban Institute Press, Washington D.C., 158 pp.

Wolf, A.T., Natharius, J.A., Danielson, J.J., Ward, B.S. and Pender, J.K., (1999) International River Basins of the World. *International Journal of Water Resources Development,* 15(4): 387-427.

Wolf, A.T., Yoffe, S.B. and Giordano, M., (2003) International waters: identifying basins at risk. *Water Policy,* 5(1): 29-60.

Yin, R.K., (1994) *Case Study Research: Design and Methods*. Sage Publications, Thousands Oaks, CA, 171 pp.

Yoe, C., (2002) *Trade-Off Analysis Planning and Procedures Guidebook*. IWR 02-R-2, U.S. Army corps of Engineers, Alexandria, VA, 141 pp.

Young, O. R., (2002) *The institutional dimensions of environmental change: fit, interplay and scale*. MIT Press, Cambridge, Massachusetts, 221 pp.

OTHER REFERENCES

EC, (2005) National and International River Basin Districts. *Retrieved* August 2006. http://ec.europa.eu/environment/water/water-framework/transposition.html

EC, (2006) Water Information System for Europe (WISE). *Accessed* August 2006. http://wise2.jrc.it/home/php/index_new.php

ESRI, (2005) ESRI Data and Maps 2005. http://www.esri.com

JRC, (2003) Catchment Database (GISCO). *Retrieved* January 2003. http://data-dist.jrc.it/en/data-dist/catchment.html

APPENDIX A. REFERENCES TO DATA AND MATERIAL USED IN THE STUDIES

PAPER I

Elbe River

Interviews

Heinrich Reincke and Michael Bergemann, Wassergütestelle Elbe, Hamburg, Germany. 22 November 2001.

Frantisek Smrcka, Ministry of Agriculture of the Czech Republic, Prague, Czech Republic. 1 November 2001.

Thomas Stratenwerth, Federal Ministry for Environment, Nature Conservation and Nuclear Safety of the Federal Republic of Germany, Bonn, Germany. 21 December 2001.

Jan Vilimec, Výzkumný ústav vodohospodáoský, TGM, Prague, Czech Republic. 1 November 2001.

Other material

(1991) Convention on the International Commission for the Protection of the Elbe. *Official Journal of the European Communities,* (L 321).

German Federal Environment Agency, (2001) *Environmental Policy, Water Resources Management in Germany, Part 1 - fundamentals.* Federal Ministry for Environment, Nature Conservation and Resource Safety, Bonn, 67 pp.

ICPE, (2001) Internationale Kommission zum Schutz der Elbe. *Accessed* 19 September 2001. http://www.ikse.de/html/ikse/ikse.htm

IWAC, (2001) *10 Transboundary Rivers in Europe Assessment Practices and Environmental Status.* International Water Assessment Centre, Szczecin, 141pp.

Ministry of the Environment of the Czech Republic, (2002) Water in the Czech Republic. *Accessed* 10 April 2002. http://www.env.cz

Schumann, A.H., and Simon, M., (1996) A transboundary water management organization: The International Commission for the Protection of the Elbe River. In: J. Ganoulis, Duckstein, L., Literathy, P., and Bogardi, I., (eds.), *Transboundary Water Resources Management Institutional and Engineering Approaches.* Springer Verlag, Berlin Heidelberg, 47-58 pp.

Lake Constance

Interviews

Thomas Blank, Amt der Vorarlberger Landesregierung, Bregenz, Austria. 7 November 2001.

Christian Gehring, Ministerium für Umwelt und Verkehr Baden-Württemberg, Stuttgart, Germany. 13 December 2001.

Peter Michel, Bundesamt für Umwelt, Wald und Landschaft, Bern, Switzerland. 7 December 2001.

Helmut Müller, Landesanstalt für Umweltschutz Baden-Württemberg – Institut für Seenforschung, Langenargen, Germany. 7 November 2001.

Franz Oberleitner, Bundesministerium für Land- und Forstwirtscahft, Umwelt und Wasserwirtschaft, Wien, Austria. 8 November 2001.

