

TRANSBOUNDARY RIVER BASIN MANAGEMENT

State-of-the-art review on transboundary
regimes and information management in the
context of adaptive management

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Authors	G.T. Raadgever, RBA Centre, Delft University of Technology E. Mostert, RBA Centre, Delft University of Technology
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Tom Raadgever

Centre for River Basin Administration, Delft University of Technology

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Preamble

Many people have cooperated in the realisation of this report. The individual basins were analysed at Ecologic - Institute for International and European Environmental Policy (Amu

Darya and Orange), RIZA - Institute for Inland Water Management and Waste Water Treatment (Guadiana and Nile), the Centre for Integrated Environmental Studies at the Free University of Amsterdam (VU-IVM) (Tisza) and the Centre for River Basin Administration at Delft University of Technology (RBA) (Elbe and Rhine).

Furthermore, some fruitful comments and discussions about the theoretical and analytical framework and the results of the analysis have taken place among the research partners. Hereby I would like to thank the authors of the basin reports: Nicole Kranz, Eduard Interwies, Antje Vorwerk, Rodrigo Vidaurre, Jos Timmerman, Jacco Doze and Erik Mostert and all others for their contribution.

All research partners are grateful for the support of the European Commission in providing funds for this research and to all others that have contributed to the project.

Tom Raadgever

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Executive Summary

This report provides a state-of-the-art review on transboundary ‘regimes’ and ‘information management’. Furthermore, it presents an analysis of regimes and information management in the NeWater case study basins and an evaluation of the extent to which they support adaptive management.

The report was prepared in the NeWater project (6th EU framework programme) that is aimed at studying and stimulating transitions towards more adaptive management (AM) of river basins. AM aims at active learning and continually improving management strategies. Active learning includes gathering comprehensive knowledge of the current system and expected changes, e.g. by experimentation or simulation. Because current knowledge is not sufficient for future water management, water management strategies need to be adaptable to new information and changing circumstances.

State-of-the-art review on transboundary regimes and information management

Almost half of the land surface of the earth is covered by international river basins. To manage these transboundary river basin effectively, the development and implementation of joint strategies is essential. Many activities can be undertaken in order to support joint river basin management.

Technical cooperation and information exchange form a good base for developing trust and political cooperation between the riparian countries. Involvement of multiple disciplines and sectors can open up a broad playing field with more opportunities for win-win situations and sustainable solutions. Furthermore, involving NGOs and the public in transboundary management can increase the acceptance of proposed strategies and donors can be a significant support in initiation or financing of transboundary cooperation.

International agreements should be based on voluntary decisions and reflect individual interests and resources as well as the principles of equitable and reasonable use, the obligation not to cause significant harm, and the duty to notify and exchange information. Furthermore, flexibility should be provided and plans should be updated periodically.

Case study basins

The case study basins of the NeWater project are the Amu Darya, Elbe, Guadiana, Nile, Orange, Rhine and Tisza basin. Each basin is confronted with specific issues. In the Amu Darya, Orange, Guadiana and Nile river basin the issues are mainly related to water scarcity, whereas in the Elbe, Rhine and Tisza basin, pollution and floods are the central issues. Effective and efficient management of these issues requires transboundary cooperation and an appropriate institutional framework.

Analysis of regimes

The transboundary regimes of the basins under study can be characterised by many similarities and differences. The most obvious similarity is that in every basin some form of structural transboundary cooperation (e.g. a river basin commission) has been established; the International Commissions for the Protection of the Rhine, Elbe and Danube River (ICPR, ICPE and ICPDR), the Orange-Senqu River Basin Commission (ORASECOM), the International Nile Commission (Nile-COM), the Interstate Commission for Water Coordination in the Aral Sea basin (ICWC) and the Commission for the Implementation and Development of the Albufeira Convention between Spain and Portugal (CADC). The Tisza and Amu Darya are sub-basins of the Danube and Aral Sea basin and the Guadiana is only one of the border rivers under attention of the CADC.

The tasks and responsibilities of the organisations differ strongly, as well as their functioning and effectiveness in reality. In the Rhine, Elbe and Guadiana basin, national governments have been the main initiating and financing parties. In the Amu Darya, Orange, Nile, and to a lesser extent also the Tisza basin, international donors have played a large role in the initiation and financing of basin organisations. It occurs that in the latter basins national governments are less committed and it is harder to develop and implement joint management strategies. Current transboundary cooperation in the African and Asian basins is therefore mainly aimed at developing trust and developing technical and institutional capacity.

The role of informal actors in transboundary water management is in general limited, due to both distrust by governmental actors and limited capacities of the stakeholders.

Analysis information management

Without sufficient information, effective and fair discussion of the main issues is hardly achievable. Thus, in all agreements concerning transboundary water management provisions have been included for better information exchange or even joint information production. In the framework of the ICPR, ICPE, ICPDR, Nile-COM and CADC several working or expert groups have been established for this purpose. The ICWC has its own Scientific Information Centre and in the Orange basin the SADC-HYCOS contributes to information exchange and management.

In practice, however, the production and exchange of information between formal actors has not been well-established in the Amu Darya, Guadiana, Nile, Orange and Tisza basin. Dissemination of information to stakeholders and the public is in general even more limited. Finally, the utilisation of information in transboundary decision-making is in many basins very limited, partly because the information production and exchange are not yet in operation.

Evaluation adaptive management

The extent to which the regimes and information management in the studied basins support adaptive management varies significantly. The Rhine regime currently offers the largest potential for adaptive management, followed by the Elbe, Tisza, Orange, Guadiana, Nile and Amu Darya. The regimes in the Amu Darya and Nile basins, as well the Orange, Guadiana and Tisza regimes, offer only little support to adaptive management. Although a first step has been made by developing institutions for transboundary cooperation, implementation of the intended institutional structures is still ongoing. As long as the political setting is not ready for a real transition, there will be little determination for the development of transboundary water laws and policies.

From the analysis it can be hypothesised that cooperation across administrative boundaries and joint information production are often part of the early phases of the transition towards AM. Somewhere in the middle of the transition an appropriate legal framework and financing system would be developed, policies would be developed and implemented and a broad communication including public participation would be established. Requirements for adaptive management that are still hardly existent in any of the studied basins are adaptable legislation, cross-sectoral cooperation, interdisciplinarity, cooperation between administrative levels, critical reflection on uncertainties, assumptions and mental models, and utilisation of information.

Recommendations

The activities that could be undertaken to stimulate the transition to more adaptive management differ from basin to basin. The transition has to be executed step-by-step and

might take decades. Goals and ambitions have to be adjusted to the current situation to make sure they are feasible.

Because the Rhine and Elbe regimes are already well-developed, the transitions towards more adaptive management can be focused on activities like stimulating cooperation with other sectors and disciplines and critical reflection on uncertainties, assumptions and mental models. In the Tisza and Guadiana basin the development of a more comprehensive framework of law and policy for transboundary RBM and the actual implementation of strategies are at the moment lagging behind other developments. The Orange regime could develop towards a better implementation of the institutional agreements through strengthening of the ORASECOM, intensifying information exchange and utilisation of information. Furthermore, a stronger legal and financial structure might be developed. As in the Nile and Amu Darya basin, donors play or have played a significant role. Commitment of national governments to transboundary cooperation needs to be developed further. In the Nile basin the legal framework needs to be improved. Because political support for change of the existing bilateral agreements is low, efforts might better be aimed at improving information management, actor networks and development and implementation of policies. In the Amu Darya the way to more adaptive management is still very long. It might be useful to focus on the further development of technical cooperation first, in order to create adequate technical capacities and mutual confidence.

Further research

It would be useful to perform a more detailed analysis of relevant regime elements and information management in the studied basins, to develop more valid insights and recommendations for specific activities supporting the transition towards more adaptive management in a basin. Besides analysis on the basin-scale, it is recommended to perform more detailed studies. Research should not only be aimed at analysis, but at the same time at stimulating the transition towards AM.

Furthermore, future research might be aimed at further development of the evaluation framework for AM, including the interactions between the criteria and the order in which changes towards more adaptive management occur. To achieve this type of knowledge, it is recommended to perform a more detailed analysis of occurred regime changes in time, in a limited number of basins. It would be interesting to include a more in-depth study of the relation between national and international regime development.

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1 Introduction

1.1 Aim of deliverable

This report provides a state-of-the-art review on transboundary ‘regimes’ and ‘information management’. Furthermore, current transboundary River Basin Management (RBM) in the Rhine, Elbe, Guadiana, Tisza, Amu Darya, Nile and Orange river basin is reviewed. The main aim is to analyse to which extent the transboundary regimes and information management support adaptive management (AM).

AM aims at active learning and continually improving management strategies. Active learning includes gathering comprehensive knowledge of the current system and expected changes, e.g. by experimentation or simulation. Because current knowledge is not sufficient for future water management, water management strategies need to be adaptable to new information and changing circumstances. Of central importance is therefore the development of adaptive capacity: the ability of the human-technology-environment system to respond to change rather than to react to undesirable impacts of change (Pahl-Wostl 2004).

The information presented in this report has been gained through literature review and in some cases additional interviews with the actors in the river basins.

1.2 Focus

A regime consists of formal institutions, like law, policy and government bodies, as well as informal institutions, like nongovernmental actors and cultural norms and values. The formal and informal institutions together influence operational water management and through this the performance of the water sector. In fact, the main factor influencing the performance of the water sector is the institutional performance (Saleth and Dinar 2004). Therefore institutional settings (or regimes) are an important aspect of (transboundary) RBM.

Another aspect of RBM, which is strongly related to the regime as well as to operational management, is information management. This report will zoom in on this aspect and explore whether current information management fulfils the information needs of AM of transboundary issues. Of central importance in this respect is the communication between the parties that need information (for decision-making) and the parties that provide information.

Because RBM covers a broad area, the analysis of the selected basins focuses on one or two issues that are relevant from the viewpoint of the actors in the basin as well as from the viewpoint of AM under uncertainty.

Three of the selected basins – the Rhine, Orange and Amu Darya – have been analysed to some more detail than the other basins, because they will be subject of additional case study research in the next phase of the NeWater project. The basins are selected because they offer an interesting perspective on several stages of a transition to more adaptive RBM.

1.3 Relation to other NeWater work

The NeWater project (6th EU framework programme) is aimed at studying and stimulating the transitions towards more AM of river basins. The project consists of theoretical workpackages (WPs) and interactions with water management in the Case study basin.

This deliverable (D1.3.1) is part of WP 1.3. ‘Transboundary regimes’. The comparative analysis is based on reports about the regimes and information management in the case study basins, which were established by the research partners in WP 1.3. The content of this deliverable is strongly related to that of Deliverable 1.2.1 (Huitema and Becker 2005), in which the current state of governance and the institutional arrangements are analysed for South Africa (Orange basin), Uzbekistan (Amu Darya basin) and Germany, Switzerland and



the Netherlands (Rhine basin). Both deliverables were produced in cooperation. D1.3.1 strongly focuses on the international scale, while D1.2.1 focuses on the national, regional and local scales.

This deliverable provides a basis for subsequent tasks within WP 1.3. The review will support the identification of points where the institutional settings and information management in transboundary issues could be enhanced. In combination with input from stakeholders, this information will give direction to the definition of a research agenda for each case study basin, which describes which approaches, methods and tools to support adaptive management will be analysed. Understanding this transition is the most crucial point for adaptive water management, because the adaptive management regime to be achieved will depend strongly on the path chosen (Pahl-Wostl 2004).

Furthermore, this report provides input to the following tasks and work packages:

- Task 1.2.5. Assessment of the influence of institutional settings and their interactions (across social sectors / administrative levels) on the ability to cope with extreme events;
- Task 1.6.2. Identification of data and information needs for IWRM;
- Work Package 1.7. Methods for the transition to adaptive water management. This work package will play a key role in integrating results of the various work packages, by developing an integrative conceptual and methodological framework for the transition towards adaptive water management regimes.

1.4 Structure of the report

This report begins with a description of the theoretical and analytical framework. In chapter two relevant elements of theory about regimes, information management and adaptive management are presented. Chapter three provides a review of previous research on transboundary river basin management and transboundary information management. A framework to analyse the regimes and the information management in the case study basins, and assess the extent to which they match the concept of AM, is developed in chapter four.

The results of the analysis are presented in chapter five, six, seven and eight. Chapter five provides a short description of the studied basins and the main (transboundary) issues. The next two chapters contain a description of the regimes and the information management in the basins. The evaluation of the extent to which the regimes support adaptive management is presented in chapter eight.

The report is finalised by some reflection on the evaluative framework for AM in chapter nine and conclusions and recommendations for further actions and further research in chapter ten.



2 Theoretical framework

In this chapter a review of the concepts regime, information (management) and adaptive management is presented. The theoretical review is aimed at contributing to the development of the analytical framework in chapter four.

2.1 Regimes

2.1.1 Regimes and institutions

The concepts 'regimes' and 'institutions' are very similar. Both refer to the 'established rules' that structure human behaviour, by reducing the chaos of an endless amount of possible actions to a complex, but tangible set of possible actions. However, there are many different definitions in use for these concepts.

A common definition of institutions is 'rules or regularities of behaviour that are generally accepted by members of a social group, that specify behaviour in specific situations, and that are either self-policed or policed by external authority' (Rutherford 2001). Institutions evolve from accumulated collective knowledge (Saleth and Dinar 2004) and are used as a substitute for information. In a world of perfect knowledge no institutions would be necessary. However, in the absence of accurate information, institutions provide a basis for making reasonably sound decisions by regulating the behaviour of others (North 1990). Because institutions regulate behaviour of others, power is also a relevant aspect of institutions. From yet another angle, institutions can be seen as frames: instruments for interpreting and giving meaning to the world around us. Because analysis of the 'subjective origins' of collective rules is very complicated, the focus of this report will be on describing their 'objective manifestation'.

In this report a regime is referred to as the set of institutions in a given issue area. This corresponds with the definition of regimes 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 (Verweij and Douglas 2000)).

2.1.2 Regime theory and International Relations

The analysis of international regimes has more and more become an important research area within the discipline of International Relations. In this field international regimes are seen as the 'rules of the game' agreed upon by the actors in the international arena (North 1990; Rittberger 1993). Regime theory strives to explain the formation, properties and consequences of these international regimes (Rittberger 1993).

The main distinction between the domestic and the international political arena is that the former lacks a central sovereign authority that is backed up by threat or use of physical force. The potential chaotic situation of anarchy is however structured by various types of social order. Besides hierarchical control by states or competition in markets, social order can also consist of communitarian and associative components ((Lindblom 1977; Streeck and Schmitter 1985) in (Rittberger 1993)). International relations are increasingly characterized by a complex blend of different kinds of social order. Collective self-regulation becomes more and more an important factor in solving collective transboundary problems. Examples of this collective self-regulation are the many, recently developed structures for international cooperation in RBM.

Differences in regimes can be explained by several institutional variables. Very important is the distribution of power between states. However, acknowledging the fact that international relations cannot fully be controlled by state power, the role of nongovernmental



organisations becomes increasingly important. Thus, all governmental and nongovernmental actors involved are relevant in the characterisation of a regime. Other variables that characterize a regime are the legal character, the comprehensiveness, the degree of specification and the ambition of the regime (Dieperink 1998). The ambition concerns the range of issues, the geographic and temporal scope, and the goals that are set to solve the issues. Finally, the presence or absence of a (multidisciplinary and influential) international community of experts and the degree of participation in decision-making can be used as variables to characterise a regime.

2.1.3 Types of institutions

Regimes consist of various types of institutions. A useful distinction can be made between formal and informal institutions. Formal institutions are explicit and officially announced, while informal institutions are not explicit and officially announced, but followed or used in practice. Both formal and informal institutions are relatively stable and durable features. In most sectors the informal institutions are most durable, but in the water sector the formal institutions change more slowly (Saleth and Dinar 2004). Because the evolution and performance of institutions is strongly path dependent, a review of the institutional development in recent history is very useful in the analysis of regimes.

Another useful distinction can be made between the institutional environment and the institutional arrangements (e.g. North 1990; e.g. Saleth and Dinar 2004). The institutional environment consists of fundamental political, social and legal rules, while the institutional arrangements provide an organisational structure within which the members of a society – individually or collectively – cooperate or compete (North 1990). Somewhat simplified, these categories refer to respectively the ‘rules of the game’ and the ‘players of the game’.

Formal institutions that are important for transboundary river basin management are (inter)national law, policy and governmental organisations. Law and policy form the formal institutional environment, whereas the governmental organisations form the formal institutional arrangements. Informal institutions can also be found in the institutional environment as well as in the institutional arrangements. Shared frames or social values that are not explicit or officially announced form the informal part of the institutional environment. Organisations, networks and individuals that are actively present in a regime, but that have no formal responsibility in water management, are in this report referred to as informal institutional arrangements, although their existence and function can be officially recognised. As stated above, the role of these nongovernmental actors is becoming more and more important.

2.1.4 Cultural influences

Social values with respect to a given issue area are to a large extent influenced by cultural aspects. A culture can be shared on the high-scale level of (groups of) nations, but also on the small-scale level of organisations. In fact, each group of people can develop common norms and values and individual frames are influenced by the cultures of all the groups that the individual participates in.

National cultures can be described using the dimensions power distance, uncertainty avoidance, individualism and masculinity (Hofstede 1991). Although it is disputable whether these dimensions are suitable in all cultural analyses, they are without any doubt useful to get a first impression on cultural differences. Cultural differences have to be accounted for in the analysis of interactions between countries that share a river basin and in the comparison between river basins. That is, shared social values might also exist at the river basin scale.

Grid-group theory focuses on the cultural bias of organisations, by which individual perception and behaviour are influenced ((Thompson, Ellis et al. 1990) in (Verweij and



Douglas 2000)). Based on the extent to which people are constrained by role differentiation ('grid') and the extent to which people commit to groups ('group'), four cultural typologies can be discerned: hierarchy, egalitarianism, individualism and fatalism. Part of the explanatory power of the theory is based on the connections that it makes between specific policy beliefs by people and their underlying cultural biases, which tell them how to go about realizing their policy preferences.

2.1.5 Regime change

Among others, three types of theories on regime change can be distinguished: theories of the evolutionary emergence of social conventions, market-based theories of exchange and selection through competition, and bargaining theories explaining institutions in terms of asymmetries of power ((Knight and Sened 1995) in (Saleth and Dinar 2004)).

An influential theory in the first domain explores the evolution of institutions for self-organisation and self-governance of small-scale common pool resources (Ostrom 1990). In a collective-action problem, a small and stable group of involved persons is not the most important precondition for institutional change. It is more important that most of the involved persons a) share the common judgement that they will be harmed if they do not adopt an alternative rule; b) will be affected in similar ways by the proposed changes; c) highly value the continuation activities from the common pool resource; d) face relatively low information, transformation and enforcement costs; and e) share general norms of reciprocity and trust that can be used as initial social capital. Although these conditions for institutional change might be less valid for evaluating large scale institutional structures (with differing and asymmetrical interests at stake), it seems useful to keep them in mind when assessing the adaptability of current river basin management regimes. Moreover, this theory can be used to emphasize that favourable conditions for the transition to more adaptive management regimes might not be created easily.

Others emphasize the role that individuals can have on institutional change (e.g. Majone 1989; e.g. Saleth and Dinar 2004). Policy actors do for example not always take the existing institutional framework as a fixed constraint. Although the rules of the policy game are fixed in the short run, on the longer term they can be changed. Policy actors apply this knowledge by not only pursuing their goals within the existing constraints, but also by striving to change these constraints in their favour. This insight can be useful for explaining the strategies and policy instruments that are applied by decision-makers (Majone 1989). The individual perception of the need for institutional change, based on either objective phenomena or individual-specific subjective factors, is the first step in the process of institutional change. In this process often four stages can be identified: perception change, procedural institutional change (e.g. concerning the structure of the policy process), substantive institutional change (e.g. concerning the measures included in policy) and actual performance impact (Saleth and Dinar 2004).

2.1.6 RBM institutions, planning and management

Now the concepts institutions and regimes have been considered, it seems to be useful to identify their place in the overarching concept of River Basin Management. RBM can be divided in four levels: the institutional framework, analytical support, planning and operational management (Mostert, van Beek et al. 1999). As indicated in Figure 1 (Left), the river basin and its users are directly influenced by operational management, which is in turn influenced by (strategic and operational) planning. Planning and management are both influenced by analytical support and all three levels are located within the institutional framework.

Another conceptual framework that describes the role of institutions in the management of shared river basins was developed by Savenije and van der Zaag (2000). The framework uses



the metaphor of the ‘classical temple’ (See Figure 1 (Right)). The foundation under the temple is the realisation that integrated water resources management should be done in an integrated way. The roof ‘sharing international water resources’ is supported by three pillars: politics, technical cooperation and institutional support. All three pillars are necessary elements to arrive at balanced management of international resources.