Gerd Schröder, Landesanstalt für Umweltschutz Baden-Württemberg – Institut für Seenforschung, Langenargen, Germany. 7 November 2001.

Benjamin Sollberger, Bundesamt für Umwelt, Wald und Landschaft, Bern, Switzerland. 10 December 2001.

Other material

(1962) Übereinkommen über den Schutz des Bodensees gegen Verunreinigung. *Gesetzblatt für Baden-Württemberg* (1): 3235-3237 pp.

(1966) Agreement between West Germany, Austria, and Switzerland relating to the withdrawal of water from Lake Constance.

AWBR, (2002) Arbeitsgemeineschaft Wasserwerke Bodensee-Rhein. *Accessed* 7 February 2002. http://www.awbr.org/

IBK, (2001) Regio Bodensee. *Accessed* 13 November 2001. http://www.regio-bodensee.net/

IGKB, (1996) Geschäftsordnung der Internationalen Gewässerschutzkommission für den Bodensee. Internationalen Gewässerschutzkommission für den Bodensee, 4 pp.

IGKB, (2001a) *Richtlinien für die Reinhaltung des Bodensees.* Internationale Gewässerschutzkommission für den Bodensee, 35 pp.

IGKB, (2001b) Seespiegel Informationen rund um den Bodensee. *Accessed* 15 May 2001. http://seespiegel.de

Living Lakes, (2001) Issues at Lake Constance. *Accessed* 16 March 2001. http://www.livinglakes.org/bodensee/

Müller, H., (2001) Lake Constance - a model for integrated lake restoration in international cooperation. In: H. Sund, Stabel, H.-H., Geller, W., Xiaogan, Y., Kechang, Y., and Fengning, S., (eds.), *Environmental Protection and Lake Ecosystem.* China Science and Technology Press, 345-356 pp.

Schröder, H.G., (1999) Lake Constance: Role of the International Commission for the Protection of Lake Constance. Presentation at the International Workshop on Management and Sustainable Development in International Lake basins, 16-17 December 1999, Tartu, Estonia.

Lake Neusiedl

Interviews

Béla Hajós, Ministry of Transport and Water Management, Budapest, Hungary. 15 January 2002.

Emil Janák, North Transdanubian District Water Authority, Györ, Hungary. 15 January 2002.

Karl Maracek, Amt der Burgenländischen Landesregierung, Eisenstadt, Austria. 16 January 2002.

Julius Marosi, Amt der Burgenländischen Landesregierung, Eisenstadt, Austria. 16 January 2002.

Miklos Pannonhalmi, North Transdanubian District Water Authority, Györ, Hungary. 30 October 2001 (reply to questionnaire).

Wolfgang Stalser, Ministry of Agriculture, Forests, Environment and Water Management, Vienna, Austria. 12 November 2001.

Konrad Stania, Ministry of Agriculture, Forests, Environment and Water Management, Vienna, Austria. 9 November 2001.

Other material

(1959) Vertrag zwischen der Republik Österreich und der Ungarischen Volksrepublik über die Regelung der wasserwirtschaftlichen Fragen im Grenzgebiet. *Bundesgesetzblatt für die Republik Österreich* (58): 1573-1584 pp.

Anonymous, (1996) 40 Jahre Österreichisch-Ungarische Gewässerkommission. Jubiläumsschrift, Bundesministerium für Land- und Forstwirtscahft, Vienna and Ministrium für Verkehr-, Nachrichtenwesen und Wasserwirtschaft, Budapest, 70pp.

Anonymous, (1998) Water Management in Hungary at the turn of the Millennium. Ministry for Transport, Communication and Water Management, National Water Authority, Water Resources Research Centre, Budapest 48 pp.

National Park Neusiedler See – Seewinkel, (2001) National Park Neusiedler See - Seewinkel A crossroads of Biodiversity. Nationalparkgesellschaft Neusiedler See - Seewinkel, Illmitz.