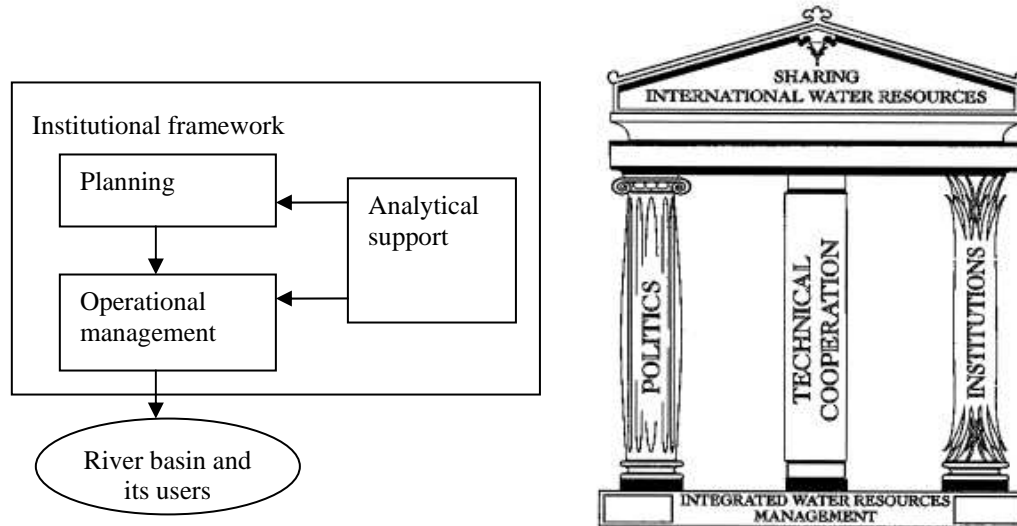


Figure 1. Frameworks for institutions, planning and management in RBM. Left: Levels in river basin management (feedback mechanisms not indicated) (Mostert, van Beek et al. 1999). Right: The classical temple of sharing international water resources (Savenije and van der Zaag 2000)

When we compare both frameworks, we see that the technical pillar of the classical temple consists of operational management and analytical support. The institutional pillar consists of the (inter)national legal and organisational framework. The politic pillar reflects the interests of (inter)national actors and the power play between them. Politics cannot explicitly be found in the framework of Mostert and van Beek et al, as the plans and policy cannot explicitly be found in the framework of Savenije and van der Zaag.

2.2 Information management

2.2.1 Information, data, knowledge and frames

Information can be defined in many ways. To address fundamental questions like ‘does information have a meaning’ it is useful to make a distinction between the concepts information, data and knowledge. Several authors propose a hierarchy of information that starts at the level of data and adds value or meaning to these data at every subsequent level. A useful distinction can be made between the following levels of information ((Barabba and Zaltman 1991) in (Sveiby 1998)):

- Data (numbers, words);
- Information (statements);
- Intelligence (rules);
- Knowledge (combination of the levels below); and
- Wisdom (combined knowledge bases).

This approach does, however, not explain how different levels of information interfere, for example how higher levels of information and lower levels of information are used to ‘produce’ information (statements).



Many authors share the opinion that data as such do not contain any meaning (e.g. Barabba and Zaltman 1991; Sveiby 1998; Working Group GIS 2002; Maurel 2003). Only after human interpretation some level of meaning can be added to end up with information (statements). Human beings use different sets interconnected rules of interpretation to understand, give meaning, perceive or interpret the world around them ((Rambaldi and Callosa-Tarr 2002) in (Maurel 2003)). Some authors call these sets of rules 'intelligence' or 'knowledge', but we will follow the area of science that refers to these sets of rules as 'frames'. A concept that is related to frames is the 'mental model', which is a conceptual mental representation of a specific aspect of the external world (cf. Doyle and Ford 1998; 1999; Pahl-Wostl 2004). Mental models are in fact some form of information formed by the continuous process of 'framing' (interpreting) objects, systems and processes in the external world. Figure 2 indicates how frames and the different levels of information influence are connected. Interpretation is influenced by frames of perception of the individual as well as the specific purpose of the interpretation.

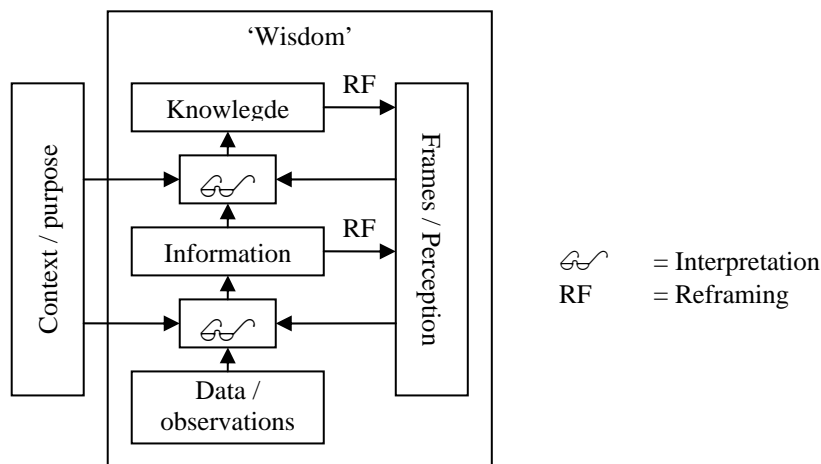


Figure 2. The role of frames in the interpretation of data and information

Regardless of the terms that are used, it is important to realise that people often derive different meanings from the same data, because they use different frames. For instance, a distinction can be made between cognitive (based on technical expertise), experiential (based on common sense and personal experiences) and value-based (social or political, based on perceptions of social values) frames (Glicken 2000). Another important notion is that frames can be explicit, tacit or unconscious (Maurel 2003; Roll 2004). Thus, information is developed in the individual's mind, but the frames that are used are often implicit. To create a shared understanding between multiple individuals about how a system works and how problems can be solved, it is important to make the mental models as well as the frames of an individual explicit.

2.2.2 Information transfer and learning

Recognising the difference between tacit and explicit knowledge (in the sense of information), Nonaka and Takeuchi (1995) identify four possible ways of knowledge conversion: socialisation (tacit \rightarrow tacit), externalisation (tacit \rightarrow explicit), combination (explicit \rightarrow explicit) and internalisation (explicit \rightarrow tacit). These conversions occur when individuals interact and can be stimulated to create knowledge in an organisation.

The interactions between the user and the supplier of information can be described with a 'knowledge transfer cycle' (Boersma and Blaauw 1999). Similar ways of describing the propagation of information in decision-making processes are the 'information cycle' (Timmerman, Ottens et al. 2000) and the 'impact-of-information chain' (Denisov, Rucevska



et al. 2004). The knowledge transfer cycle and information cycle are combined in Figure 3. The information impact chain describes a broader range of interactions - between the producers of information, the audience of its users, and the environment - and includes creating awareness, opinions and attitudes, decision-making and impacts on the environment.

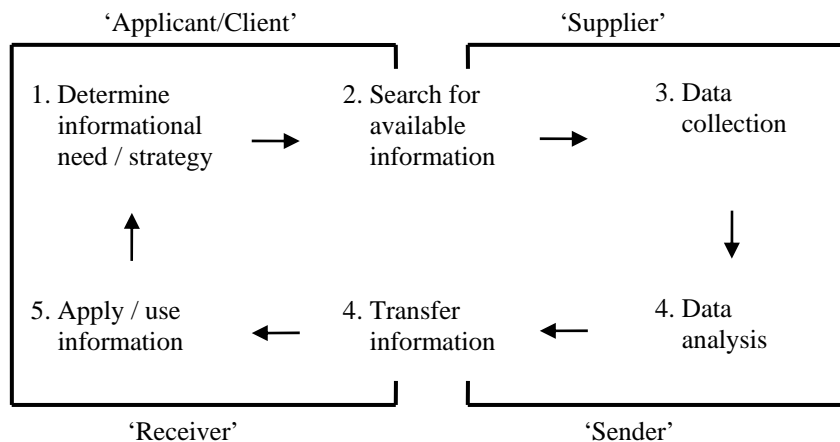


Figure 3. Information cycle and information transfer (cf. Boersma and Blaauw 1999; Timmerman, Ottens et al. 2000; UN ECE Task force on Monitoring & Assessment 2000)

Although the cycle in Figure 3 is a bit rigid, it can be used to make explicit what can go wrong (and often goes wrong) when information is ‘produced’. Often the ‘applicant’ does not know exactly what information is needed, what information is available and what information can be produced. Interaction between the receiver, supplier and applicant is needed to elicitate this. A second problem is to find out who can deliver the required information. Both problems have to be dealt with iteratively and in dialogue between the future users and the possible suppliers of information. When the information needs have been elicited and transferred to the supplier, the supplier has to find, select and/or produce the required information. To be sure the right information is produced, the applicant has to agree with critical assumptions that are made during this process, e.g. regarding the temporal or spatial resolution of a model. Subsequently, the supplier has to transfer the demanded information to the receiver, which requires capacities at both sides (and again deliberation). The exercise has been successful when the user receives and understands the information, changes its behaviour and can apply the information in an effective and durable way (Boersma and Blaauw 1999).

It may be clear that differing mental models can negatively influence the statement of informational needs, the interpretation of information and thus success of information transfer. Mental models are embedded in the frames of the involved individuals, which are partly determined by national and organisational culture. When the supplied information corresponds to the frame of the receiver, the receiver can adapt its behaviour based on the information. In case the information does not correspond to the frame of the receiver, either the received information or the receiver’s frame needs to be changed (‘reframing’) or simply nothing happens with the information. When the receiver of the information changes either its behaviour or frame, a learning process takes place. Learning can be seen as the process of creating new cognitions (information, knowledge or frames), new attitudes or new skills or actions. All these types of learning are important for the improvement of RBM.

In transboundary RBM many stakeholders with different frames and different ideas about which information is relevant for RBM are involved. Technically grounded actors for example prefer other types of information than decision-makers. Moreover the various actors have different interests and can apply strategic behaviour in interactions with others (e.g.



negotiations). This includes strategic use of information. As the lack of information can hinder proper definition of a situation or can hinder appropriate action, control over information gives an advantage over those who do not have this information. Also, information can be used as a ‘weapon’ by directing blame at other parties and by validating claims that it is for instance the other party that is polluting the water or causing floods. Further, information can be used as a commodity, where it contains a certain value and can be subject to trade (Timmerman and Langaas 2005). Strategic and irrational behaviour can be decreased when the whole network of stakeholders interacts to develop common insights in the behaviour of the river basin system and in appropriate management strategies. A useful strategy to stimulate this learning process could be to involve the stakeholders as much as possible in the production of information.

2.2.3 The DSPIR framework

It will be clear that there are multiple types of information and obtaining accurate environmental information involves multiple disciplines. The different types of information can be analysed with the DPSIR-framework, an often-applied causal framework for describing the interactions between society and the environment ((EEA 1999) in (Nilsson 2003)). The framework, which was adopted by the European Environment Agency, makes a distinction between Driving forces, Pressures, State, Impact and Responses. According to the view represented in the DPSIR-framework, social and economic developments are the Drivers (or Driving forces) that put Pressure on the environment resulting in a change of the environmental State. This changing State imposes Impacts on human health and ecosystems. Such unwanted Impacts induce societal Responses that feed back on the Driving forces, Pressures, State, or Impacts depending on the action taken. In Figure 4 the DPSIR framework is presented, including examples of the elements in the context of flood management.

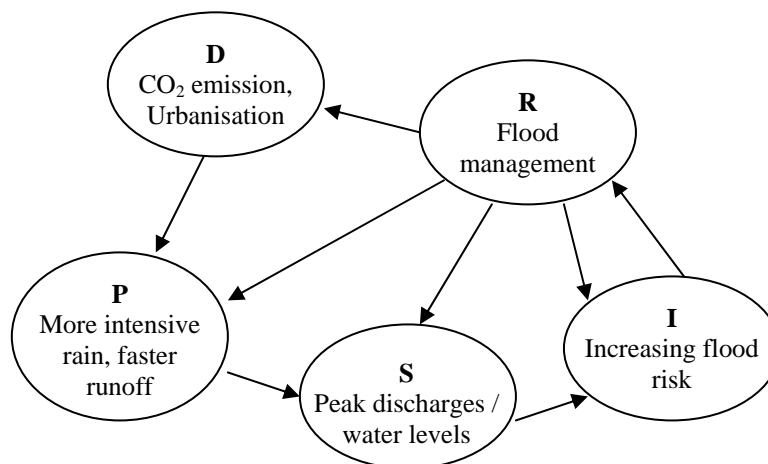


Figure 4. The DPSIR framework applied to an example of flood management

2.3 Adaptive management

2.3.1 Development of the concept adaptive management

The concept of adaptive environmental management originates from systems and complexity theory and was introduced in the 1970's (e.g. Holling 1978). In recent years the interest in the application of the concept has increased strongly (e.g. Geldof 1995; Pagan and Crase 2004; Pahl-Wostl 2004; Tompkins and Adger 2004).

Water management acts as a complex adaptive system that learns and evolves. Water management should not aim at reaching a state of equilibrium, which is impossible, but at



adapting to signals from outside the system boundaries (Geldof 1995). These signals can be new knowledge about natural systems, changing objectives and preferences of the community (Pagan and Crase 2004), or external developments. Individual mental models and frames adapt to these changes in natural systems and community values (Pahl-Wostl 2004).

The dynamic nature of ecological systems causes changes in the system state that neither are the result of human management nor can be predicted. Therefore 'even comprehensive knowledge of the current system is unlikely to be sufficient in the future' (Pagan and Crase 2004). Tompkins and Adger (2004) acknowledge this and suggest - as a strategy to deal with the threats posed by future climate change - to increase resilience by the extension and consolidation of social networks.

Three ways can be identified to structure management as an adaptive process (Pagan and Crase 2004): evolutionary or trial and error management, passive AM (using lessons from the past) and active AM (using policy and its implementation as a tool for accelerated learning). In this report 'adaptive resource management means continually improving management strategies and policies by learning from the outcomes of implemented management' (Pahl-Wostl 2004). This may include elements of evolutionary, passive and active AM. Although in theory active experimentation results in the fastest learning, it is not always possible. The other forms of adaptation can also contribute significantly to better management.

Within the NeWater project a three-day workshop has been dedicated to the development of the concept of AM (Pahl-Wostl 2005). A water management regime was referred to as the 'whole complex of technologies, institutions (= formal and informal rules), environmental factors and paradigms that are highly interconnected and together form the base for the functioning of the management system targeted to fulfil a societal function'. It was assumed that distinct management regimes can be identified, among which AM.

Furthermore, it was noted that the idea of AM is a valuable addition to the concept of Integrated Water Resource Management (IWRM). IWRM would emphasize the goals to be achieved for sustainable water management, whereas AM would refer to the means to reach these goals. The NeWater project is based on the hypothesis that the transition towards more AM regimes is necessary to realise IWRM (Pahl-Wostl 2005).

2.3.2 Elements of adaptive management

Several authors have tried to clarify the concept AM by stating a number of characteristic elements. Geldof identifies five elements of (active) adaptive water management (Geldof 1994):

- Humanising water management (communication);
- Flexibilisation of evaluation mechanisms;
- Learn to manage complexity;
- Accept subjectivity;
- Accept uncertainty to a certain level.

Although these elements do form a part of AM, it is hard to use them as criteria to 'measure' to what extent a regime is adaptive. At the previously mentioned NeWater workshop about the concept AM, it was assumed that distinct management regimes can be identified based on the following characteristics:

- Management paradigm;
- Mode of governance (institutions and actor networks);
- Information management;
- Present technical infrastructure;



- Scale(s) of analysis and operation; and
- Environmental factors taken into consideration.

In Figure 5 similar characteristics are represented for a stereotype ‘prevailing regime’ and an ideal ‘adaptive regime’. Moreover, the elements that are necessary for the transition towards an adaptive regime are identified. A typical order of change has not been identified so far.

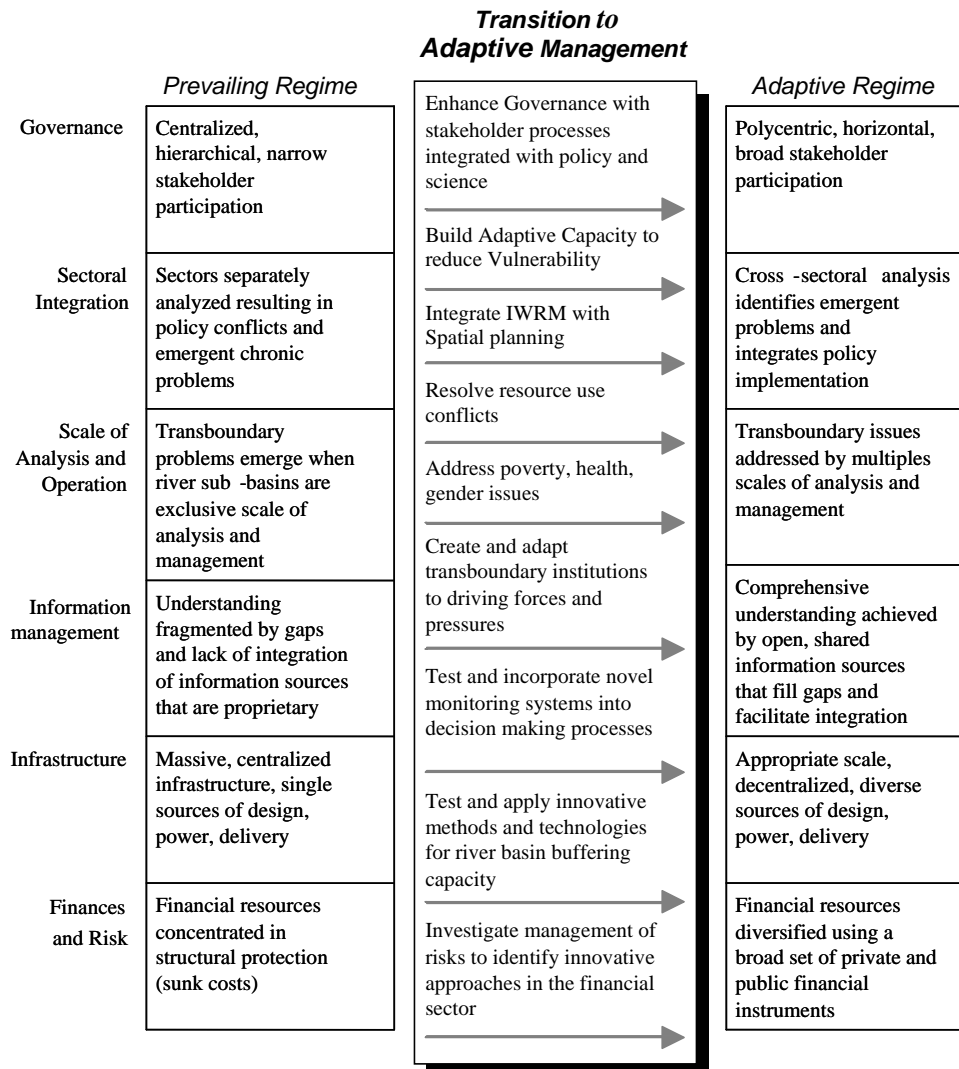


Figure 5. Major factors that determine the transition from the prevailing to an AM regime (Pahl-Wostl, Downing et al. 2005)



3 Review state-of-the-art research

In this chapter an overview is presented of the state-of-the-art of research on transboundary regimes and information management. It includes the general conclusions of previous research in the international river basins in the world. Because previous research, in particular on information management, has been concentrated on Europe, this chapter might be biased to the European situation.

3.1 Transboundary regimes

3.1.1 International rivers basins of the world

There are 261 international river basins in the world, covering 45.3 percent of the land surface of the earth (excluding Antarctica). Although Europe is the continent with the highest number of international basins (71), Africa (62%) and South-America (60%) have a larger percentage of area within an international basin than Europe (54%). A total of 145 countries include territory within international basins, of which 21 countries are covered entirely by international basins. Nineteen basins, including the Rhine and the Nile basin, are shared by five or more countries (Wolf, Natharius et al. 1999).

3.1.2 Transboundary conflict and co-operation

Unilateral action in international basins is often ineffective, inefficient or simply impossible and can harm the countries that share the basin. This type of actions can lead to conflicts over water. A distinction can be made between five basic sources of conflict (UN ESCAP 2003):

- Relationship conflicts, rooted in poor communication, misperceptions, duelling egos, personality differences, stereotypes and power struggle;
- Data conflicts, resulting from a lack of important information, contradictory information, misinformation or different 'frames';
- Values conflicts, based on disagreement about what is good or bad, right or wrong or just or unjust;
- Structural conflicts, resulting from a situation that is set up in a way that conflict is built in, like unreasonable time or physical constraints or unequal power or authority;
- Interest conflicts, based on substantive, procedural or psychological issues.

The first three types of conflicts can be solved by communication, exchange of information and perceptions, and developing a shared understanding. Structural conflicts can be resolved by restructuring the situation in which the conflict was built-in. Finally, interest conflicts can only be resolved by addressing (a significant part) of the interests of the conflicting parties (UN ESCAP 2003). Issue linkage, or in other words making the resolution of one issue dependent upon the resolution of another, is often successfully applied to address the interest of multiple parties. Alternative strategies for conflict resolution are the offering of payments, the threat of an action before the International Court of Justice and the use military strength. Maintaining good relations is however the most powerful strategy for reaching agreement and preventing any type of conflict in international issues (Mostert 2003).

**Box 1. The Jordan basin peace treaty (Fischhendler 2004)**

For over decades Israel and Jordan have been confronted with continuous water shortages. In 1994 Israel and Jordan concluded a peace treaty, which included an annex addressing both water and the environment. A Joint Water Committee was established to implement the agreement regarding the shared water along the border, including the water of the Jordan and Yarmouk River and the Arava groundwater. The main tradeoff in this agreement was that Jordan provided Israel with groundwater from the Arava in the South in return for Israeli water from Lake Kinneret in the North. Furthermore, Israel allowed Jordan to use Lake Kinneret as a joint storage facility. During crises both sides would share water deficiencies and disputes would be resolved through negotiations.