Ramsar Database, (2001) Ramsar Database. *Accessed* 2 October 2001. http://www.wetlands.agro.nl/Ramsar_Database/Ramsar_Dir/Austria/At001d99.doc

PAPER II

Material on WFD implementation

Gudas, M., (2006) WFD and Spatial Planning (Lithuanian case), Presentation at the TRABANT WP2 workshop on the Interface of spatial planning with river basin management planning, 13-14 February 2006, Stockholm.

Herbke, N., (2006) Collaboration between WFD Implementation and Spatial Planning: Experiences from Schleswig-Holstein, Presentation at the TRABANT WP2 workshop on the Interface of spatial planning with river basin management planning, 13-14 February 2006, Stockholm.

Hiiob, M., (2006) WFD and spatial planning in Estonia, Presentation at the TRABANT WP2 workshop on the Interface of spatial planning with river basin management planning, 13-14 February 2006, Stockholm.

Krok, P., (2006) Spatial planning system / water management planning under the Water_Framework Directive in Poland, Presentation at the TRABANT WP2 workshop on the Interface of spatial planning with river basin management planning, 13-14 February 2006, Stockholm.

Langaas, S., (2006) Country report: Sweden, Presentation at the TRABANT WP2 workshop on the Interface of spatial planning with river basin management planning, 13-14 February 2006, Stockholm.

Lindblom, P., (2006) Interface of spatial planning and river basin management planning: Poland. Working report of Interreg IIIB project TRABANT WP2. Nordic Centre for Spatial Development, 33 pp.

Lithuanian EPA, (2004) Report on competent authorities, administrative arrangements and the general information on river basin districts of the Republic of Lithuania. Lithuanian Environmental Protection Agency, Vilnius, 38 pp.

Moss, T., (2006) Spatial Planning and the Water Framework Directive: the case of Germany, Presentation at the TRABANT WP2 workshop on the Interface of spatial planning with river basin management planning, 13-14 February 2006, Stockholm.

Mäkinen, H., (2006) Implementation of WFD in Finland and its connection to the Finnish spatial planning system, Presentation at the TRABANT WP2 workshop on the Interface of spatial planning with river basin management planning, 13-14 February 2006, Stockholm.

Stephan, U. and Gustafsson J.-E., (2005) Vattenförvaltning och aktörsdeltagande i Tyskland. *Vatten,* 61(3): 201-214.

SYKE, (2006) River basin districts. *Accessed* 12 June 2006. http://www.ymparisto.fi/.

Topilko, J., D. Zharkov, E. Lagzdina and Sare M., (2004) *Public Participation in water management in the Eastern Baltic Sea Region.* Global Water Partnership CEE, Public Participation Task Force, Tartu, Riga, Vilnius, Gdansk, 55 pp.

Vattenmyndigheterna, (2006) Vattenmyndigheterna. *Accessed* 13 June 2006. http://www.vattenmyndigheterna.se.

Veidemane, K. 2006. Spatial Planning and WFD in Latvian legislation. Presentation at the TRABANT WP2 workshop on the Interface of spatial planning with river basin management planning, 13-14 February 2006, Stockholm.

Latvian material

Interviews

Sigita Šulca, head of strategy unit, Water Basin Management division, Latvian Environment, Geology and Meteorology Agency, Riga, Latvia. 16 May 2006.

Iveta Teibe, project coordinator, Water Resources division, Environmental Protection Department, Ministry of the Environment, Riga, Latvia. 4 May 2006.

Dzintra Upmace, senior official, National and Regional Planning division, Spatial Planning Department, Ministry of Regional Development and Local Government, Riga, Latvia. 25 May 2006.

Other material

(2006) Draft statement on the policy planning development.

(2002) Law on Water Management.

(2002) Regulations regarding the National Spatial Plan.

(2004) Regulations regarding Local Government Spatial Planning.

(2005) Regulations on District Spatial Planning.

(2002) Spatial Planning Law.