In the years after the peace treaty was signed, the treaty proved to offer only a partial remedy against conflict, because the agreement left a lot of room for interpretation. Many additional negotiations were necessary to prevent controversies during water shortage from becoming conflicts. Moreover, it is unclear how the treaty will function in the future. The upper riparians Syria and Lebanon, who are not part of the agreement, are expected to their water use and there is also uncertainty about the Jordan plans to further dam the Yarmouk, because the treaty lacks in clarity concerning such an action.

Wolf and Yoffe et al (2003) have compiled a database of every reported interaction between two or more nations, where water is the driver for conflict or cooperation. The database contains the river basin, the involved countries, the scaled intensity of each event, the issue type and a summary of the event. A GIS that contains approximately 100 layers of biophysical, socio-economic and geopolitical spatial data was developed, to be able to assess the historical setting in which each event of conflict/cooperation took place. Subsequently, hypotheses were developed about what factors could be indicators for conflict or cooperation and these hypotheses were tested by statistical analysis.

The event database indicated that most interactions are mild and cooperative, water can act both as an irritant and as a unifier, nations cooperate in a wide variety of issues and nations conflict mainly over quantity and infrastructure. The analysis of indicators showed that parameters that are commonly used to identify conflict, like climate, water stress and population are only weakly linked to dispute. The study suggest that the institutional capacity within a basin is as important, if not more so, than the physical aspects of a system. The authors hypothesize that 'the likelihood and intensity of dispute rises as the rate of change within a basin exceeds the institutional capacity to absorb that change'. Therefore extremely rapid changes in the institutional environment or in the physical river basin could be the most significant indicators. These rapid changes take mainly place in 'internationalized' basins - where 'institutions were developed under a single jurisdiction, but are altered or shattered as the jurisdiction suddenly becomes divided among two or more countries - or when major projects are planned in hostile and/or institutionless basins'.

The Mantra East project explored 'Integrated Strategies for the Management of Transboundary Waters on the European fringe' and used Lake Peipsi and its drainage basin as a pilot study. The point of departure of the project was the EU Water Framework Directive as the central tool for the environmental management of transboundary river basins in Europe (Peipsi Centre for Transboundary Cooperation 2005). In one of the Mantra East working papers, about 140 articles and books about existing structures, models and practices for transboundary water management were reviewed (Gooch, Hoglund et al. 2002).

With respect to transboundary cooperation, Gooch and Hoglund et al (2002) conclude that there are several reasons for states to cooperate in environmental issues. First of all, states tend to interact with other states to defend their interests in transboundary issues. When states recognise that they are confronted with the same problem (problem symmetry), the



opportunities for cooperation increase (cf. Dieperink 1998; Marty 2001). However, there are more triggers for cooperation. Many authors, who studied the 1986 Sandoz incident, which resulted in severe pollution of the Rhine downstream of Basel, state that crises can be a major trigger for cooperation (cf. Dieperink 1998; van der Zaag and Savenije 2000). Others claim that political and economical changes, like the fall of the Berlin Wall and the termination of the Apartheid regime, can give opportunities for collaboration (Nachtnebel 2000; van der Zaag and Savenije 2000). Furthermore, contacts between states in other fields, as well as the wish to develop or maintain good international relations (Mostert 2003), can trigger transboundary cooperation in water management. A major factor that hinders cooperation is a lack of compatibility between monitoring, information and data management systems (Dieperink 1998).

To prevent conflicts and stimulate co-operation, a wide variety of institutional solutions can be and has been developed. Mostert (2003) explored the development and effectiveness of the institutions in 35 case studies concerning international freshwater resources, with a wide geographical spread and a wide variety of contexts. The most common topics for co-operation in these case studies were water scarcity and water allocation, followed by water pollution, shipping, hydropower development, flooding, fisheries and boundary issues. The case studies suggest that the development of effective international cooperation takes at least ten years. With some reservations, Mostert finally concludes that a paradigm shift is taking place 'from national water resources development to integrated, participatory river basin management'.

Box 2. Institutional arrangements for the management of the transboundary Incomati river in Southern Africa (Hilders and Slinger 2005)

The Incomati basin is shared by Mozambique, South Africa and Swaziland. Already in 1983 the Tripartite Permanent Technical Committee (TPTC) was officially established, to advise the three governments on water use and water policy. In 2002 the Tripartite Interim Agreement (TIA) on water sharing of the Maputo and Incomati River was signed, including the IWRM principles of the Dublin and the Rio Declaration (see section 3.1.3). However, the availability, adequacy and use of information appeared to be insufficient for future decision-making.

Hilders and Slinger studied the information usage and its influence on the functioning of the TPTC. A water management body would function well when it can develop effective and efficient water sharing rules and operate the system accordingly. A number of problems and underlying causes were identified, among which: cultural and language differences, differences of perception, lack of stakeholder involvement, political commitment and capacity and a weak mandate of the international decision-making body.

Hilders and Slinger concluded that the functioning of the TPTC could be improved by both improving the international institutional structure and improving the perception each country holds of the other countries. Furthermore the analysis indicates that when designing an international institutional structure the socio-political interface is as important as information flows to the water managers.

3.1.3 International principles

There are several principles for (transboundary) integrated water resource management or river basin management established in international agreements. The most important ones are presented below.

In 1992, the International Conference on Water and the Environment was held in Dublin, Ireland to serve as the preparatory event, with respect to water issues, to the Rio United Nations Conference on Environment and Development. The principles as developed in



Dublin are the key concepts to integrated and sustainable water resources management with an emphasis on demand driven and demand oriented approaches and with decision-making at the lowest possible level ((ICWE 1992; UNCED 1992) in (Savenije and van der Zaag 2000)). The principles are (ICWE 1992):

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

The UN ECE Convention about the Protection and Use of Transboundary Watercourses and International Lakes was adopted in 1992 in Helsinki. The objective is to strengthen national and international measures aiming at protection and ecological sound management of transboundary waters. The principles that the parties to the convention agreed to follow are the 'precautionary principle', the 'polluter pays principle' and the 'sustainability principle' (UN ECE 1992).

The 1997 UN Convention on the law of Non-navigational Uses of International Watercourses strengthens the Helsinki Convention. Moreover it stresses as key principles the 'reasonable and equitable use of water resources' and the obligations 'not to cause significant harm', 'to cooperate' and 'to regularly exchange data and information' (UN 1997). However, the vague formulation and the lack of methods, guidance and specific provision have hindered the application of these principles in practice (Gooch, Hoglund et al. 2002).

The UN ECE Convention on Access to Information, Public Participation in Decision-Making, and Access to Justice in Environmental Matters, was adopted in 1998 in the Danish city of Aarhus at the Fourth Ministerial Conference in the "Environment for Europe" process. In 2001 seventeen states had ratified the Convention and the Convention entered into force. The Convention links environmental rights and human rights by acknowledging the right for all citizens now and in the future to be involved in sustainable environmental development. It ensures to all citizens ((UN ECE 1998) in (Frijters and Leentvaar 2003)):

- The right to access to environmental information;
- Public participation in environmental decision-making;
- Access to justice in environmental matters.

A last agreement to be mentioned here is the European Water Framework Directive (WFD), which has a large impact on RBM in Europe. The purpose of the WFD is manifold, but the main idea is to reach 'good water status' by 2015, using the natural geographical and hydrological unit for the management organisations instead of the former administrative or political borders (See further section 6.1.2).

3.1.4 Transboundary policy implementation

A major problem of joint water management is that the actual implementation of international policy has to be done on the national, regional or local level. Therefore, the efficiency is dependent on the legitimacy in the eyes of a number of different actors in the participating countries, like municipalities, stakeholders and citizens. Another major risk is that politics in other issue areas can come into conflict with water management aims. Integrated water resource management is aimed at a balanced prioritisation between different objectives. Public participation and communicative approaches to manage governance networks have become important tools to deal with these problems.



3.1.5 Transboundary water management in Europe

With respect to transboundary management in Europe, Gooch and Hoglund et al (2002) conclude that agreement in literature can be found on the following points:

- There are severe environmental problems in the European transboundary waters;
- Knowledge about the environmental condition is important to convince decision-makers and the public of the seriousness of the problem;
- Cooperation is a prerequisite for solving environmental problems;
- A solution has to involve an integrated approach and perceive the entire river basin as an entity of management;
- The involved parties have to share information and harmonise databases;
- One of the most important tasks of a joint commission is the collection and dissemination of scientific information.

The examined literature however disagrees on the:

- extent to which citizens should be involved in the management process;
- measures that should be taken to reach the goal of sustainable water management (market-based tools versus community-based tools); and
- tasks that a joint commission or river basin authority should have.

Gooch and Hoglund et al finalise their literature report with some reflections on a more cooperative, effective and democratic management of transboundary waters in Europe. They state that cooperation processes are not only based on rationality (interests), but also on the participants' perceptions of the problems and the other actors. A process characterised by communicative rationality deals with both ratio and perception and therefore the (policy) outcome of such a process has a good chance to be legitimate in the eyes of the participating actors.

3.1.6 Involving donors in Transboundary RBM

In many basins (e.g. in developing regions) transboundary cooperation is initiated and financed by international donors. Although their role is limited, it can still be significant. Donors can (Mostert 2005):

- support the conclusion of an international treaty;
- support the resolution of the underlying issues and promote action on the ground;
- support social, economic and / or political change in the basin;
- provide continuing support after conclusion of an agreement.

The instruments that can be used include exchange of expertise, capacity building, provision of capital (e.g. loans), financial support for specific activities and direct intervention (e.g. mediation). Although information about the effectiveness of donor involvement in transboundary RBM is scarce, Mostert (2005) formulated six recommendations for effective donor involvement:

1. Effective donor involvement starts with a critical assessment of the motivations and capacities of the donor himself;
2. Donors should build on developments within the basin and promote ownership;
3. All stakeholders should be involved, not just 'states'. In absence of interest, public participation can however not be imposed;
4. Past experiences should be evaluated to learn about their effectiveness;
5. Donors should regularly reconsider the suitability of their activities in a basin;
6. Plans, evaluations and reviews should be published on the Internet to facilitate learning.



3.2 Transboundary information management

3.2.1 The role and use of information in transboundary water management

Nilsson (2003) reviews various existing models that may be used for understanding the role and use of information in transboundary water management and assesses the information management in three transboundary water regimes in Europe. Three categories of models and approaches to information management are identified. Information management models (e.g. the DPSIR framework) can be used for managing and assessing different types of information; information cycle models explain the production and communication of data from a producer/sender perspective; and the third group of approaches focuses on the communication between (different types of) actors.

Nilsson applied models from the first two categories to explore information management by the international water commissions for Lake Neusiedl, Lake Constance and the Elbe River. All three commissions have an expert or technical perspective. Because of that, the need for and collection of state and environmental impact information (elements of the DPSIR-framework) dominate. Although Nilsson agrees with van der Zaag and Savenije (2000) that gathering and sharing such information is a basic requirement for sharing a transboundary basin, she emphasizes that integrated water management also requires other types of information. Nilsson refers here to an experimental study that demonstrated the need for information about driving forces, pressures and responses (See Timmerman, Gooch et al. 2003). Another similarity is that the commissions mainly use passive channels for communication with stakeholders and the general public. Besides these similarities there are also some differences in information management in the three basins. Only the Elbe commission acknowledges the information needs of stakeholders and the public and as a result communicates most actively with these parties. Moreover, the collection of (different types of) information is performed most systematically in the Elbe basin. This can be explained by the assumption that the greater number of water users in the Elbe basin poses higher demands on the management of different types of information and puts a higher pressure on government to generate reliable information. Additionally, the Elbe commission has been established most recently, in response to severe pollution, and has the most extensive mandates. It should be noted that the Elbe is the only river case study. Lake management may be easier to some extent as the countries share the same problem, whereas in river management there often is an upstream-downstream inequality in problems and possibilities to deal with them. This could very well be the underlying reason for the differences in information management (Timmerman and Langaas 2004).

Considering the requirements of IWRM and the WFD, Nilsson recommends basin commissions to take the information needs of stakeholders and the public into account, to develop more participatory approaches to communicate with them and to balance information collection by focusing more on driving forces, pressures and responses. This advice does however not fit to (developing) basin commissions (e.g. in Africa and Asia) that only have very little influence on actual RBM.

3.2.2 Environmental information in European transboundary water management

Information management has been one of the focus areas of the Mantra East project and the research on this topic has resulted in a book containing articles about environmental information in European transboundary water management (Timmerman and Langaas 2004). The editors completed the book with some general conclusions clustered along the lines of the framework of the classical temple as developed by Savenije and van der Zaag. These conclusions are summarised below.



In the political pillar the use and communication of information between decision-makers play a central role. Information can influence decision-making in many ways. First of all, information can be used in a rational way. A second view is that information is used, but rationality is bounded by the fact that different people value information in a different way. People interpret information based on norms, values and beliefs. A third view on decision-making is the social-practice model, according to which the dominant societal norms and values are the main drivers for people's behaviour and not information.

In the process of transferring information, the content and the appreciation of information as well as the power connected to the possession of information play a role. A common understanding of a situation and common interests trigger cooperation, because building mutual trust diminishes the role of power.

The production of information and the communication between consultants, scientist or experts and decision-makers is part of the pillar of technical cooperation. The information cycle provides an analytical framework for information production, but does not support the flow of information through the river basin management process. In information production the focus needs to be shifted to 1) determining the goal of information production and dissemination, 2) determining the informational needs of the relevant actors, 3) accounting for differences between countries in technical ability and the approach to the production and dissemination of information, 4) integrating similar disciplines on different sides of the border and 5) thinking of presentation in the dissemination of information (e.g. using GIS).

The legal framework sets the context for institutional actors and is the driver for the behaviour and the professional activities of these actors. The behaviour of an institutional actor can be rational, bureaucratic or political. Rational behaviour leads to an orderly use of information, bureaucratic behaviour to a procedural use and political behaviour to a disorderly or strategic use. Differences in types of institutional behaviour on either side of the border can hinder cooperation. This situation can be caused by differences in historical and cultural background created in the context of a different legal framework.

Transboundary commissions are necessary for cooperation in transboundary river basin management. Transboundary commissions, however, often have a technical bias, limited size and abstract level of thinking. Public participation is needed to incorporate public concerns at the local level, and in participatory processes full access to information is required for all participants.

The classical temple is based on the integration of various spatial and temporal scales and integration of various disciplines. Indicators can be defined and quantified to enable decision-making on such dissimilar scales. Integrated problem assessment should from the start be an effort of joint disciplines, and the need for preparation – 'to ensure that the right problem is addressed in the right way' – cannot be overemphasised.

The roof of the classical temple, sharing of international water resources, requires that common goals are set. If sustainability is preferred as a goal, the diversity of functions of water resources should be taken into account, which requires public participation and full access to information for the participating parties. The technical/scientific bias of commissions however hinders involvement of stakeholders and the public. Another major hindrance to the practice of transboundary cooperation is the fact that downstream problems are often not of direct concern to the upstream country.

The conclusions can be summarised by the statement that 'information production lags behind developments in water management'. Some aspects that hinder production of improved information are (Timmerman and Langaas 2004):

- strong disciplinary boundaries;



- insufficient consideration of information needs and goals of information dissemination prior to information production and reluctance of actors to participate in processes aimed at this consideration;
- differences in institutional behaviour that hinder cooperation between institutions; and
- insufficient tuning of organisational structures to the needs of the external environment.

And even though information production may be improved, the use of information will still be limited because of (Timmerman and Langaas 2004):

- different valuation of information by people with dissimilar beliefs, values, norms and cultural habits;
- insufficient access to information for all actors;
- insufficient communication channels; and
- insufficient coordination between different levels and scales.

3.3 Existing guidelines for transboundary management

There are a lot of guidelines for river basin management and integrated water resources management. In this section only those that focus on transboundary aspects are presented. It is difficult to identify specific methods, tools or techniques that are exclusively suitable for transboundary management. However, institutions in the form of river basin commissions are widely recognised to be beneficial for transboundary management. Moreover, there are many tools or methods for information management and decision-making and also many for involving the public or stakeholder in these processes.

Several authors recommend concrete actions or strategies to enhance transboundary river basin management. These actions and strategies will be summarised below. Factors that do trigger transboundary cooperation but cannot be applied as management instrument, like natural disasters and political revolutions, are omitted from the list. Because some of the sources reviewed here were also explored in the Mantra East project, some of the previously stated conclusions might be repeated in the list.

First of all, the case studies on which the lessons were based are described in short, to give an idea of their validity for other cases:

- Van der Zaag and Savenije (2000) studied cases in Europe and Africa that were presented at the Maseru conference of 1997 and drew conclusions that are considered to be of a more general nature. They conclude that ‘finally, one can observe that the process towards sharing of international rivers may be as important as the result, and that this process is one of continuous learning. Basin organisations in EU and SADC could benefit from each other's experiences, and quicken the learning process [...]. A next step could involve the exchange of technical expertise between basin organisations, for instance through twinning agreements’;
- Huisman and de Jong et al (2000) studied transboundary cooperation in the basin of the Rhine and Meuse and the North Sea. They conclude their article with the notion that ‘history and experiences of the international cooperation in the Rhine basin and North Sea area can help to recognise and analyse the situation in other transboundary river basins and seas’;
- Marty (2001) studied the institutional and political determinants of efforts at managing international rivers, and investigated and compared five cases (Austria – Switzerland, India – Nepal and three cases in the USA – Mexico);
- Wolf (1998) studied the plausibility of future water wars and concluded that ‘international water is a resource whose characteristics tend to induce cooperation and incite violence only in the exception’. The lessons presented below are concluded from studying 145 water-related treaties that were signed in the 20th century;



- Finally, Mostert and van Beek et al (1999) developed recommendations and guidelines on sustainable river basin management in an expert meeting that was organised in preparation of the International Workshop on River Basin Management in 1999. The guidelines for 'the management of international river basins' are included in the overview below.

The cases that were studied in the above-mentioned studies are located all over the world. Because most case studies were performed in Europe and subsequently Africa and North America, the conclusions might be biased towards the situation in these continents. They might be less valid for Asia (in a strict sense Australia does not share international basins). In the list below the conclusions of the authors are as much as possible combined and furthermore the points on which the authors disagree are indicated. The conclusions are structured in the categories formal actors, informal actors, agreements (law and policy), information management and financial aspects. The conclusions have been used in the development of criteria to evaluate AM in transboundary basins (See section 4.3).

A. Formal actor network

A1. Adequate capacities

The cooperating countries should all have adequate technical capacities and negotiating skills. Joint capacity building helps to develop these capacities (van der Zaag and Savenije 2000).

A2. Mutual confidence

Mutual confidence is the only basis for successful cooperation and the development of trust requires small steps (Mostert, van Beek et al. 1999; Huisman, de Jong et al. 2000).

A3. Dispute amelioration

Water dispute amelioration is as important as and less costly than conflict resolution. Early cooperation requires that incentives are made sufficiently clear to the riparian countries (Wolf 1998).

A4. International river basin commission

The presence of an international river commission is beneficial for both information management and for negotiations (Dieperink 1998). International commissions are almost indispensable for international basins located in more than two states and advisable for many basins located in two states (Mostert, van Beek et al. 1999). Marty is also in favour of linking administrations. The UNECE Water Convention (1992) also foresees the establishment of joint bodies as one of the main vehicles for transboundary cooperation.

A5. International river basin authority

International river basin authority with decision-making authority and enforcement powers can be practical for performing specific operational tasks, like restoration of water quality or operation and management of infrastructure (Mostert, van Beek et al. 1999).

A6. Cooperation between river basin organisations

Cooperation and mutual support between river basin organisations are important means of strengthening river basin management. Twinning is an important form of such cooperation. Cooperation is most effective between organisations that have some similar characteristics (Mostert, van Beek et al. 1999).

A7. Interdisciplinarity

Because water is by nature an interdisciplinary resource, the attendant disputes can only be solved through active dialogue among disciplines. Institutions have to be developed that support this interdisciplinarity (Wolf 1998). Mostert and van Beek et al advise to establish a multilateral interdisciplinary forum to develop general principles and minimum standards for the sustainable management international river basins.



A8. Downstream initiatives

Downstream parties often have to be alert and creative to convince upstream parties of the need for cooperation (Dieperink 1998; van der Zaag and Savenije 2000).

A9. Account for differences between countries

In transboundary water basins, activities on communication and information are much more important than in the national context, as information is exchanged across different legal and institutional frameworks, cultures and languages, sometimes with different problems and issues (Gooch, Stalnacke et al. 2006).

B. Informal actor network

B1. Public involvement

(Nongovernmental) stakeholders and the general public should be involved, although this may take a lot of time initially, to support cooperation and enlarge the acceptance of proposed measures (Huisman, de Jong et al. 2000; Marty 2001).

B2. Active stakeholders

Nongovernmental actors that are confronted with a problem themselves should get active, rally forces and commit the government (Marty 2001).

B3. International donors and banks

Donors and banks can play a positive role (Wolf 1998; Mostert, van Beek et al. 1999; Mostert 2005). Donors and recipient countries should coordinate funding programmes in order to ensure a coherent approach and long-term solutions (See further section 3.1.6).

C. Agreements

C1. Voluntary decisions

Only voluntary decisions by riparian states create the basis for sustainable cooperation on an international level (Huisman, de Jong et al. 2000).

C2. Broad 'playing field'

To reach agreements on transboundary issues, the playing field needs to be broadened, involving other sectors than just the water sector, to open up new opportunities for win-win situations (issue-linking) (Mostert, van Beek et al. 1999; van der Zaag and Savenije 2000) and to avoid considerable harm to the ecosystem (Huisman, de Jong et al. 2000). Marty however seems to oppose issue linkage, because he advises to 'separate, focus and simplify'.

C3. Interests and resources

Management solutions should be adapted to interests and resources (Marty 2001). Conflicting interest could be overcome by issue-linking, financial compensation and accepting less favourable agreements in the expectation that other countries will do the same ("diffuse reciprocity") (Mostert, van Beek et al. 1999).

C4. Flexibility and adaptation

Flexibility should be provided for (Marty 2001). Plans should be updated periodically to give the opportunity to adapt objectives and measures to the changing conditions and opinions in society (Huisman, de Jong et al. 2000).

C5. Specific agreements

Agreements should be specific (Marty 2001). Pollution of the Rhine from point sources was, however, successfully reduced by stating only a common goal, instead of explicit norms and standards (Dieperink 1998).

C6. International legal principles

Treaties and other forms of international cooperation should reflect the relevant principles of equitable and reasonable use, the obligation not to cause significant harm, and the duty to notify and exchange information (Mostert, van Beek et al. 1999).



C7. Harmonisation with policy recipient sea

Policies for river basins and policies for the protection of the recipient seas have to be harmonised (Huisman, de Jong et al. 2000; van der Zaag and Savenije 2000).

D. Information management

D1. Technical cooperation

Technical communication and cooperation – involving the collection and dissemination of information - is essential to support transboundary management of water resources (Mostert, van Beek et al. 1999; van der Zaag and Savenije 2000). It is good to start cooperation early in the policy process and to establish mutual insights (in the ‘facts’) (Marty 2001). Common measurement methods and standards are important for pollution reduction (Huisman, de Jong et al. 2000).

D2. Free access to information

Free access to essential information is essential to obtain and maintain mutual trust and technical cooperation (Mostert, van Beek et al. 1999; van der Zaag and Savenije 2000).

D3. Link between policy and information

Information production is often done from a technical perspective with little consideration of the needs of the users and little consideration for application of information in policy making and policy development (Nilsson 2003; Timmerman and Langaas 2005)

E. Financial aspects

E1. Free markets

A system of open economic cooperation and a free access to markets is instrumental in facilitating the trade of ‘virtual water’, which is the most powerful tool to achieve more economic output per drop of water in arid regions (van der Zaag and Savenije 2000).

Box 3. Development of institutional frameworks for the management of transboundary water resources (Kliot, Shmueli et al. 2001)

Kliot and Shmueli et al compared the institutions (treaties and agreements) for the management of transboundary water resources in nine river basins. According to the level of cooperation and commitment the studied basin can be divided in three categories:

- Highly committed (Colorado, Niger, Rio Grande and Senegal);
- Middle level of cooperation (Danube, Elbe and Mekong); and the
- Least cooperative level (Ganges-Brahmaputra and Indus).

Very few of the investigated rivers corresponded to the ideal model of a basin-wide, multipurpose institution. Almost all showed that competition among various water users was growing rapidly. Further concluding remarks were that:

1. Basin-wide institutions with a broad authority, such as in the Niger basin, do not always succeed in managing transboundary water resources, whereas institutions with less mandate, such as in the Mekong basin, can still become very active in many areas;
2. Agreements stating the principles for cooperation are generally preferred and adhered to more than other agreements (such as temporary agreements). Furthermore, external support in the form of mediation, technical assistance or financial support can be very influential in the establishment of institutions;
3. There is a need to differentiate between the formal structure of institutional frameworks and their de facto functioning. For instance, in the Niger basin the formal structure is well-developed, but implementation is limited.



4 Analytical framework

In this chapter a framework for analysing transboundary water institutions and information management is presented. The framework has been used to address the following question:

To what extent do current regimes and current information management in the case study basins support adaptive river basin management?

In the framework the concepts ‘regime’ and ‘information management’ are decomposed into analytic elements. This allows for a comparison of these elements between the case study basins. A second part of the analytical framework consists of qualitative criteria that can be used to indicate the extent to which a regime supports AM.

4.1 Regime elements

In Figure 6 the analytical elements of a RBM regime and the important relations between them are presented in the dashed textbox. The regime consists of water law and water policy (the formal institutional environment), and the formal and informal actor networks (institutional arrangements). The possible interactions within the regime are represented by the small arrows in the figure.

The context (which is not seen as a part of the regime) consists of general law, policy and administrative structure, the general (international) political climate and general social and cultural values. The institutional context can be used to explain the existence and the interactions between elements of the RBM regime. Besides by more general institutions, the RBM regime is also influenced by other regimes that operate in neighbouring policy fields (e.g. spatial development, economy and ecology). On the lower levels, the regime influences operational management, which on its turn influences the physical river basin system. All elements of Figure 6 together form the system that should be able to adapt to change.

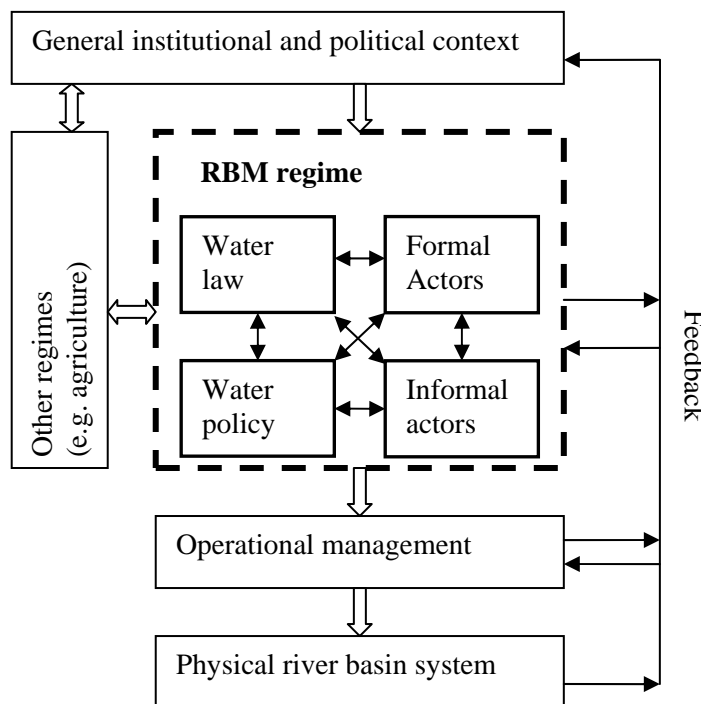


Figure 6. Framework for analysing transboundary RBM regimes.



To get a useful insight in the regime properties, the four elements within the RBM regime need to be described, including the relevant relations between them. Important sub-elements and interactions can be derived from the framework that was developed to assess the extent to which the institutions and the information management are adaptive (see section 4.3).

A few remarks can be made about using the presented analytical framework:

- Policy can be defined as 'ideas about objectives and strategies that are to be used'. These ideas can be written down in policy documents, but can also be 'approaches' that are not written down. Policy ideas can even be written down in legislation, which makes the difference between law and policy rather ambiguous;
- Because it is impossible to draw a clear line between the RBM regime and general institutions or regimes of other sectors, all institutions that significantly influence management of the relevant issues will be included in the analysis;
- The framework as such does not represent the various administrative levels that might be relevant for transboundary management. Formal actors can be international commissions, national governments or even regional or local governments and law and policy are established at similar levels. In this report only those levels that are most important in transboundary issues are described;
- The links with the institutional context and other regimes can differ between administrative levels. The overall culture in an international regime might for example differ from the culture in a nation that is part of that regime.

4.2 Analytical elements information management

To be able to evaluate to what extent information management in current RBM is adaptive, the various stages of information management are used as analytical elements. To make the influence of the information production on water management explicit, a combination of the stages according to the information cycle and the information impact chain are used. The stages that will be described are:

- Specification of information goals, needs & strategy;
- Information production (data collection and interpretation);
- Communication (exchange of data and produced information);
- Information utilisation (e.g. in decision-making).

Interaction between actors that demand information and actors that can supply information is crucial. Clear communication about goals, needs and strategies requires that frames and mental models are made explicit. Information can be produced by field experiments and monitoring of the effects, or by computer simulations that predict system responses to management actions. The assumptions made in information production and the resulting uncertainty in information are important results of the production process, but are not always explicitly communicated. Factors that might influence information management are the presence or absence of an international community of experts and the coordination and development of research and training.

To describe what information is produced, communicated and used, the DPSIR framework can be used. This allows for identifying gaps in information production. Others characteristics of the content of information are the spatial and temporal scales and the multi-disciplinarity of the information.



4.3 Criteria for adaptive regimes

4.3.1 Relation between regime, information management and operational management

The elements of AM represented in Figure 5 employ a very broad view on the regime concept. In this report a regime corresponds to the network of actors, law and policy and can be distinguished from operational management (interventions in the physical and socio-economic system) and the (resulting) state of the system (See Figure 6). Specific structures for information management are developed as part of the regime, but information management in a broader sense supports regimes in making decisions and sometimes directly supports operational management.

The idea of adaptive water management is that the whole system of the regime, information management, operational management and the physical system (including established infrastructure) should be able to adapt to changing circumstances. To analyse the extent to which regimes and information management contribute to the adaptive capacity of the whole system, the following questions should be addressed:

- *To what extent can regimes adapt themselves?*
- *To what extent can regimes support changes in operational management?*
- *To what extent can information management support changes in regimes, and vice versa?*
- *To what extent can information management support changes in operational management?*

4.3.2 Criteria for adaptive management

Figure 5 and discussions at the kick-off meeting of the NeWater project in Osnabrück, 17-19 January 2005, have been used in the design of an operational framework to answer these questions, as well as the guidelines for transboundary river basin management as described in section 3.3. The framework, as presented in Table 1, consists of five groups of criteria and for each criterion of a few specific indicators. The indicators are not meant to be exhaustive but are meant to help to 'score' regimes on the criteria. Scoring will necessarily be qualitative.

4.3.3 Relation between criteria

The transition from a traditional to a more adaptive management regime can take decades. It would be interesting to see whether some of the criteria mentioned in Table 1 are preconditions for achieving others criteria. It can be hypothesised, for example, that criteria like 'Flexible measures, keeping options open', 'Experimentation', 'Actual implementation of policies' can only be reached in a situation in which an appropriate legal, organisational and financial structure have been established. Identification of typical stages of change in the transition towards adaptive water management would enable a better assessment of the extent to which regimes and information management are adaptive. Moreover, it would provide insights in the actions that are required to create good preconditions for progress in the transition towards more AM in a given situation.

**Table 1. Framework for assessing to which extent regimes and information management support AM**

CRITERIA	INDICATORS
<i>A. Formal and informal actor networks</i>	
1. Cross-sectoral co-operation	<p>Sectoral governments actively involve other government sectors</p> <p>Co-operation structures include government bodies from different sectors; many contacts generally</p> <p>Conflicts are dealt with constructively, resulting in inclusive agreements to which the parties are committed</p>
2. Co-operation between administration levels	<p>Lower level governments are involved in decision-making by higher level governments</p> <p>Co-operation structures include government bodies from different hierarchical levels; many contacts generally</p> <p>Conflicts are dealt with constructively, resulting in inclusive agreements to which the parties are committed</p>
3. Co-operation across administrative boundaries	<p>Downstream governments are involved in decision-making by upstream governments</p> <p>International/ transboundary co-operation structures exist (e.g. river basin commissions); many contacts generally</p> <p>Conflicts are dealt with constructively, resulting in inclusive agreements to which the parties are committed</p>
4. Broad stakeholder participation	<p>Legal provisions concerning access to information, participation in decision-making (e.g. consultation requirements) and access to courts</p> <p>Co-operation structures include non-governmental stakeholders</p> <p>Non-governmental stakeholders actually contribute to agenda setting, analysing problems, developing solutions and taking decisions (“co-production”)</p> <p>Non-governmental stakeholders undertake parts of river basin management themselves, e.g. through water users’ associations</p> <p>Governments take stakeholder input seriously</p>
<i>B. Legal framework</i>	
5. Appropriate legal framework	<p>A complete and clear legal framework for water management exists (with sufficient detail)</p> <p>Policies have to be reviewed and changed periodically</p>
6. Adaptable legislation	<p>Laws and regulation can easily be changed</p> <p>Water (use) rights can easily be changed / are not permanent</p>
<i>C. Policy development and implementation</i>	
7. Long time horizon	<p>Solutions for short term problems do not cause more problems in the (far) future (20 years or more)</p> <p>Already now preparations are taken for the (far) future (20 years or more)</p>

Table continues on next page



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8. Flexible measures, keeping options open	Measures taken now or proposed for the near future do not limit the range of possible measures that can be taken in the far future and are preferably reversible.
9. Experimentation	Small-scale policy experiments take place/ are financially supported.
10. Full consideration of possible measures	Several alternatives and scenario's are discussed Alternatives include small and large-scale and structural and non-structural measures
11. Actual implementation of policies	Plans and policies are actually implemented Policies are not dogmatically stuck to when there are good reasons not to implement policies, such as new and unforeseen circumstances and new insights
<i>D. Information management</i>	
12. Joint/ participative information production	Different government bodies are involved in setting the TORs and supervising the search, or at least consulted (interviews, surveys etc.) Idem for non-governmental stakeholders
13. Interdisciplinarity	Different disciplines are involved in defining and executing the research: in addition to technical and engineering sciences also for instance ecology and the social sciences
14. Elicitation of mental models/ critical self-reflection about assumptions	Researchers allow their research to be challenged by stakeholders and present their own assumption in as far as they are aware of them Research results are not presented in a an authoritative way, but in a facilitative way, to stimulate reflection by the stakeholders about what is possible and what it is they want
15. Explicit consideration of uncertainty	Uncertainties are not glossed over but communicated (in final reports, orally)
16. Broad communication	Governments exchange information and data with other governments Governments actively disseminate information and data to the public: on the Internet, but also by producing leaflets, though the media, etc.
17. Utilization of information	New information is used in public debates (and is not distorted) New information influences policy
As to the issues on which information should be produced, communicated and utilized: see under C.	See under B.
<i>E. Financial</i>	
18. Appropriate financing system	Sufficient (public and private) resources are available Costs are recovered from the 'users' by public and private financial instruments (charges, prices, insurance etc.) Decision-making and financing in one hand Authorities can take loans and depreciate their assets, to facilitate efficient use of resources and replacement of assets



5 Overview case study basins

5.1 Introduction and overview

In this chapter a short introduction to the main characteristics of the NeWater basins is presented, including an overview of the most pressing (transboundary) issues. The sections are largely copied from the basin reports written by the research partners in WorkPackage 1.3. The studied basins are the Amu Darya, Elbe, Guadiana, Nile, Orange, Rhine and Tisza (See Figure 7).

Table 2 gives an overview of the main characteristics of the NeWater basins. The largest basin studied (Nile) is more than forty times as large as the smallest (Guadiana) and variations in the discharge are of the same order of magnitude. River lengths vary from about 800 to about 3,500 km and the number of riparian countries varies between two and ten. In the Amu Darya, Orange, Guadiana and Nile river basin the problems are mainly related to water scarcity, whereas in the Elbe, Rhine and Tisza pollution and floods are central problems.

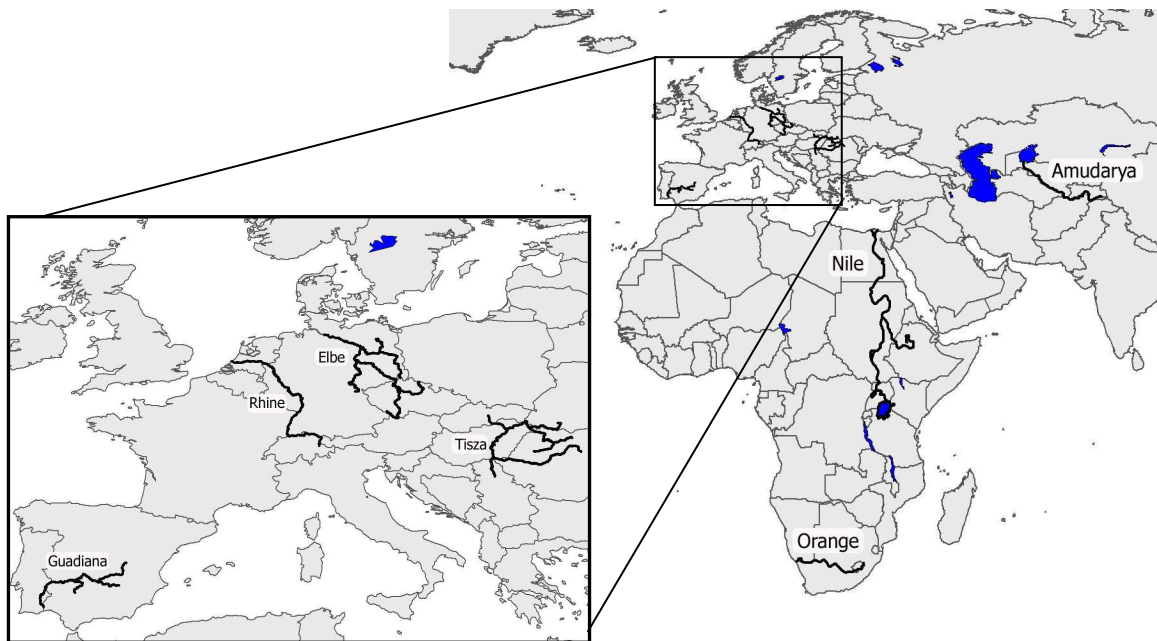


Figure 7. Location of case study basins of the NeWater project

**Table 2. Overview of characteristics and issues in the NeWater river basins**

Basin	Basin Area (10 ³ km ²)	River Length (km)	Countries (% of basin area)	Average discharge at mouth (m ³ /s)	Main river/water users	Main issues
Amu Darya (part of Aral Sea basin)	> 300	2,540	Tajikistan Afghanistan Kyrgyzstan Turkmenistan Uzbekistan (Iran)	2,400	Irrigation for agriculture (mainly cotton, wheat and rice production) Hydropower (increasing)	Water availability / allocation Environmental degradation / Salinisation Drying up of Aral Sea
Elbe	140 ¹	1,094	Germany (64%) ¹ Czech Republic (36%) Austria (<1%) Poland (<1%)	850	Industry Agriculture Domestic use Navigation	Pollution / water quality Floods Water availability
Guadiana	67	778	Spain (83%) Portugal (17%)	80	Agriculture Domestic use Industry	Water availability / allocation Agricultural / industrial contamination Fragmentation by dams
Nile	3,038 ¹	6,695	Sudan (64%) ¹ Ethiopia (12%) Egypt (9%) Uganda (8%) Tanzania (4%) Kenya (2%) Congo (<1%) Rwanda (<1%) Burundi (<1%) Eritrea (<1%)	3,500	Agriculture Hydroelectric power generation	Water availability / allocation Erosion and siltation Ecosystems Dams

Table continues on next page

¹ Based on Wolf, A. T., Natharius, J. A., Danielson, J. J., Ward, B. S., et al. (1999). "International River Basins of the World." Water Resources Development **15**(4): 387-427.



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Orange	948 ¹	2,200	South Africa (60%) ¹ Namibia (25%) Botswana (13%) Lesotho (2%)	95 ²	Irrigation Environmental demands Power generation Industrial and domestic use	Water availability / allocation (Interbasin) water transfers Droughts
Rhine	198 ³	1,300	Germany (54%) ³ Netherlands (17%) Switzerland (14%) France (12%) Austria (1%) Luxembourg (1%) Belgium (<1%) Liechtenstein (<1%) Italy (<1%)	2,200	Navigation Agriculture Industry Power generation Domestic use Waste water disposal	Pollution / water quality Floods
Tisza (part of Danube basin)	157	966	Romania (47%) Hungary (29%) Slovakia (10%) Ukraine (8%) Serbia-Montenegro (6%)	766	Agriculture Industry	Floods Water availability / droughts Pollution / water quality

² Estimation based on a figure displaying the discharge at a downstream location at <http://www.ngo.grida.no/soesa/nsoer/issues/water/state2.htm#rivers>
³ Based on Coördineringscomité Rijn (2005). Internationaal stroomgebiedsdistrict Rijn - Kenmerken, beoordeling van de milieueffecten van menselijke activiteiten en economische analyse van het watergebruik (Deel A = overkoepelend deel, stand 18-03-05). Rapportage aan de Europese Commissie inzake de resultaten van de inventarisatie conform de Richtlijn 2000/60/EG van het Europees Parlement en de Raad van 23 oktober 2000 tot vaststelling van een kader voor communautaire maatregelen betreffende het waterbeleid (Artikel 15 (2), 1e gedachtestreepje).