FAO, (1997) Aquastat (electronic version). http://www.fao.org/ag/agl/aglw/aquastat/main/index.stm

Ministry of Environment, (2004) *The first report on implementation of the Water Framework Directive (2000/60/EC) in Latvia.* Ministry of Environment of the Republic of Latvia, State Geological Survey and Latvian Environment Agency, Riga, 9 pp.

Ministry of Environment, (2005) *Characteristics of the Latvian river basin districts, A review of the impact of human activity and the status of surface waters and groundwater, Economic analysis of water use.* Latvian Environment, geology and meteorology agency, Riga, 130 pp.

Ministry of Regional Development and Local Government, (2006) *Accessed* 7 February, 2006. http://www.raplm.gov.lv/

Oregon State University, (2002) International Freshwater Treaties Database. http://www.transboundarywaters.orst.edu/

Swedish EPA, (2003) *The Transboundary Waters Programme of the Swedish Environmental Protection Agency 1997-2002.* Swedish Environmental Protection Agency, Stockholm, 35 pp.

Upmace, D., (2001) Latvia and European Spatial Development Perspectives. In: M. Hansen and Böhme K., (eds.), *Spatial Planning in the Baltic Sea Region.* Nordregio, Stockholm**,** 24-30 pp.

VASAB, (2000) Compendium of Spatial Planning Systems in the Baltic Sea Region. http://www.vasab.leontief.net

Veidemane, K., (2006) Spatial Planning and WFD in Latvian legislation. Presentation at the TRABANT WP2 workshop on the Interface of spatial planning with river basin management planning, 13-14 February 2006, Stockholm.

Lithuanian material

Interviews

Aleksandras Gordevicius, head of Spatial Planning and Regional Development Division, Ministry of Environment, Vilnius, Lithuania. 30 May 2006.

Aldona Margeriene, director of Basin Management and Protection Department, Lithuanian Environmental Protection Agency, Vilnius, Lithuania. 09 June 2006 (reply to a questionnaire).

Mindaugas Gudas, head of River Basin Management Division, Lithuanian Environmental Protection Agency, Vilnius, Lithuania. 3 May 2006.

Other material

(2004) Law on Territorial Planning.

(2003) Law on Water.

Defris, (2005) *Sustainable Regional Spatial Planning and Working Methods*. Development of first division regions, BSR Interreg IIIB project, 9 pp (excluding appendixes).

ESPON, (2006) *Espon 2.3.1 Application and effects of the ESDP in the Member States National report Lithuania*. 30 pp.

FAO, (1997) Irrigation in the countries of the former Soviet Union in figures (electronic version). http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/W6240E/W6240E00.htm.

Gudas, M., (2006) WFD and Spatial Planning (Lithuanian case), Presentation at the TRABANT WP2 workshop on the Interface of spatial planning with river basin management planning, 13-14 February 2006, Stockholm.

Lithuanian EPA, (2004) *Report on competent authorities, administrative arrangements and the general information on river basin districts of the Republic of Lithuania*. Lithuanian Environmental Protection Agency, Vilnius, 38 pp.

Lithuanian EPA, (2005) *Report on Articles 5 and 6 of the Directive 2000/60/EC of the European Parliament and the Council of 23 October 2000 establishing a framework for Community action in the field of water policy*. Lithuanian Environmental Protection Agency, Vilnius.

Swedish EPA, (2003) *The Transboundary Waters Programme of the Swedish Environmental Protection Agency 1997-2002*. Swedish Environmental Protection Agency, Stockholm, 35 pp.

VASAB, (2000) Compendium of Spatial Planning Systems in the Baltic Sea Region. http://www.vasab.leontief.net.

PAPERS III-V

Material on international cooperation

(2003) Avtal med Finland om inrättandet av ett gemensamt avrinningsdistrikt. SÖ 2003:26, Utrikesdepartementet, Stockholm.

BMU, (2005) *Water Framework Directive - Summary of River Basin District Analysis 2004 in Germany*. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Berlin, 66 pp.