5.2 Amu Darya (from Kranz, Interwies and Vorwerk 2005)

5.2.1 Basin description

The Amu Darya situated in Central Asia is the largest tributary in terms of run-off to the Aral Sea. The basin is divided into high mountain areas of the Pamir-Alai-System and desert areas of the Turan Plain that consists of the Kyzylkum desert in the East and the Karakum desert in the West. The basin borders in the North on the Usturt-Plateau, which drains to the Caspian Sea. The length of the Amu Darya is 2,540 kilometres from the river source of Pyandj – the main tributary to the Amu Darya – to its delta. The catchment area covers more than 300 thousand square kilometres.

The head rivers Pyandj and Vaksh originate in the high mountains of Kyrgyzstan and Afghanistan. The Vaksh comes from the Alai in Kyrgyzstan and joins the Pyandj which is coming from the Pamir at the Afghan-Chinese border. Afterwards the river continues its way under the name Amu Darya. At Termez, the border city between Afghanistan and Uzbekistan, the river leaves the high mountains of Pamir, enters the desert plain of Karakum and then flows down to Turkmenistan. Upon returning to Uzbekistan the Amu Darya finally ends in the Delta downstream of Nukus in the Autonomous Republic of Karakalpakistan.

The Amu Darya Basin is a typical endorheic basin (it does not drain into the sea/ocean but into a 'land-locked' system) under arid conditions. The climate is continental with cold winters and hot summers. Precipitation rates vary from 100 mm per year in the desert plains to 2000 mm in the high mountain areas. Most of the water of the Amu Darya derives from the high mountain glaciers of the Pamir-Alai-System, while the desert plains that cover about two thirds of the basin do not contribute significant amounts of water. In the opposite, the evaporation rate is very high in the plains and the river loses most of its water through evaporation, infiltration and withdrawal for irrigation. High water levels occur twice a year in April/May and June/July. Water shortage occurs mainly in March. The largest water share of the river originates in Tadjikistan (72.8 %), 14.6 % of Amu Darya water comes from Afghanistan and Iran and about 8.5 % of the water is formed in Uzbekistan (CAWater 2005). The largest tributaries are Kafirnigan, Surkhandarya and Sherabad from the east and Kunduz and Koksha from the west. The Amu Darya has an average water flow of 70-80 cubic kilometres (ca. 2,400 m³/s) per year.

The Amu Darya is the river with the second highest sediment load in world after the Huang He in China. Thus the river bed in the plains is not very stable. The steadily shifting river created the unique Tugai-forest landscapes which unfortunately almost disappeared due to human overexploitation of the forests in the last century. In the Amu Darya Basin the most territories with favourable natural and economic conditions for irrigated farming are located far from the river.

Riparian states to the Amu Darya are Tajikistan, Afghanistan, Kyrgyzstan, Turkmenistan, Uzbekistan and to a very little share Iran. While Tajikistan, Kyrgyzstan and Afghanistan are mountainous countries, Turkmenistan and Uzbekistan are dominated by desert plains. All countries are landlocked with a low population density and a share of rural population well above 50 %. All these countries highly depend on agriculture in their economies even though especially Uzbekistan is also rich in fossil fuels and other mineral resources. The main crops in the desert plains are cotton, wheat and in the alluvial areas rice. All these plants are highly dependent on irrigation. Cotton is the most important export good and cash crop in this region.



Figure 8. Map of the Amu Darya basin

5.2.2 Main issues

Water is the most important natural resource in Central Asia. The region is highly dependent on agriculture and most of the cultivations need irrigation. The semi-arid to arid conditions of the region create a high potential for water scarcity. Thus sustainable water management is a major challenge in the socio-economic development in the Amu Darya Basin. The Aral Sea cannot be excluded from the analysis of transboundary issues in the Amu Darya basin, as the water management policies in the river basin have direct repercussions on the lake, with problems culminating here in many instances. Three basic issues for (transboundary) water management can be identified:

Water allocation schemes in the basin, with high potential for conflict among the newly independent, riparian states. In the Soviet period, infrastructure was built to serve the needs of the entire Aral Sea basin. In many cases, infrastructure located in one state was planned for the benefits of other states. The operational responsibility and provision of maintenance for transboundary water infrastructure are now in dispute. The upstream countries only use a little share of the surface water economically, but the downstream countries Uzbekistan and Turkmenistan use over 80 % for their production needs. The expansion of the generation of hydropower in upstream countries is conflicting with irrigation needs;

Gradual drying-up of the Aral Sea, with huge adverse socio-economic and environmental effects throughout the entire region. Today, water withdrawal for irrigation purposes amounts to 90 % of the water flow of the Amu Darya. This development resulted in a decrease of the water discharge to the Aral Sea and finally to its desiccation;

Environmental degradation, with an increase in land and water salinisation. These problems are mainly related to inefficient and wasteful water management schemes and have negative impacts on many different sectors.



5.3 Elbe (from Raadgever 2005a)

5.3.1 Basin description

The Elbe originates in the Czech *Riessengebirge* and has a length of 1,094 km, of which 367 km is located in the Czech Republic and 727 in Germany (IKSE 2005). The river basin covers an area of nearly 150,000 km² and is in size the fourth basin of Middle-Europe. About two third of the basin is located in Germany, about one third in the Czech Republic and a negligible part in Austria and Poland. The basin covers different geographical regions from middle mountain ranges in the west and south to large flatlands and lowlands in the central, northern and eastern part of the basin (UNEP GRID 2005). The larger tributaries are the Labe, Moldau/Vltava, Mulde, Saale and Havel. The average discharge at the mouth of the river into the North Sea is 850 m³/s, varying from about 3,000 m³/s after snowmelt in spring to about 150 m³/s in late summer (Nienhuis, Chojnacki et al. 2000). About 25 million people live in the river basin and the biggest cities in the basin are Berlin, Hamburg and Prague. A map of the Elbe basin is presented in Figure 9.

The river is used for various purposes. The basin consists for 25% of original forest and from the cultivated land 74% is used as cropland and 21% as developed land (Nienhuis, Chojnacki et al. 2000). The industrial sector withdraws the largest amount of river water (about 70%), followed by the agricultural sector and the water withdrawals for domestic use of about 1.8 million people (both about 15%) (Kliot, Shmueli et al. 2001). The Elbe has been navigable by commercial vessels since 1842 and provides an important trade link between the North Sea and Prague. The river is linked by canals to the German industrial areas and to Berlin. The Elbe-Lübeck Canal links the Elbe to the Baltic Sea (UNEP GRID 2005).

The Czech part of the Elbe contains many weirs and barrages, whereas the German part is almost free from these constructions. The only German weir can be found at Geesthacht, near Hamburg, which forms the artificial limit of the estuarine, tidal brackish environment. The port of Hamburg is one of the largest ports in Europe (Nienhuis, Chojnacki et al. 2000).

5.3.2 Main issues

Compared with other areas of Europe, in the Elbe basin water availability per inhabitant (680 m³) can be considered extremely low. The low water availability has always been a problem (UNEP GRID 2005).

In the period between 1959 and 1989 the Elbe was one of the most heavily polluted large rivers. After the German reunification in 1989, water quality improved because most heavy-metal emissions from point sources in eastern Germany were shut down and a beginning was made with effective municipal and industrial waste water treatment (Nienhuis, Chojnacki et al. 2000). The (relative) importance of the pollution problem can be illustrated by the fact that the International Commission for the Protection of the Elbe was established with water quality management as the only purpose. More recently the Commission also has also started a working group on flood management.

The disastrous floods in august 2002 in the Elbe and parts of the Danube basin have strongly shifted general attention to the flooding problem. As a result of the flood in 2002, 38 people died and the economic damage is estimated \$9 billion in Germany and \$3 billion in the Czech Republic. The rainfall in the Elbe basin in August 2002 exceeded most previously measured rainfall amounts and intensities. Due to climate change the intensity of rainfall and, as a result of that, the frequency of extreme events are expected to increase (Becker and Grunewald 2003). Implications for the Elbe region are still unclear, but the need to take proper flood management measures is strong.



In general, implementation of measures in the Elbe basin is slow due to lack of finances (Kliot, Shmueli et al. 2001).

The most obvious differences in perception of water management between Germany and the Czech Republic originate from upstream-downstream differences and from the institutional and economic differences between the former 'Eastern' and 'Western' Europe. Although since 1989 the differences are decreasing, there is still a major development gap between the Czech Republic and Germany (Kliot, Shmueli et al. 2001). The former East Germany has developed faster than the Czech Republic, but is not yet as developed as the Western parts of Germany.



Figure 9. The Elbe basin (UNEP GRID Europe 2005)

5.4 Guadiana (from Timmerman and Doze 2005)

5.4.1 Basin description

Portugal and Spain share a total of five watercourses. The Guadiana River, runs through Spanish territory, then enters Portugal and finally turns into an estuary bordering the two countries. The Guadiana catchment is one of the largest hydrographical basins of the Iberian Peninsula, covering 66,800 km², of which 55,200 km² (83%) are in Spain and 11,580 (17%) in Portugal. The length of the river Guadiana is 778 km and the average discharge is about 80 m³/s. The River flows westward through south-central Spain and southeastern Portugal to the Gulf of Cádiz and the Atlantic Ocean (Cosme, Sousa et al. 2003; UNEP GRID Europe 2005).



Figure 10. The Guadiana basin (UNEP GRID Europe 2005)

5.4.2 Main issues

Having sufficient quantity of water is of major concern in the Guadiana basin. The semi-arid climatic conditions of the basin affect availability of adequate quantities of water. The main problems within the river basin are the overexploitation of the aquifers in the Upper River Basin through the large extractions for agricultural use, the agricultural contamination and the fragmentation by dams (Cosme, Sousa et al. 2003; WWF 2003b). This section will first discuss the water quantity problems in the Guadiana River basin and next describe the water quality problems.

Water quantity problems

Water storage on a large scale is necessary as agricultural irrigation is a major end-user of water in Spain and Portugal, and water for agriculture is especially high in demand in spring and early summer. Agriculture accounts for over 40% of the total amount of water used in Portugal, and over 60% of that used in Spain (Gooch 2004). In the Spanish part of the catchment agriculture, and particularly spray irrigation, is the sector with the highest water demand. The large consumption, together with the sensitivity of an extremely irregular regime of volumes, is at the root of overexploitation and shortage of resources. This situation is even worse due to deficiencies of water networks and to inadequate handling and planning of the water resources. The problem of overexploitation not only affects agriculture, but also the water supply of numerous municipalities. Climate change and socioeconomic changes



are expected to increase the pressure on the availability of water. On the Portuguese side, irrigation and cattle farms suffer from reduced volumes coming from Spain. In years of drought serious difficulties arise in the satisfaction of even the minimum water necessities. Agricultural use faces serious problems related to guaranteeing the minimum supply needs (Cosme, Sousa et al. 2003).

One of the most frequent applied solutions to face the water shortage problem and protection against floods is the construction of artificial water reservoirs; there are 1,824 dams in the Guadiana river basin. Still, there is no national or regional policy or strategy addressing dams. Existing policies address the need for each sector to be taken separately (agriculture, energy production, domestic supply, etc.) and do not recognise the negative impacts of dams in the ecosystems or in the overall river basin.

Water quality problems

The needs to satisfy the basic requirements of water must be accompanied by the availability of water of enough quality for its use for human consumption and irrigation. The increase of water demand and the inadequacy of water management in the agricultural, industrial and domestic sectors, together with the consequences of the climatic conditions in the river regime, contribute to the decreased availability of adequate water quality. In semi-arid regions the availability of surface water in wet periods is worsened by the increase of pollution load and water temperature. The decrease of the river flow leads to loss of water quality from less dilution of partially polluted water. The main sources of pollution in the Guadiana basin are untreated discharges, especially from industries and diffuse pollution, originating from agriculture and cattle, without any treatment. Big investment effort in wastewater treatment infrastructures has been made in the last years by the administrations of both Spain and Portugal. In intensive agriculture zones, the aquifers have a high nitrate pollution risk (Olay, Gomes et al. 2004).

There are serious concerns related to the water quality in the reservoirs. The main problems that may affect this quality are: eutrophication caused by the discharge of nutrients, silting caused by accumulation of low size inorganic material, and salinisation when evaporation exceeds precipitation. These processes cause serious constraints in the utilisation of water for irrigation and human consumption (WWF 2003a).



5.5 Nile (from Timmerman 2005)

5.5.1 Basin description

The geography of the Nile Basin is both distinct and varied. From the most remote source at the head of the River Luvironzo near Lake Tanganyika, to its mouth on the Mediterranean Sea, at 6,695 km the Nile is the longest river in the world. Some 2.9 million km² in extent, the basin drains about 10 percent of the continent. The Nile is a confluence of the Blue Nile stemming from Lake T'ana in Ethiopia and the White Nile, stemming from Lake Victoria in Uganda. The Blue Nile and the White Nile thank their name to the colour of the water. The Nile and its tributaries flow through ten countries, the White Nile flows through Uganda, Sudan, and Egypt, the Blue Nile flows through Ethiopia, while Kenya, Tanzanian, Democratic Republic of Congo (DRC), Rwanda, and Burundi all have tributaries, which flow into the Nile or into lake Victoria Nyanes. The Blue Nile rises at a spring site upstream of Lake Tana in Ethiopia, 2,150 m above sea level. The river flows west then north until it eventually meets the White Nile at Khartoum. A length of 800 km is navigable during high water. The Nile River's average discharge is about 300 million cubic metres per day (ca. 3,500 m³/s).

322 km below Khartoum the Nile is joined by the 'Atbarah River. The black sediment brought down by the 'Atbarah and Blue Nile Rivers used to settle in the Nile delta making it very fertile. This process historically occurred during the annual flooding of the Nile in the summer months. However, the opening of the Aswan High Dam in the early 1970s allowed for control of the flooding and reduced sediment deposits in the river as these now settle in Lake Nasser. From Khartoum to Aswan there are six cataracts. The Nile is navigable to the second cataract, a distance of 1,545 km. The water level behind the Aswan Dam fell from 170 m in 1979 to 150 m in 1988, threatening Egypt's hydroelectric power generation. The delta of the Nile is 190 km wide (Nicol and Shahin 2003; Anonymous 2005; Nile Basin Initiative 2005).

5.5.2 Main issues

Today, the Nile Basin faces the challenges of poverty (4 of its riparian countries are among the 10 poorest in the world), instability (conflicts in the Great Lakes, Sudan, and the Horn of Africa), rapid population growth, and severe environmental degradation (especially in the East African highlands). But joint regional development of the Nile offers significant opportunities for cooperative management and development that will catalyse greater regional integration for socioeconomic development, making it possible to meet these challenges. These socioeconomic benefits will exceed the direct benefits from the river alone (Economic Commission for Africa 2004). We will discuss the main issues here.

Water use

Agricultural water use is the most important use of the water in all the Nile basin countries. On average 85% of the water use is utilised for agricultural purposes. In Egypt and Sudan the amount of water used for irrigation is almost as much as the total annual renewable water resources. Approximately one third of the total water abstraction from the Nile River is used for irrigation in Egypt (El-Sebae 1989). Furthermore, The Nile River is an important source of hydroelectric power. Several dams have been constructed for this purpose. Hydroelectric power will play an increasing role in water management.



Figure 11. The Nile basin (Mason 2005).



Erosion and siltation

Agricultural and grazing lands are being degraded through erosion and siltation, and wetlands and forests are being lost. Deforestation and soil erosion can lead to increased sedimentation and greater flood risks downstream, while sediments also accumulate in wetlands and reservoirs. Also, the water quality is declining while pollution from urban, industrial and agricultural sources is increasing. Urbanisation and industrialisation often lead to greater pollution of the Nile River and its tributaries as pollution prevention and treatment measures generally do not keep pace with this development. Increased use and improper application of pesticides and fertilisers, especially in the large irrigation schemes in the northern reaches of the Basin, lead to increased runoff and pollution of drainage canals.

Ecosystems

Water-dependent ecosystems throughout the Nile Basin contribute to the stability, resistance and resilience of both natural and human systems to stress and sudden changes. In particular, significant transboundary benefits derive from the Basin's wetlands in maintaining water quality, trapping sediment, retaining nutrients, buffering floods, stabilising micro-climates and providing storm protection. Key plant and animal species often have habitats in adjoining countries, requiring cross-border protected areas and other conservation measures for effective management. For example, the Nile is a principal flyway for birds migrating between central Africa and Mediterranean Europe, and Nile wetlands in a variety of countries provide indispensable habitats for these birds. Water hyacinth and other invasive aquatic weeds have spread throughout many parts of the Nile Basin, impairing the functions of natural ecosystems, threatening fisheries and interfering with transportation. The overexploitation of natural resource is continuing, and waterborne diseases are proliferating. Waterborne diseases such as malaria, diarrhoea and bilharzia (schistosomiasis) are prevalent throughout the Basin and thus of major concern the Nile countries. Finally, the harmful impacts of floods and droughts are intensifying (Nile-COM 2001).

Dams

The Aswan High dam is an example of a dam that can store floods, although the main purpose is to store water for water supply (e.g. for irrigation) and power generation. The Aswan High dam can store 1.5 times the average annual flow of the Nile River (150-165 km³) in the artificial Lake Nasser and has provided a high degree of protection to the lower Nile simply by retaining the whole flood. At the same time the beneficial aspects of natural flooding – for example restoring the fertility of the floodplain – have been lost (World Commission on Dams 2000).



5.6 Orange (from Kranz, Interwies and Vidaurre 2005)

5.6.1 Basin description

The river basin of the Orange is the largest watershed in South Africa, and the Orange is the largest river in Africa south of the Zambezi. Approx. 60% of the around one million square kilometres that form the catchment area lie in the country of South Africa. The remainder falls within Botswana (11%), Namibia (25%) and Lesotho (4%), the latter country lying totally within the basin (Nakayama 2003).

The river originates in the Drakensberg range in Lesotho and stretches over 2,200 km westwards to the South Atlantic. The Orange basin is characterised by extremely variable rainfalls, ranging from around 2,000 mm per year in the Lesotho Highlands to 50 mm per year - and thus extremely arid climatic conditions - near its mouth, and an average annual potential evaporation that of approx. 1,100 mm in the Lesotho Highlands to over 3,000 mm in lower areas of the basin (Nakayama 2003).

The main tributaries of the Orange are the Caledon, Kraal and Vaal rivers; further downstream the Orange receives water from the Hartbees, Molopo and Fish rivers. These rivers usually fall dry during several months of the year, and the same has happened to the Lower Orange during severe droughts. The Orange does not have extensive floodplains or a significant delta. Only in the downstream area there are low-lying areas with fertile land which is suitable for irrigation.

The climatic variability within the Orange Basin produces large differences in the distribution of water resources within it. Botswana, for instance, whilst having a large area of the country within the basin, does not actually contribute runoff to the Orange: within living memory the Molopo 'tributary' has not contributed any surface runoff to the main river (Nakayama 2003). Meanwhile Lesotho, constituting only 4% of the basin area, contributes approx. 45% of its runoff. South Africa dominates the basin in terms of land area and runoff contribution. Namibia contributes about 4% to total surface runoff, and as downstream member of the country, faces a relative scarcity of water resources.

In terms of water use, the situation in the basin can be described as follows: irrigation dominates water use with 54%, contrasting with the 10% that goes towards environmental demands and the 2% provided to urban and industrial use. The remaining 34% is accounted for by evaporation and run-off to the ocean through rivers and canals.

5.6.2 Main issues

Water availability, and hence water allocation, is probably the main transboundary issue in the region. Of the four riparian states of the Orange River Basin, three belong to the driest countries in the Southern African Development Community (Nakayama 2003). South Africa, for example, faces a water deficit in 11 of its 19 Water Management Areas (a deficit being defined as water requirements exceeding water availability). In the northern parts of the country, both surface and groundwater resources are nearly fully developed and utilised. Growing industrialisation and urbanisation, as well as population growth, will place further demands on water resources unless corrective measures are taken (GEF 2005).

Namibia has an extremely arid climate, a high level of water stress and absolute water scarcity. In the arid southern parts of the country, the main development potential lies in irrigation and Namibia is interested in an expansion of the irrigated surface. As well as agriculture, industrial uses, mines, and a proposed gas field power station are activities Namibia would like to support through a new water reservoir on the lower Orange River, which would give the country increased assurance of supply (Nakayama 2003; Heyns 2004). Being the downstream riparian, Namibia depends on South Africa in these matters.



Figure 12. Orange River Basin and riparian states

With an aridity comparable to Namibia's and a water demand which is expected to double in the next 15-20 years, Botswana faces a situation of water resources under high level of stress. The country realises that augmentation of its internal water resources through the utilisation of internationally shared supplies (border-rivers and perhaps transboundary aquifers) will become extremely important over the next decade (GEF 2005).

Lesotho, in spite of not facing water stress, does face distribution problems: the concentration of population and industry does not coincide with the availability of large quantities of water (GEF 2005). The main transboundary issues for Lesotho, though, are water transfers, which can be both within the Orange Basin and to/from other river basins. South Africa plays a dominating role in developing the Orange River system, which include a series of complex inter-basin transfer schemes. Currently, the extension of the Lesotho Highlands Water project, as well as a wide array of other possible water transfers (e.g. from Lesotho to Botswana and from Botswana to South Africa) are being considered, and the importance of water transfers in the region looks set to grow in the future (Turton and Henwood 2002; Heyns 2004).

Droughts are an important issue for all countries within the basin. South Africa, as the country most dependent on the water of the Orange River, is especially affected, but has some reaction capacity thanks to the extensive damming and the existence of water transfer infrastructure (Nakayama 2003). In spite of the relatively high amount of rainfall, droughts and desertification are also an issue for Lesotho, especially in the southern districts of the country (African Development Bank 2003). Botswana and Namibia are clearly very vulnerable to droughts, due to their water resources stress.

Water and energy issues are linked in the basin in complex ways. The thermal power generation in the South African Gauteng area requires a lot of water, which is obtained largely from water transfer schemes. More than 80% of South Africa's electricity requirements are met through the resources of the Vaal (principal tributary of the Orange), and water is also supplied from the Vaal to some of the largest gold and platinum mines in the world, as well as to production activities in some of the world's largest coal reserves (GEF 2005).



5.7 Rhine (from Raadgever 2005b)

5.7.1 Basin description

The Rhine has a length of 1,300 km, of which 800 km is navigable. From the source to the mouth, the river consists of the High Rhine, Upper Rhine, Middle Rhine, Lower Rhine and Rhine delta. Important tributaries are the Aare, Neckar, Main, Moselle, Saar and Ruhr rivers. The average discharge at the mouth is 2,200 m³/s, and the river has favourable hydrologic characteristics and a favourable flow distribution over the year that explain why it became an important traffic link (Huisman, de Jong et al. 2000). Besides for navigation, the river is used for domestic and agricultural water supply, industry (incl. water cooling), waste water disposal, hydropower generation, fisheries, recreation and other purposes. The Rhine basin is spread over an area of almost 200,000 km² (Coördineringscomité Rijn 2005). Although topographically the Meuse is part of the Rhine basin, in European politics - and also in this report - it is treated as a separate basin. The Rhine basin is shared by nine countries. However, the Rhine basin area in Liechtenstein, Italy and Belgium is negligible and the basin area in Austria and Luxembourg is also small. Germany (54% of basin area), the Netherlands (17%), Switzerland (14%) and France (12%) share the larger parts of the basin (Coördineringscomité Rijn 2005). About 60 million people live in the Rhine basin (Huisman, de Jong et al. 2000). A map of the Rhine basin is presented in Figure 13.

5.7.2 Main issues

Although each country has some temporal and spatial problems, in general the Rhine-countries have sufficient resources to meet all legitimate needs for water (Hendriks 1996; Nunes Correia 1998). Considering the historical and current policy agenda, the main problem in the Rhine basin is pollution and a 'good second' is flooding.

In the 1960's and 1970's the Rhine was heavily polluted and was even called the 'sewer of Europe'. After a lot of effort – including transboundary cooperation – the Rhine is currently one of the cleanest rivers in Europe (e.g. Verweij and Douglas 2000). Because point discharges have already been reduced very strongly, the current effort is aimed at reduction of non-point discharges (e.g. of nutrients from agricultural areas) and at restoring ecology in the rivers and floodplains.

According to recent research on climate change, severe floods and droughts are expected to occur more often in the Rhine basin. Even now, high river discharges and floods take place regularly (e.g. in 1995 and 1998). After years of increasing the height of embankments, other types of measures, like creating more room for the river, are considered. Moreover, increasing attention is paid to upstream and downstream effects of measures, which triggers transboundary cooperation.

To a much lesser extent there are concerns about a possible increase in the number and severity of dry spells. In extreme dry years water levels can become too low for (fully loaded) navigation, the drinking water and energy supply in certain areas can encounter serious problems and agricultural yields may decrease. Moreover, when flows decrease, water quality problems (including high water temperatures) often arise.

Some countries are confronted with specific problems because of their position in the river basin. The main problem in the upstream countries Switzerland and France is pollution from non-point sources. For example, a lot of nutrients from agricultural sources end up in the Swiss lakes. Germany is a large country that has to deal with the whole spectrum of (upstream and downstream) problems concerning water quality and water quantity. The main water management issues are therefore pollution control and flood protection (from river and sea water). The more downstream parts of the basin are confronted with problems originating from the more upstream parts of the basin. Upstream pollution, deforestation and



paving increase problems in the downstream parts of the basin. The Dutch government therefore has always tried to stimulate international cooperation. Typically Dutch problems are desiccation and sea level rise.

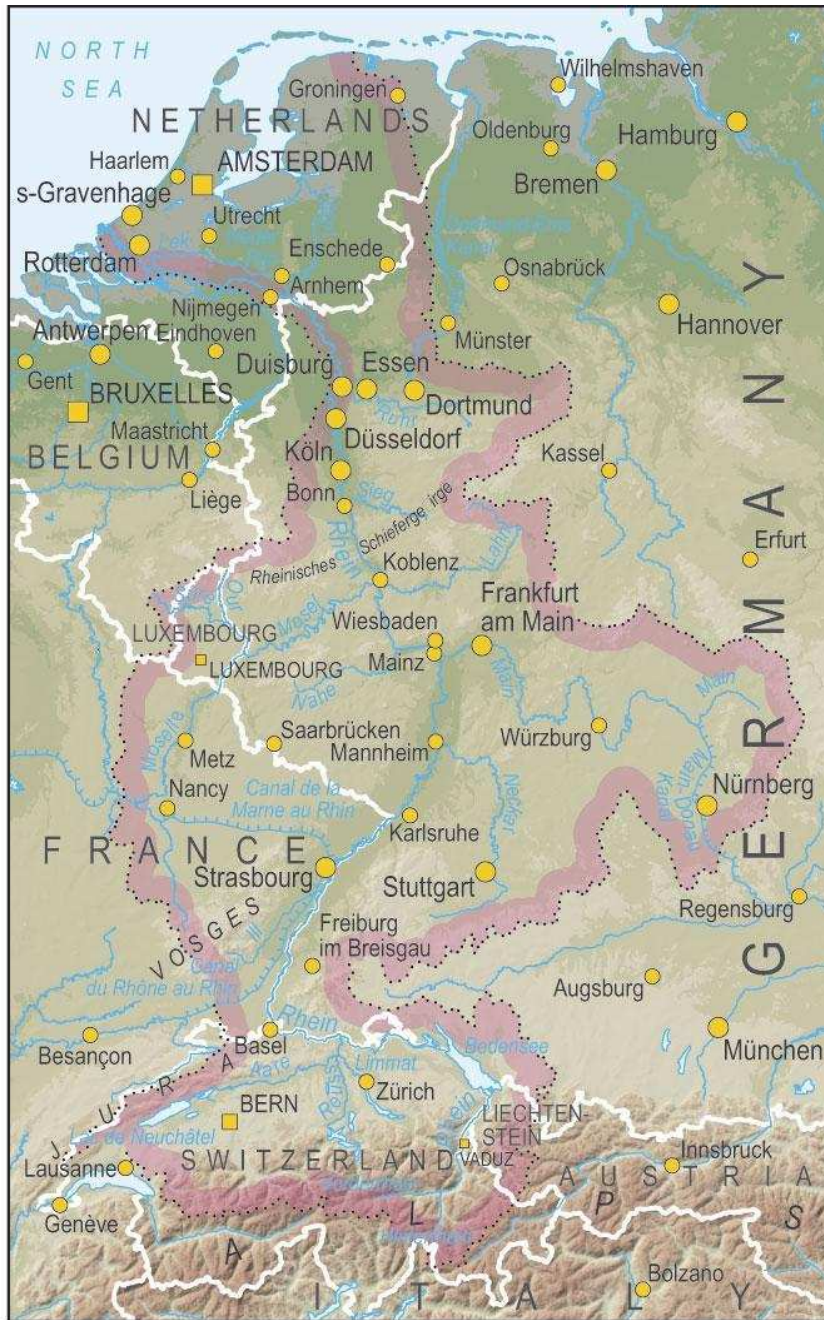


Figure 13. The Rhine basin (UNEP GRID Europe 2005)



5.8 Tisza (from Becker 2005)

5.8.1 Basin description

The Tisza river basin (TRB) originates in the Carpathian Mountains in the territories of Romania, Slovakia and Ukraine and is the largest (157,218 km²) among the 15 sub-basins of the Danube Basin (801,463 km²). The Tisza has a length of 966 km, flows through the Pannonian flood plain of eastern Hungary and joins the Danube in Serbia-Montenegro. The river can be divided into three main parts:

- The mountainous Upper Tisza in the Ukraine (including the tributaries of Romania);
- The Middle Tisza in Hungary, receiving the tributaries Bodrog and Sajo from the Carpathian mountains in Slovakia and Ukraine and the Szamos, Koros and Maros draining Transylvania in Romania;
- The lower Tisza downstream of the Hungarian-Serbian border, where it receives the Begej and small tributaries through the Danube-Tisza Canal system and joins the Danube between Novi Sad and Belgrade.

The TRB is characterized by a high diversity of landscape, fauna and flora with a significant number of nature protected areas, wetlands and national parks (Burnod-Requia 2004). The total population living in the river basin is over 14 million people.

The mean discharge at the confluence with the Danube is 766 m³/s, ranging from 371 m³/s to a 1% peak discharge of 3,867 m³/s (Schnellmann and Heimhofer 2002; ICPDR 2004). During the 19th and early 20th century, the former huge floodplain was drained and dikes were constructed with 84% loss of the floodplain and 32% of the river length was regulated. About 60% of the upper TRB gets more than 1,000 up to 1,600 mm precipitation annually. This means, that heavy flash floods are common in spring and summer, causing enormous inundation in the vast lowland areas. In recent years the sequence of major floods increased.

Table 3. Characteristics Tisza basin for each country (REC 2002; Burnod-Requia 2004)

Country	Area (km ²)	Fraction of country area (%)	Fraction of basin area (%)	Number of inhabitants (millions)
Ukraine	12,734	2	8	1.30
Romania	72,636	30	47	6.10
Slovakia	15,250	31	10	1.67
Hungary	46,222	50	29	4.13
Serbia and Montenegro	10,376	10	6	0.81
Total	157,218		100	14.01

5.8.2 Main issues

The Tisza region (with exception of Serbia and Montenegro) is characterized by economic stagnation, creating a high pressure for economic development (REC 2004). The decline of the heavy industry, an agricultural crisis after decennia of intensive, exhausting large-scale farming resulted in a high level of unemployment, up to 30 % in the Slovak and Romanian territories (FAO 2003; Burnod-Requia 2004). Poverty and increasing social and ethnic tension is becoming an increasingly important issue in the North-Eastern Tisza basin. Better integrated land use and water management could be important tools to avoid increasing



inundation and soil degradation and therefore effective elements for sustainable development for the region.

As a result of the political and economic changes during the last 20 years, agricultural and industrial production has significantly dropped resulting in a generally reduced environmental pressure. However, many industrial sites, but also the lack of fully implemented municipal sewage treatment, continue to be serious pollution and accidental risk spots. In summary, there are significant environmental and social concerns in the basin related to:

- excess and shortage of water, almost simultaneously in a given year;
- frequent landslides in the upper part of the TRB due to deforestation;
- hazards of diffuse and point source pollution and further pollution accidental industrial “hot spots”;
- different phases of economic development and future sustainable agricultural and industrial potentials.

In the last 30 years, the Tisza region has been affected by some 115 flood events. During that time, the strength and the number of floods has continuously increased, with two particularly severe events in 1998 and 2001. In the Hungarian part of the Tisza, canalization of rivers for irrigation purposes led to repeated severe flood damage. 2.4 million people live in dike protected flood plain areas, constituting 23% of the Hungarian country (www.ovf.hu).

Although the Pannonian plain is very suitable for agriculture, the average precipitation is not sufficient for intensive cultivation, and water deficiencies and droughts occur regularly. The implementation program of retention areas is considered to provide a solution for both problems.

The surface water quality is mainly affected by industrial and municipal pollution, as well as agricultural run off. Serious temporary water quality problems are still caused in tributaries (mainly Hungary, Romania, Serbia-Montenegro) as a consequence of deficiencies in municipal sewage treatment system. Mining, petrol-chemical, cellulose industry and crude oil and gas pipelines traversing the TRB are significant spot sources risks.

Table 4 summarizes the key issues as expressed by Tisza country representatives in a multilateral seminar 2003 (FAO 2003).

Table 4. Key water management issues in the Tisza basin countries (FAO 2003)

Country	Key issues
Ukraine	Flood management, International Cooperation, Good Agricultural Practice, Implementation WFD
Romania	TRB management with ICPDR (Coordination), Water supply and sewage treatment, Water quality improvement, Ecological reconstruction
Slovakia	Flood management, Water supply, Ecology (Biodiversity), Agricultural potential
Hungary	Flood management, Reforestation in the Carpathians, Water quality, Reduction of contamination, Industrial development, Job diversification
Serbia and Montenegro	Flood management, Water supply, Water quality, Biodiversity, Navigation



6 Analysis of regimes

In this chapter the regimes in the different NeWater basins are described and compared. Because a full description of the regimes can already be found in the basin reports (Becker 2005; Kranz, Interwies and Vidaurre 2005; Kranz, Interwies and Vorwerk 2005; Raadgever 2005a, 2005b; Timmerman 2005; Timmerman and Doze 2005), this chapter only concerns general characteristics and remarkable similarities and differences between the basins. Only when larger pieces of text are copied from the basin reports references are included.

This chapter is structured as follows. First the regime elements law, policy, formal and informal actors are described, then interactions between these elements and finally the institutional changes that occurred in the recent past. Because it was not possible to find information on all the topics for all the basins, some gaps exist in the description.

6.1 Law

6.1.1 Multilateral and bilateral agreements

In Table 5 an overview is presented of the main agreements about the basin-wide transboundary cooperation in the NeWater basins. It should be noted that only a very small part of the multilateral agreements are represented and that in fact the legal and organisational structures are much more comprehensive and complex.

It appears that basin-wide cooperation started particularly early in the Rhine basin. Already in the 19th century commissions for the specific functions navigation and fishing were formed. Furthermore, the International Commission for the Protection of the Rhine against pollution (ICPR) was established much earlier than the basin organisations in the other NeWater basins, which all started after 1990. The recently established forms of cooperation, e.g. in the Nile and Tisza basin, are still focussing on creating trust and commitment and are not ready yet to substantially address water management issues. Nevertheless, in all basins, except for the Guadiana, organisations for cooperation between (nearly) all riparian countries exist.

Another difference can be noticed between the initial aims of on the one hand the Elbe and Rhine commissions and on the other hand the Amu Darya, Orange, Nile and Tisza commissions. The former were founded with one initial aim (protection against pollution), which was broadened during operation, whereas the latter have a broader set of goals from start. In most basins many bilateral agreements were signed decades before basin-wide cooperation structures existed. In the Nile basin for example many bilateral agreements were signed in the 19th and 20th century, concerning river development and water allocation.

Table 5. Main agreements for international cooperation in the NeWater case study basins

Basin	Agreement (year)	Signatories	Content
Amu Darya (Aral Sea Basin)	Agreement on co-operation in the management, utilisation and protection of interstate water resources (1992)	Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan	Lead to establishment of Interstate Water Management Coordinating Commission (IWMCC), later referred to as the Interstate Commission for Water Coordination (ICWC), responsible for the short and long-term water development and allocation planning, water quality control, conservation and environmental protection.

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Amu Darya (Aral Sea Basin)	Agreement on the institutional structure of international basin organisations (1996)	Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan	Establishing the interlinkages of the various institutions and aiming to streamline their areas of responsibility. The IFAS, ICWC and the Basin Organisations Syr Darya and Amu Darya emerged as the main institutions in managing transboundary regimes.
Elbe	Convention on the International Commission for the Protection of the Elbe (1990)	Germany, Czech Republic, EU	Established International Commission for the Protection of the Elbe (ICPE). Contracting parties agreed to cooperate in the ICPE to prevent the pollution of the Elbe and its drainage area. At present also flood and ecological issues.
Guadiana	Albufeira Convention (on Co-operation for Protection and Sustainable Use of Portuguese-Spanish River Basins) (1998)	Spain, Portugal	Agreement that establishes minimum flows at specific river sections during normal precipitation years. The agreement also covers cooperation in the promotion and protection of good surface/groundwater conditions, water quality management, coordination of pollution prevention and information exchange.
Nile	Nile Agreement for Full Utilization of Nile waters (1959)	Sudan, Egypt	Agreement aimed at gaining full control and utilisation of the annual Nile flow. Created the legal foundation for allocating water between the two countries before building the Aswan High Dam (66% for Sudan, 34% for Egypt).
Nile	Nile Basin Initiative (NBI) (1999)	Congo, Uganda, Rwanda, Ethiopia, Burundi, Sudan, Kenya, Egypt, Tanzania	Established Nile-COM (to replace Tecconile), with the ultimate goal to provide a peaceful means to reduce conflict in the Nile Basin. Aims to develop water resources in a sustainable and equitable way, ensure efficient water management / use, ensure cooperation and joint action between riparians, target poverty eradication, promote economic integration and ensure implementation.
Orange	Southern African Development Community Protocol on Water Resources (1995) & Revised SADC Protocol on Shared Water Resources (2000)	Include Botswana, Lesotho, Namibia and South Africa.	Provides objectives, general principles and specific provisions that reflect best-practice concerning shared watercourse legislation. Addresses conflict-resolution, establishes a framework of general co-operation and provides framework for specific shared watercourse agreements in the region (several river basin organisations have been formed referring to the protocol).
Orange	Establishment of the Orange-Senqu River Basin Commission (ORASECOM) (2000)	South Africa, Lesotho, Namibia, Botswana	ORASECOM is empowered to serve as the technical advisor of the parties on matters relating to the development, utilisation and conservation of the water resources of the Orange River Watercourse System

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Rhine	Treaty of Bern (1963)	Switzerland, France, Germany, Luxemburg, Netherlands, EU (added later)	International Commission for the Protection of the Rhine from Pollution (ICPR) formally established. At present also flood and ecological issues.
Tisza	Danube River Protection Convention (1994)	Include all Tisza countries and EU	Aims to strengthen international cooperation in the Danube river basin and ensure sustainable management and use of its waters.
Tisza	Memorandum of Understanding (2004)	All Tisza countries	Intention to intensify the cooperation and to bundle the different efforts (economic, social, water related) and partners/supporters (UNDP GEF, ICPDR, the EU Commission, FAO).

6.1.2 EU legislation

EU legislation is described separately because of the large influence on four of the seven studied basins. The European Union uses different types of legislative instruments. Directives are binding only to the result to be achieved by the member states to which they are addressed, but not to the means to reach these results. The Water Framework Directive (WFD) of 2000 has been and will be very influential to the organisation of water management in (among others) the Elbe, Guadiana, Rhine and Tisza basin. The purpose of the WFD is manifold, but the main idea is to reach 'good water status' by 2015, using the natural geographical and hydrological unit for the management organisations instead of the former administrative or political borders. If member states share a river basin, they are obliged to establish an international basin district and if a basin is shared with non-member states, the member state should try to establish coordination to achieve the objectives of the WFD (European Parliament 2000; Gooch, Hoglund et al. 2002). Furthermore, the WFD requires new spatial and temporal scales of policy development and implementation and public participation. All Rhine, Elbe and Guadiana countries are, except for Switzerland, all member states of the EU. In the Tisza basin Hungary and Slovakia are member states, Romania is a candidate and Ukraine and Serbia-Montenegro are non-member states. The national laws of all member and candidate states have to be adapted to comply with the WFD.

6.1.3 National law

Within the Orange basins large differences exist between the national water laws. In Lesotho water law is rather outdated and spread over multiple Acts. It does not take IWRM into account. In South Africa water law is rather comprehensive and combined in one newly developed Act. It supports decentralised water management. Namibia is currently in the process of transfer between multiple old water Acts and one new, integrated water bill (Kranz, Interwies and Vidaurre 2005).

National laws in all Amu Darya countries refer to the allocation of water resources. The more progressive legal frameworks include pollution prevention and transboundary cooperation as well. Implementation of the legal provision is however in many cases problematic.

In the Guadiana basin, both countries are adapting their law to European requirements. In Spain the Water Act has been revised in 1999 and River Basin Authorities have been set up. In Portugal water law is rather outdated and, although since June 2005 foreseen in the



National Water Law, administrative units for water management do not yet coincide with the river basins.

The content of national water laws in the Rhine and Elbe countries is very similar. All countries use a combination of permits and charges to regulate abstractions and polluted discharges and strive for cost recovery of specific water management activities from the beneficiaries of these activities. Furthermore, all ownership and user rights are strongly regulated by government. There are also some differences in law. The German legal framework is for example more comprehensive and tight than the others. Furthermore, the federal states Switzerland and Germany have an extra level of legislation. Until 2001 Czech water law reflected the centralised, socialistic regime, but in 2001 new Act was adopted, which complies with the EU requirements and prescribes modern financing mechanisms.

6.2 Policy

6.2.1 Multilateral policy documents

In Table 5 an overview is presented of the main policy documents for river basin management in the NeWater basins. As the overview of law, this overview is far from complete.

The Aral Sea Basin Programme, the Tisza Environmental Programme and parts of the Nile Shared Vision Programme (SVP) are aimed mainly at strengthening transboundary cooperation by building trust and improving institutional capacity. Other policy documents are directed at specific issues (e.g. pollution, floods or water scarcity): the Rhine Action Plans, the Elbe Action Programmes, the RSAP-IRWM and parts of the SVP include agreements about the selection of measures and planning of their implementation. For management of the Guadiana no transboundary policy has been formulated at all. The countries of the European Union are currently in the process of developing River Basin Management Plans, which are required according to the WFD.