CTC, (2005) Peipsi.org. *Accessed* June 2005. http://www.peipsi.org/gef/

Haimi, P: South East Finland Environment Centre, Kouvola. Personal communication October 2005.

ICPOAP, (2005) International Commission for the Protection of the Odra River against Pollution. *Accessed* June 2005. http://www.mkoo.pl/index.php

Kinnunen, K: Lapland Regional Environment Centre, Rovaniemi. Personal communication June 2005.

Mathisen, R: Statens forurensningstilsyn, Oslo. Personal communication May 2005.

Miljöministeriet, (2005) *Vattenförvaltningsområden*. *Retrieved* June 2005. http://www.miljo.fi/

Ministry of Environment Estonia, (2005). Estonia and Latvia manage the transboundary water bodies together. *Retrieved* July 2005. http://www.envir.ee

Oregon State University, (2002) International Freshwater Treaties Database. http://www.transboundarywaters.orst.edu/

Roll, G., Maximova, T., & Aliakseyeva, N. (1999). *The Daugava Directory - Environmental Organisations, Water Protection and Management*. Center for Transboundary Cooperation, Tartu-Pskov, 20 pp.

SFS, (2004) Förordning om förvaltning av kvaliteten på vattenmiljön. 2004:660.

Swedish EPA, (2003) *The Transboundary Waters Programme of the Swedish Environmental Protection Agency 1997-2002*. Swedish Environmental Protection Agency, Stockholm, 35 pp.

Swedish EPA, (2005) *Beskrivning, kartläggning och analys av Sveriges vatten – sammanfattande rapport, Rapportering 22 mars 2005 enligt EU:s ramdirektiv för vatten (2000/60/EG)*. Swedish Environmental Protection Agency, Stockholm, 128 pp.

Topilko, J., Zharkov, D., Lagzdina, E., and Sare, M. 2004. *Public Participation in water management in the Eastern Baltic Sea Region*. Global Water Partnership CEE, Public Participation Task Force, Tartu, Riga, Vilnius, Gdansk, 55 pp.

Veidemane, K: Baltic Environment Forum, Riga. Personal communication October 2005.

Wirkkala, R.-S: South East Finland Environment Centre, Kouvola. Personal communication October 2005.

Spatial data and statistics

Banque HYDRO, (2006) Water quantity data for France. *Retrieved* March 2006. http://hydro.rnde.tm.fr/accueil.htm

Bund- Länder- Informations- und Kommunikationsplattform, (2006) WasserBlick. *Retrieved* April 2006. http://www.wasserblick.net/servlet/is/1/?lang=en

CISL, (2006) CISL'S Research Data Archive. *Retrieved* February 2006. http://dss.ucar.edu/datasets/ds552.0/

EEA, (2006) Waterbase. *Retrieved* September 2005 and November 2005. http://dataservice.eea.europa.eu/dataservice/available2.asp?type=findtheme&theme=water

ESRI, (2005) ESRI Data and Maps 2005. http://www.esri.com

Ireland's EPA, (2006) Water quantity data for Ireland. *Retrieved* March 2006. http://www.epa.ie/PublicAuthorityServices/HydrometricProgrammeandSurfaceWaters/

JRC, (2003a) Catchment Database (GISCO). *Retrieved* January 2003. http://data-dist.jrc.it/en/data-dist/catchment.html

JRC, (2003b) Global Land Cover for the year 2000. http://www-gvm.jrc.it/glc2000/

NERC, (2006) The National Water Archive. *Retrieved* March 2006. http://www.nerc-wallingford.ac.uk/ih/nwa/index.htm

Oak Ridge National Library, (2005) LandScan 2003 global population database. http://www.ornl.gov/sci/landscan/

SMHI, (2006) BALTEX Hydrological Data Centre. *Retrieved* March 2006. http://www.smhi.se/en/menyer/ind_hydro.htm

Other material

EC, (2005) National and International River Basin Districts. *Retrieved* August 2006. http://ec.europa.eu/environment/water/water-framework/transposition.html