Table 6. Main policy documents for River Basin Management in the NeWater basins

Basin	Policy document (signatories, year)	Content & implementation
Amu Darya	Aral Sea Basin Programme (ASPB) (5 central Asian states & donors, 1994)	Contains practical projects to be implemented at the regional level for stabilisation of the Aral Sea at a sustainable level, socio-economic development of the affected areas, management of the water resources of the Amu Darya and the Syr Darya and installation and strengthening of institutions for planning and implementing these measures. Regional institutions are responsible for the implementation of the programme. First phase (almost) implemented in 1997.
Elbe	Action Programme Elbe (ICPE Ministers Conference, 1995).	Aimed at reducing polluted discharges by communities, industries and diffuse sources, ecological recovery of floodplains and improvement of biotope structures and development of Elbe water quality. Additional policy goals, which were stated by the ICPE after 1995, are flood protection and implementation of the EU WFD. Progress in implementation is made, according to progress reports.

Table continues on next page



Continuation from previous page

Elbe	Flood Action Programme the Elbe (ICPE Ministers Conference, 2003)	Contains a broad package of measures aimed at reducing the threat of flooding in a step-by-step approach until 2015. It prescribes, retaining precipitation, maintaining remaining flood plains, identifying former flood as flood prone areas, reviewing the option of reclaiming areas as flood plains, creating additional retention polders, improving dikes, raising awareness, improving preparedness and establishment of a joint flood warning system. A first report on the implementation will be elaborated at the end of 2005.
Guadiana	No transboundary policy established	n/a
Nile	Shared Vision Programme (SVP) (Nile-COM, 2001)	The SVP comprises eight projects, working both on a regional and national level. The projects involve applied training, transboundary environmental action, regional power trade, water for agriculture, water resources planning and management, confidence-building and stakeholder involvement, socio-economic development and benefit sharing. A separate project has been set-up to strengthen the basin-wide institutions and coordinate the implementation of the SVP.
Orange	Regional Strategic Action Plan for Integrated Water Resources Development and Management (RSAP-IWRM) (all SADC members, 1998)	Defines 31 projects addressing the problems considered most pressing, grouped within 7 general areas. Areas include river basin management, public participation and information acquisition, management and dissemination. A number of these projects are of relevance for the Orange basin, addressing capacity building, stakeholder participation, future developments and management options. The RSAP-IWRM is mainly financed through international donor organisations.
Rhine	Rhine Action Plan (RAP) (ICPR Ministers Conference, 1987)	The riparian countries committed themselves to the vision of return of the salmon in the Rhine by 2000 and to several measures to reach this vision. Measures include stricter norms for pollution loads, stricter reporting, stricter safety prescriptions and management of non-source pollution. Implementation has been quite successful.
Rhine	Action plan on Flood Defence (ICPR Ministers Conference, 1998)	The goal of the Action plan is to improve the protection of people and goods from floods in combination with the goal of ecological improvement of the Rhine and its floodplains. The executed measures consist of retention of precipitation and river flows, technical protection measures, precautionary measures and improvement of flood warning systems. Implementation will be monitored after each phase.
Tisza	Tisza Environmental program (Tisza country Environmental ministers, 2001)	The main aim is to reduce the pollution risks and to prevent transboundary pollution. The plan includes the development of the legal and administrative framework of cooperation and public involvement and is based on the short term bi- and multilateral projects that can be financed from local sources, on the long term on projects which require international financial support.

6.2.2 Implementation

The initiative and the (financing of) the implementation of the policies is not in all described cases the task of governmental bodies in the riparian countries. The RSAP-IWRM in



Southern Africa is initiated and largely financed by donor organisations and also the Tisza River Basin Sustainable Development Program was initiated by donors. However, when transboundary cooperation is initiated and financed by international donors, without commitment of the national governments, an important support base for the implementation of measures is missing. Therefore, donor initiatives are mainly aimed at building trust and creating communication and cooperation between the national governments. Furthermore, financing by donors produces the need to adjust plans to the changing agendas and priorities of the international donor community. In the Nile, Orange and Amu Darya basin the influence of external donors on transboundary resource management is (or has been) very significant. Although many positive developments have been established, supported by the donor community, most laws and policies include only generic goals, and concrete steps to ensure their implementation are often lacking.

In the Rhine and Elbe basin the national governments are responsible for the initiatives and for the implementation of the measures that were agreed upon in the transboundary policies. These transboundary strategies are incorporated in national policies. Implementation is checked periodically.

6.3 Formal actors

6.3.1 National governments

The key governmental actors in the basins are the national ministries for water or environmental management. They make the decisions about transboundary as well as national management strategies. Differences between countries in the degree of centralisation, the way of dealing with water management problems, but also in language and culture can make transboundary cooperation a complex task. Additionally, differences of opinion might occur within a country. In many countries different ministries are stakeholders in water management issues. The national official delegations in the ICPR for example include two to four different ministries or services from each country. Because of their different perspectives, ministries of the same country may have differing interests. For an overview of the national ministries involved in RBM in the NeWater basins, the reader is referred to the basin reports.

6.3.2 Basin & supra-basin organisations

In all NeWater basins, except for the Guadiana basin, the riparian countries cooperate in a certain form on the scale the basin. The established organisations at the scale of the basin are the:

- Basin Water Management Organisation (BVO) Amu Darya, embedded in the framework of the Interstate Commission for Water Coordination (ICWC) for the Aral Sea basin;
- International Commission for the Protection of the Elbe (ICPE);
- Nile Council of Ministers (Nile-COM), Technical Advisory Committee (Nile-TAC) and secretariat (Nile-SEC);
- Orange-Senqu River Basin Commission (ORASECOM);
- International Commission for the Protection of the Rhine (ICPR).

The Tisza basin is part of the Danube basin, in which the International Commission for the Protection of the Danube River (ICPDR) is the main international operating actor. The Tisza sub-basin does not have its own transboundary basin organisation, although in size the basin is comparable to the Rhine and Elbe basin. In 2004 however, the Tisza countries agreed on the intention to intensify the cooperation and to bundle the different efforts and partners/supporters.



There is no international basin organisation established for management of the Guadiana. In the framework of the Albufeira Convention, Spain and Portugal have however established the ministerial Conference of Parties, in charge of political issues, and the joint working Commission for the Implementation and Development of the Convention (CADC). A number of Working groups and Sub-commissions are active in the Guadiana basin and several joint studies have been executed. However, joint management is yet to be achieved (WWF 2003a, 2003b).

In the Amu Darya and Orange basin, river basin organisations have been established, but the regimes are strongly embedded in a larger institutional framework. The Amu Darya is part of the larger Aral Sea Basin. The ICWC and the International Fund for the Aral Sea (IFAS) are the main institutions operating at the Aral Sea basin level, and they work strongly together with the BVOs Amu Darya and Syr Darya. The main issues in the transboundary cooperation in Central Asia are that implementation of basin-wide agreements is lacking due to a variety of reasons and that the former Soviet Union water management approaches have not been adapted sufficiently to new circumstances. Another weak spot is that Afghanistan as an upstream country has largely been ignored so far. A successful integration of Afghanistan is, considering its development path and increasing water usage, crucial for achieving sustainable water management.

The development of transboundary cooperation in the Orange basin, including the establishment of the ORASECOM, has been strongly dependent on the cooperation in the South African Development Community (SADC). The ORASECOM as a fully functional river basin institution is still in an emerging state and massive donor involvement is foreseen for the coming year, in order to speed up the processes. On the scale of the continent formal actors exist as well, like the African Ministerial Council on Water (AMCOW), which was established in 2002 and is intended to be the highest political body in relation to water management in Africa.

Conceptually, the international basin organisations that were established are important structures for information exchange and shared research and often also offer a platform for (periodical) meetings between the responsible national ministries. The transboundary cooperation between the national governments is therefore likely to be better with the existence of transboundary commissions. The organisation, tasks and responsibilities of the transboundary commissions do however vary strongly between the basins under study, as well as the implementation gap. The first period of cooperation is often aimed at finding proper organisational and communicational structures and focusing on technical cooperation, to develop mutual trust. The Nile-COM, ORASECOM, ICWC and to a lesser extent also the also the ICPDR are currently in such a situation.

In the framework of the ICPR and the ICPE policy recommendations are prepared and proposed to the involved ministries at periodical ministers' conferences. It took however many years before these kinds of tasks could be effectively executed within the framework of the basin commissions.

In Europe the European Union is an increasingly important actor, influencing water management in the Elbe, Guadiana, Rhine and Tisza basin. The member states have to adopt the rules that are formulated in the WFD and other environmental directives.

6.3.3 Bilateral cooperation

In the Orange basin some interesting bilateral institutions have been established. The Lesotho Highlands Water Commission (LHWC) is the bi-national organisation co-ordinating and supervising the South African and Lesothian national institutions working on the Lesotho Highlands project. The other relevant bilateral institution in the Orange basin is the Permanent Water Commission (PWC), formed by Namibia and South Africa in 1992



(replacing the Joint Technical Committee created in 1987), and its mission is to advise both governments on the development possibilities of the Lower Orange (the section of the river that forms the border between both countries) (Kranz, Interwies and Vidaurre 2005).

6.3.4 Regional and local cooperation

Except for the national governments and the basin-wide commissions, regional and local governments often are important stakeholders in water management. In particular in the more decentralised countries in Europe, commitment of regional and local governmental levels, even in transboundary issues, is necessary to ensure that measures get implemented. An example of a transboundary regional cooperation is the German-Dutch Working group on flood management. This Working group is a regional cooperation to which the Dutch province of Gelderland and the German *Land* Nordrhein-Westphalia are the main contributors, but also higher and lower governmental levels are involved. In federal states like Germany and Switzerland the national level has much less sovereignty and the additional adjustment is needed between the *Länder* respectively *Cantons*. In Germany the *Länder* cooperate in water management at the federal level in the LAWA and at basin level in the ARGE Elbe and the FGG Elbe.

6.4 Informal actors

6.4.1 NGOs

A great number of NGOs are active in RBM. There is however a large difference in activity between the NGOs in the NeWater case study basins. In the Rhine and Elbe basin stakeholders can be characterised by a high degree of organisation. The interests of water user groups are represented by many organisations, like industrial associations, navigation commissions and agricultural associations. In particular the number of nature organisations is very large. In the Rhine basin the water supply sector has even established a basin wide framework for cooperation (the IAWR), which is among others active in the ICPR. Although stakeholders have knowledge of each others' existence and goals, direct interaction between the groups with opposing interests is usually limited. Citizens negatively affected by the implementation of planned measures (e.g. retention polders), often organise themselves in citizen action groups, which can be very effective in their resistance (Raadgever 2005a, 2005b).

In Portugal public participation is very limited. One of the aims of establishing the National Water Council and River-basin Councils in 1994 was to introduce PP. In practice NGOs do participate in these advisory bodies, but the agricultural (irrigation) associations and representatives of other water using sectors do not frequently attend the meetings (Aquastress 2005).

In the Tisza basin a number of international NGOs and many local NGOs are active in RBM. The local NGOs often lack financial resources and capacity to have a major political impact, but do contribute to raising awareness among citizens. On a basin scale, local and regional environmental NGOs cooperate in the framework of the Danube Environmental Forum. Business in the region and local municipalities seem to be underrepresented (Becker 2005).

The lack of finances and capacity of local NGOs and the involvement of international donors and NGOs can also be found in the Orange and Amu Darya basin. In the Orange basin, the implementation of the Lesotho Highlands Water Project has generated considerable environmental and social problems, and has thus met growing national (mainly in Lesotho) and international resistance. The International Rivers Network, a respected California-based NGO, is one of the international NGOs active in the region and has worked extensively with local organisations (Kranz, Interwies and Vidaurre 2005). In Central Asia stakeholder organisations are still at an emerging stage. Water user associations are forming in some of



the Central Asian states. Other interest groups would be fisheries and navigation organisations, industrial and municipal water users and environmental groups. International donors as well as western NGOs have been strongly lobbying for the strengthening of local NGOs (Kranz, Interwies and Vorwerk 2005).

6.4.2 Donors

Several donors are active in the field of (transboundary) RBM. Among the most influential are the World Bank and the United Nations (Development Programme (UNDP) and Environmental Programme (UNEP)). The Global Environment Facility (GEF) is a financial mechanism for projects and programmes for the protection of the global environment, of which the World Bank, UNDP and UNEP are implementing agencies.

The World Bank is one of the most important international organisations that are actively involved in development aid in Central Asia. The World Bank's mission to Central Asia started quite soon after independence of the Central Asian states in 1992. Together with other international donors the World Bank and the Central Asian Countries launched the Aral Sea Basin Programme.

Also in the Orange region, the involvement of international institutions in water affairs has been extremely significant, for infrastructure projects as well as institutional development and research. The development of transboundary water management in the region has been very positively influenced by this involvement. Currently the World Bank is one of the main supporters and financiers of a number of RSAP-IWRM projects in which also GEF is involved. Other donors that have been involved in the region are the African Development Bank, UNDP, UNESCO and the EU.

6.4.3 Research and science

In Soviet Union times, university education had a high quality standard and the information exchange between scientists was well established in the Amu Darya basin. This situation changed with the independence of the Central Asian states. While science and good education still have a high relevance, universities and scientific institutes are often lacking sufficient funds. Networking and information exchange among scientists became much more difficult simply because travel costs could not be covered any more. Currently, some scientific networks still exist, but the nature of the interaction is very informal and not institutionalised (Kranz, Interwies and Vorwerk 2005).

The European Commission finances many research projects on (the different aspects of) integrated RBM, like HarmoniCOP, Mantra-East, NeWater, and FloodSITE. Furthermore, the European Commission organises research by institutions like the European Environment Agency and the Joint Research Centre, which provides independent, customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies (JRC 2005).

The scientific actors in the Elbe and Rhine area cooperate on numerous levels. The scientific actors have developed into an active, extensive community that cooperates on numerous levels in structural or project organisations. On the Rhine basin level, structural cooperation has been established in the International Commission for the Hydrology of the Rhine Basin (CHR), established in 1970 on initiative of UNESCO and WMO. In the CHR scientific institutes from Switzerland, Austria, Germany, France Luxembourg and the Netherlands cooperate, exchange data and information and standardise measuring and calculation methods.



6.5 Interactions

A regime is a complex network structure comprising many interactions between the regime elements. In this section some of the interactions between law, policy and formal and informal actors are described. The description is focused on the attention of the actors to transboundary management, the involvement of informal actors and the scientific community in RBM and the relation of the water management network with other policy networks.

6.5.1 Attention to transboundary water management

Most citizens in the Elbe and Rhine basin only pay attention to transboundary water management during severe problems or after catastrophic events. Examples of these situations are the severe pollution in the 1970s and 1980s and the floods of 1995 (Rhine) and 2002 (Elbe). Attention of governments to transboundary water management is more constant, but severe events have triggered the development of international regimes. At present, the implementation of the WFD requires that attention is paid to transboundary water management. In sum, history has created the awareness (at least of politicians) that the riparian countries are mutually dependent in several aspects of water management.

In the more dry basins, like the Orange basin, water scarcity and the uneven distribution of the resource, which have a direct impact on human welfare, have caused transboundary water management to be an important concern for the political actors for considerable time. In the Amu Darya basin, rivers that had been national rivers in Soviet times became international after the development of independent states, creating the necessity for hydrodiplomatic relations between the countries.

In the Rhine, Elbe and Orange basin the public does not pay a lot of attention to transboundary water management. Involvement mainly arises in response to negative impacts that management actions cause or are expected to cause. In the Orange basin the negative impacts of the Lesotho Highland Water Project triggered public involvement, whereas in the Rhine area the expected impact of proposed flood reduction measures (like retention areas) recently caused a lot of citizen action.

6.5.2 Public and stakeholder involvement

At the current stage, non-governmental actors and the public do not strongly participate in water policy in Central Asia. The reaction of water management officials towards the involvement of non-governmental stakeholders is rather sceptical. Western as well as local NGOs are by far not allowed to work completely unhindered. This might be due to the inherent fear that NGOs might effectuate a complete overhaul of water management regimes, resulting in the loss of power and influence. At the international level, there are already explicit provisions for better addressing different groups of water users. The first attempts in assuring the provision of appropriate information to stakeholders and the public and raising awareness are reflected in the mandate of the ICWC (Kranz, Interwies and Vorwerk 2005).

The Spanish-Portuguese Convention as well as the work of the CADC is almost unknown to the general public and even to the local administrative bodies in the Guadiana basin. Information about the agendas and decisions of the commission is not available for the public in any media (Timmerman and Doze 2005).

The NBI includes broad access to information and participation in decision-making, including NGO's. A large number of NGO's that must be involved and can possibly cooperate in the process is identified. Broad stakeholder participation is therefore defined in the initiative and several stakeholder meetings were established. However vast problems still have to be faced and the cultural and socio-economic setting in the Nile Basin countries is not fully developed to establish the initiative to its full extent (Timmerman 2005).



In the Tisza and Orange basin, public participation is also weak. This is mainly caused by lack of public attention and lack of resources and capacity of NGOs. In the Tisza basin, despite enabling legislation, communication and cooperation between NGOs and government remains difficult. Local NGOs are inexperienced and hampered by inadequate funding. The fact that levels of public participation vary greatly between the riparian countries, increases the challenge for participation in transboundary issues. On the Danube River Basin level, the ICPDR is promoting public participation in the planning process via multiple information, monitoring and operating systems. Ten organisations, including NGOs, organisations representing private industry, and intergovernmental organisations, have become observers to the ICPDR and participate in decision-making and at experts meetings. The ICPDR also developed a network of national PP focal points to ensure a concerted approach throughout all countries (Becker 2005). In the Orange basin a situation exists in which stakeholder participation is explicitly wished for by the authorities but is not yet being found on the ground. The lack of public attention is partly caused by lack of adequate activities aimed at providing information and generating stakeholder participation (Kranz, Interwies and Vidaurre 2005).

In the Rhine and Elbe basin there are a lot of formal and informal ways in which stakeholder and the public as well as the scientific community are involved in water management. NGOs are involved as observers in the working groups of the ICPE and ICPR. In the ICPR a large group of NGOs, dominated by nature organisations, have observer status, but in the ICPE so far only a few environmental NGOs became observer, because of the significant resources required from the NGOs. When there are no formal ways to participate, stakeholders often make themselves heard via more informal ways, like lobbying, disseminating information to the media etc. When the desired results are not achieved in this way, juridical actions sometimes follow, like the procedures of *Reinwater* and others against the French potassium mines. At national level various institutionalised (e.g. public hearings and water associations) and uninstitutionalised (e.g. citizen action groups) ways of involving stakeholders exist. Sometimes public participation is limited to the legal requirements. In other cases, citizens and stakeholders are involved much more than legally required. In practice however, in many cases citizens still perceive a lack of information supply and a lack of transparency in the decision-making processes (Raadgever 2005a, 2005b).

6.5.3 Link policy makers and the scientific community

In the Orange basin the scientific community shows a larger degree of involvement than other stakeholders. The universities and research institutions show a very significant production of research on transboundary water management, from all kinds of perspectives. In South Africa specifically, the importance of the Water Research Commission regarding research and its close relationship with the Department for Water Affairs and Forestry ensure the existence of research related to the main policy processes. Both the amount of local research and the interaction between the scientific community and the policy makers, seem to be adequate for the processes at hand (Kranz, Interwies and Vidaurre 2005).

In the Soviet Union, science was important, but its main function was to support the Soviet regime's policy. With the new political situation in the Amu Darya basin, new ways of collaboration need to be established, in order to create a climate where scientific research can provide information to policy-makers that allow a critical examination of the issues in question. At the transboundary level the situation is more promising. New scientific institutions have been established in water management like the Scientific Information Centre of the ICWC. These developments are highly influenced by international organisations calling for more transparency. The agreements on transboundary water management furthermore intend to support independent research in order to base international negotiations on a sound scientific basis (Kranz, Interwies and Vorwerk 2005).



In the Guadiana basin governmental organisations, universities and environmental NGOs carry out several pilot projects and research projects financed by the European Common Agricultural Policy. Results are disseminated but seldom in a pro-active way ((WWF 2003a) in (Timmerman and Doze 2005)).

6.5.4 Relation water management network with other policy networks

In Central Asia water management has been and still is inextricably linked to agricultural interests and specifically to the continuation of cotton monoculture. In Soviet times, water was provided at almost no charge in order to cater to the needs of cotton farming. The specific actor constellation in cotton farming led to the emergence of certain power structures, which partly remained functional until the present day. The fast emergence of the first international agreements is explained by this strong interdependence of water and agricultural issues (Kranz, Interwies and Vorwerk 2005).

A similar situation is present in the Orange basin, where the linkage between the water management network and other networks seems to be weak, with the exception of the agricultural network and to a lesser extent the energy sector. The strong connection between water and agriculture is caused by the wide expanse of irrigated land in the area (Kranz, Interwies and Vidaurre 2005).

In the Tisza basin a more holistic handling of water management by connecting the water management network with the agricultural, environmental and spatial planning networks is currently in the early stages of development. At the Elbe and Rhine basin level water management hardly involves other sectors, although multiple disciplines are involved in the ICPR and ICPE working groups. Adjustment of water policies to agricultural and spatial planning policies takes place on national or lower levels.

6.6 Institutional change

In this final section of the chapter the main changes that occurred in the regimes and the factors explaining these changes. Furthermore, attention is paid to the question whether occurred changes can be characterised as slow and reactive or quick and anticipating.

The Central Asian region went through a fundamental political change with the demise of the Soviet Union. However, changes in the water management regime have only occurred very slowly and rather reactive to the new boundary conditions. Water management during Soviet times was highly centralistic with most decisions taken in Moscow in the context of the national planned economy. While the involved newly independent states sought to set up their own water management systems in order to secure their national access to and the availability of this important resource, transboundary issues in water management, including water allocation and water quality, emerged. Many changes in water management approaches were introduced following the pressure and the facilitation of international (donor) organisations and NGOs, while the implementation of the international agreements in practice remains limited. The most visible institutional change is the newly established structure of international joint bodies set up to manage transboundary water resources. After the initiation phase, the structure has been adapted several times in order to assure more transparency and efficiency of these institutions. Some success has been achieved in this respect, but the necessary shift in water management paradigms, away from a technocratic, centralistic command and control approach towards more resource-oriented participatory strategy has not yet been finalised. Very dominant and conservative national government structures, looking to maintain the old dominance of irrigated agriculture, counteract the developments at the international level (Kranz, Interwies and Vorwerk 2005).

The institutional changes that have occurred in the Orange basin seem to be the product of two sets of political processes: the regime change in South Africa in the early nineties and



the growing regional integration between African states. The regime change in South Africa provided the opportunity to rethink and readdress the principles behind and implementation of political institutions, including those in charge of water management. While the new system is still being implemented in South Africa, the positive evaluation of this reform process may have influenced the situation in other countries as well. In fact, many other countries of the region are currently reforming their water sectors. The growing regional integration in the framework of the SADC created a context in which international cooperation regarding water resources has become part of a much wider series of cooperation efforts. These developments, in addition to the importance of transboundary river basins, the scarcity of water and its limiting effect on the region's development, have resulted in the establishment of national and international water laws and policies, and the creation of river basin organisations such as ORASECOM. The implementation of these policies and laws, though, has only occurred only slowly. The complex transformation processes that are occurring at the national level may generate a reduction of the dynamics of international institutions (Kranz, Interwies and Vidaurre 2005).

The Nile Basin Initiative strategy is to cooperate where possible, with a focus on interests rather than only on legal positions. Environmental impacts of macro and sectoral policies on the Nile Basin's land and water resources, including transboundary impacts linked to trade, transport and migration, are poorly understood. Therefore, in the coming years cooperation needs to be grounded in wider development concepts in which poverty reduction is the major driving force. Hampering factors for transboundary institutional development might be the different interests of the countries and their limited economic and political capacity, which often threatens the implementation of policies (Timmerman 2005).

Until recently, the bilateral relationships between Spain and Portugal on the water related aspects were only based on sharing water for hydroelectric generation. In November 1998, both countries signed the Albufeira Convention under the International and Community environmental laws. Both countries have started the transposition of the European Water Framework Directive (WFD) contents for internal laws, in order to prevent the ecological state deterioration and the pollution of surface waters and in recoup surface waters in order to reach a good water condition, according to the aim of the WFD. These developments have excellerated the water management developments on the Iberian Peninsula, but still a lot needs to be done concerning implementation of both legal obligations (Timmerman and Doze 2005).

Transboundary cooperation on the Elbe has been triggered by specific problems. The pollution problem in the 1970s and 1980s triggered the general attention, but transboundary cooperation was not feasible due to the cold war. The ICPE was established very quickly after the end of the cold war. New initiatives for cooperation and new policy were quickly established after the severe flood of 2002 and new flood management concepts (e.g. creating room for the river) were incorporated in the new policy. Similar developments can be noticed in the Rhine basin, where the ICPR was established when pollution became a serious problem. Only after serious incidents the ICPR booked progress in the implementation of legal agreements and policies to clean the Rhine. The establishment of transboundary cooperation in the Rhine and Elbe basin can thus be called reactive and, dependent on the political context, in some cases slow and in some cases fast (Raadgever 2005a, 2005b). At present, the implementation of the WFD requires countries to cooperate on the basin scale and requires national institutional changes. In Germany the most important (historical and future) development in the institutional system might even be driven by this ongoing 'Europeanisation' (Kraemer and Jäger 1998).



7 Analysis of information management

In this chapter information management in the NeWater basins is described. The chapter is divided in four sections: specification of information goals, needs and strategy, information production, communication and information utilisation.

7.1 Specification of information goals, needs & strategy

A summary of the information needs, current availability of information and current strategy to fulfil the information needs of the main transboundary formal actors in the NeWater basins can be found in Table 7.

7.1.1 Information needs

The information needs in a basin are strongly related to the main issues in the basin. In the basins in Africa and Asia and in the Guadiana basin, the main driving force of transboundary relevance is water scarcity. Therefore, information is required about (current and future) water availability and water demand. Insight in future trends like climate change, population growth and economic and technological developments is crucial for basin wide planning and management. In the Nile basin, insight in the downstream effects of measures (e.g. reservoirs) is very important. In the Elbe, Rhine and Tisza basin, flooding is an important water management issue, which requires information about rainfall, peak discharges and climate change as well as socio-economic developments. Water quality management plays a role in all basins (although attention to water quality is in some cases limited) and requires transboundary monitoring networks.

Non-governmental stakeholders need more specific forms of information to influence the management process. In the Rhine and Elbe basin, for example, the shipping and industrial sectors depend on information that expresses their economic value and therefore underlines their needs. The drinking water sector needs up to date information about potentially harmful substances in the river water. The public seems to have little information needs concerning water management.

7.1.2 Availability of information

Without sufficient information, effective and fair discussion of the main issues leading to realistic agreements is hardly achievable. Thus, information is needed on the international level to support negotiation and decision-making processes, but also on the national level to allow the individual states to position themselves (Kranz, Interwies and Vidaurre 2005).

In the Nile, Orange, Amu Darya and Tisza basin, the availability of information needed by formal actors to manage transboundary water resources is far from satisfactory. The two main reasons for the limited availability are limited data collection and limited distribution of information. Limited data collection is caused by limited technical and institutional capacity to produce relevant information, for example by operating monitoring systems. Limited exchange of information is often caused by the fact that information is treated as confidential by national formal actors in an effort to defend their own interests.

In the Nile basin, the absence of relevant information about water quality has lead to a situation in which awareness of downstream impacts is generally lacking. Moreover, there is insufficient understanding of the river basin dynamics to assess the downstream environmental impacts of future river system interventions or changes in watershed management regimes. Part of the challenge is knowing how and where to develop the basin resources in order to maximise benefits for states through more efficient as well as equitable use of the resource (Timmerman 2005). Many activities to achieve this are currently being



implemented, partly supported by donors. In the Guadiana basin the specialists in the CADC produce information about many aspects of (Transboundary) water management. The work of the CADC is, however, almost unknown to regional and local governments, water users and the general public. This is due to the fact that this information is not actively disseminated nor easily accessible (Timmerman and Doze 2005).

Table 7. Information needs, current availability of information and the main strategy to fulfil the information needs for basin-wide formal actors in the NeWater basins

Basin (actor)	Information needed	Current availability & limitations	Main strategy / action
Amu Darya (ICWC)	Water availability, losses and quality. Economic and technological data on agriculture and power generation	Availability far from satisfactory, due to limited data collection and limited distribution of information (that is perceived confidential)	The Scientific Information Centre (SIC ICWC) has been established for the collection, analysis and distribution of information, limited implementation;
Elbe (ICPE)	Water quality, ecology and floods.	Information available, but limited socio-economic and institutional information, and long-term predictions are still very uncertain.	Production within ICPE working groups. Exchange between national governments
Guadiana (CADC)	Water quality and quantity, about water use, discharges, and plans for new installations and programmes	Data collection takes place but availability is limited despite willingness of both countries to share information.	CADC is responsible for exchanging and managing information
Nile (Nile-COM)	Downstream impacts of interventions and pollution (& potential win-win situations).	Availability poor, in particular for water quality, due to past focus on river flows and different priorities and capacities among riparians.	Transboundary Environment Action Project (2002) for more effective stakeholder cooperation on transboundary issues & development of DSS (Nile-COM)
Orange (ORASE COM)	(Current and future) water availability, water demand and water quality.	Information available about DPSIR components, but too scarce to form a sound basis for decision-making on basin level. No integrated data and information systems.	Common approach for improvement of measurements and better exchange of information.
Rhine (ICPR)	Water quality, ecology and floods.	Information available, but limited socio-economic and institutional information, and long-term predictions are still very uncertain.	Production within ICPR working groups Coordination exchange between national governments
Tisza (ICPDR)	Water availability, (future) water use, floods, landslides, pollution, and economic data.	Information available, but lack of appropriate analysis, use and dissemination and limited information available for sub-basin Tisza.	Awareness raising Public participation Developing a network of experts

It is widely acknowledged that in the Orange basin there is no integrated data and information system which could be used to adequately address the use of the basin's water



resources. There is an increasing awareness, however, that for effective future joint basin management a common base for information, production, dissemination and exchange is necessary. In the Tizsa Basin discussions have indicated that there is not a lack of data but rather a lack of appropriate use (flood warning system), analysis (economic) and dissemination.

7.1.3 Strategy

The basin organisations are all aimed at improving information production and exchange. The strategy of the ICPR and the ICPE to fulfil their informational needs is to gather information, to produce additional information within the several working groups and to coordinate the exchange between different actors. In the Orange basin, the development of a common base for information, production, dissemination and exchange by the ORASECOM is considered crucial. The Nile Basin Initiative is aimed mainly at more effective cooperation and exchange and not so much at additional data collection (due to lack of resources). The ICPCR pays a lot of attention to public participation in information management.

7.2 Information production

Information supporting RBM is produced in structural (institutionalised) forms and in projects. Some river basin organisations focus on combining the knowledge that is available at the national governments and others focus on the (joint) gathering of additional information. The main information production activities in each NeWater basin are described below.

In the Aral Sea basin the Scientific Information Centre (SIC) was set up, as one of the executive bodies of the ICWC, for the collection and analysis of data and the distribution of information. In fulfilling its tasks the SIC collaborates with scientific institutions in the contracting countries as well as on the international level with organisations like the World Water Council, the Network of Basin Organizations and the Global Water Partnership. In 1995, a Water Resources Management Information System was created in collaboration with the sub-basin organisations and foreign specialists. The system should allow for the permanent exchange of information related to water use in an agreed format. The SIC also engages in the development of a river basin model and future scenarios, which are intended to be used as tools for devising water strategies and priority setting in international RBM. While the systems should draw on data collected by the national hydrometeorological services of Central Asia, the actual practice is far from satisfactory. The hydrometric monitoring system was in its best shape in the 1980s, but deteriorated considerably and is currently old-fashioned. Efforts are currently concentrating on improving monitoring systems and data transmission and on observing snow and glaciers in mountains for hydrological forecasting (Kranz, Interwies and Vorwerk 2005).

The history of collecting data on the Nile is thousands of years old. However, apart from the data sharing between British experts in colonial times, it was not until the 1960s that concerted data sharing was attempted. The Hydromet project was established in 1967 between Egypt, Kenya, Sudan, Tanzania, and Uganda, and aimed at the collection and analysis of data for the Lakes Victoria, Kyoga, and Albert catchments and a study of the water balance of the Nile. More recently, data acquisition models have been developed in projects that resulted in significant capacity building in Upper Nile countries. In the early 1990s, Tecconile came into being, and included elements concerned with strengthening data processing, GIS / Image Analysis Systems and the implementation of basin-wide networking on data sharing (Nicol and Shahin 2003). Currently, the Nile Basin Initiative is coordinating basin-wide information management. Regional exchange of information will use existing national infrastructure and guidance. National databases exist in some form in most countries and are housed in or connected to the agencies responsible for water quality and enforcement



in each country. Several national monitoring programs are running. The information needs to be adjusted to a format that is transferable between countries (Timmerman 2005).

At the international level, there have been several efforts to improve the information and knowledge base on water management in the Orange basin. These were initiated in the context of bilateral international agreements or by international donors. Under the framework of the SADC Protocol on Shared Watercourses, a number of priority actions, interventions and projects for the region were defined. Of these priority activities several pertained to the acquisition, management and dissemination of information, e.g. the assessment of surface water courses, training in surveying, mapping and geographic information systems, and the expansion of the SADC-HYCOS (Hydrological Cycle Observation System). The SADC-HYCOS was launched by the World Meteorological Organisation in collaboration with the World Bank in 1995, in order to promote the exchange and use of consistent and reliable water resources data and information using modern information technologies and the Internet, to strengthen the institutional capacities of national hydrological services for the collection and processing of data and to improve the sharing of information on a basin-wide level. Policy fields that are expected to benefit include flood control and disaster mitigation, drought forecasting and management, irrigation management, protection of aquatic ecosystems, and the monitoring of international agreements for shared watercourses. Due to its prominent role in the basin and its economic strength, at the national level major efforts are undertaken by South Africa (Kranz, Interwies and Vidaurre 2005).

In the Guadiana basin some effort has been undertaken to produce information for transboundary assessment and management. The national water quality monitoring networks have been extended by eleven sampling stations specifically aimed at transboundary issues (Timmerman and Doze 2005).

Being part of the Danube River Basin, the ICPDR is a main producer and communicator of information about the Tisza basin. Recent analysis provides an overview of the main pressures in the basin and related impacts, based on data from past and ongoing programs. It is addressed to EU and country officials, water managers, interested parties as well as the public. In the Tisza River project scientific institutes and numerous working groups collect specific information (flooding, hydrological, spatial, and environmental) and promote metabases available via internet (Becker 2005).

The ICPR and ICPE working groups and project groups monitor and collect all kinds of information about discharges, pollution, fish etc. The groups consist of national senior officials and experts. Specific tasks are dealt with by expert groups. Within the working groups a lot of computer models are applied to simulate and predict system behaviour. NGOs do not have the capacity to produce a lot of information themselves and thus obtain most information via internet, mailing lists, government documents, conferences and through networking with other actors. Some NGOs cooperate in the working groups of the ICPR and the ICPE. Moreover, there are many research projects going on in both basins (Raadgever 2005a, 2005b).

7.3 Communication

7.3.1 Exchange information between national governments

Exchange of information in international context is hindered by many barriers. The most obvious barrier is the language barrier. Additionally, differences in culture (e.g. non-verbal behaviour) can form barriers to clear communication. Confidentiality of information is the third barrier (Stoks 2005). A fourth barrier would be the incompatibility of collected data. Well-developed transboundary institutions contribute to overcoming these barriers.



In the Aral Sea basin the SIC ICWC should provide information to all ICWC members through quarterly meetings of the ICWC, conferences and seminars, databases on the internet and publications. Much information of the SIC should be available on the internet in Russian and English. However, internet access is, although coverage is increasing, not yet available in every government administration office, which means that not every actor concerned with water management in the region can obtain access to the information via the web (Kranz, Interwies and Vorwerk 2005).

Similar provisions for the collection, dissemination and sharing of data among the riparian states are recorded in international agreements in the Orange Basin. In the framework of the SADC Protocol on Shared Watercourses, the sharing of information is considered central to the co-operation and economic integration in the region. Under the ORASECOM agreement, parties committed to sharing information relevant for river basin management, including information on river flows, droughts, floods irrigation development, water uses and infrastructure operations (Kranz, Interwies and Vidaurre 2005).

However, in both basins the exchange of information has in practice not been fully established until today. In the Aral Sea Basin, the exchange of information between the hydrometeorological agencies has not been realised and recent assessment of the performance of the ORASECOM revealed that the efforts for sharing information have not yet resulted in any significant exchange of data.

In the Nile Basin the information exchange has been planned, but not implemented yet. Exchange of information and dialogue between Nile Basin countries will be stimulated within the Nile Basin Initiative (NBI). This includes workshops, study tours and training. One of the policy priorities adopted by Nile-COM and also one of the objectives of the Long-term Communication (LTC) Project is to develop confidence in regional cooperation under the NBI. The 'public information track' of the LTC communication program will raise awareness and understanding of the NBI and foster support for regional cooperation and economic integration (Timmerman 2005).

In the Guadiana basin exchange of scientific and technological data and information to support transboundary decision-making is in an early stage of development. The establishment of the Albufeira Convention was mainly politically driven and not based on existing scientific or technical cooperation. Transboundary cooperation between administrative bodies on the regional and local scale is much more intense, but these structures do not correspond to the mechanism described in the Convention, which is exclusively aimed at national governments (Timmerman and Doze 2005).

Relatively strong communication has been established between the (formal and informal) actors in transboundary river management in the Rhine basin and to a lesser extent in the Elbe basin. The working groups and ministers' conferences of the ICPR and ICPE provide technically respectively politically oriented platforms for communication between national governmental actors. Data exchange and shared data processing (e.g. in modelling exercises) are common in the technical oriented working groups (Raadgever 2005a, 2005b).

7.3.2 Communication with stakeholders and public

A further aspect of communication is the communication with stakeholders in the basin. The information of stakeholders is the first step towards ensuring a further involvement of stakeholders in planning and decision-making processes in the basin. However, in basins where it already takes a lot of effort to establish communication and information exchange between national governments, the involvement of stakeholders is a great challenge. This is reflected in the transboundary institutions in the Aral Sea Basin, which do not include an official information policy with regard to other relevant stakeholders or the general public.



As a result, large user groups, such as land-users, agriculture and industries are not provided with specific information relevant to local issues (Kranz, Interwies and Vorwerk 2005).

Other transboundary institutions do include the intention to involve stakeholders. For example, the second objective of the LTC Project in the Nile Basin is to ensure full stakeholder involvement in the NBI and its projects. The 'development communication track' will lay the foundation for the use of participatory communication to achieve full stakeholder involvement in NBI projects. Also in the Orange basin the requirements for information dissemination and PP have been recorded in transboundary law and policy, but are at the current stage not well implemented, due to deficits in the interaction with stakeholders in general. The picture is similar at the national level, where the still transitory nature of water institutions does not provide a good basis for stakeholder involvement. Access to information and PP in the Guadiana basin are prescribed in the Albufeira Convention, but still need further development.

In ICPDR policy, communication with stakeholders is considered an important activity. The 2004 Public Participation Plan aims at raising awareness about water management in general, informing the public (including stakeholders and NGOs) about the WFD and the possibilities to participate in the implementation, ensuring that appropriate mechanisms for PP are in place and appropriate stakeholder groups are involved and developing a network of experts throughout the basin. To ensure meaningful inputs, the ICPDR organized PP at the international basin, national, sub-basin level and local level. A media network is being developed as well to provide transparent and direct information for the public. Still, doubts are raised about how coordinated, user-friendly and available data - particularly on the Tisza sub-basin level – are for decision-makers and the general public. Mainly due to the limited capacity of institutions and NGOs (including financial constraints), free flow of and access to information are limited (Becker 2005).

In the ICPE and ICPR, NGOs can participate as observers. Where most NGOs in the Elbe basin are still hesitant due to lack of capacity, in the Rhine ICPR this form of stakeholder involvement is already well-established. Both Commissions differ also in the dissemination of information to the general public. The ICPE presents only basic information about the Elbe on a simple website, which reflects their tight budget. Because of the limited communication, the activities of the ICPE are not considered fully transparent and the information of the ICPE does not always reach the different stakeholders. The website of the ICPR displays all sorts of information about the Rhine, the ICPR and specific (working groups) themes in multiple languages, and through publications.

Although the free access to information has been legally established, NGOs find that access to information at the (Dutch and German) national level is sometimes limited. In those cases an active, searching and lobbying approach is required to get access to the information that is treated as confidential by government bodies (Raadgever 2005a, 2005b). Communication and exchange of information between NGOs in the Rhine basin encounters much less barriers. Environmental organisations are for example very open towards mutual exchange of information and cooperation. This situation is totally different from that in the Nile basin, where exchange of information and knowledge sharing among and between key resource users, research institutions and other stakeholders throughout the Nile Basin is very limited and relatively few local stakeholders have access to adequate means of communication.

7.4 Information utilisation

The use of information in decision-making is part of an often non-transparent process in a complex network of actors. Therefore, it is in many cases not clear which information is used in what way in decision-making processes, in particular when also stakeholders and the



public try to influence decision-making by producing and disseminating their own information (e.g. using the media).

In Central Asia the data collected at the international level is used in order to monitor the allocation of water shares according to the agreement among the riparian states. Forecast data on run-off data is instrumental in managing the water systems sustainably by predicting the water availability during the growing season. Incorrect forecasts can cause (and have caused) serious damage. The latent conflict over the allocation of resources is aggravated by the claimed discrepancies between the reported and the actual usage of the individual states. In addition, data on the actual conditions in the basin are conflicting. Data collection procedures as well as the usage of data in decision-making processes are not transparent (Kranz, Interwies and Vorwerk 2005).

Detailed knowledge about the variability and availability of water is also crucial for the sustainable management of resources in the semi-arid conditions in the SADC region. The Lower Orange River Management Study (started in 2002) is a prime example for the collaboration of two riparian states on the assessment of water management practices and future options resulting in concrete recommendations for initiatives. However, the collaboration between the riparian states in the utilisation of the information is still limited (Kranz, Interwies and Vidaurre 2005).

In the dry Nile basin information is required for assessing and responding to the development needs of basin states as well as developing effective and transparent institutions and processes of cooperation. Although the international water use conflict in the Nile Basin is not over water pollution, much of the focus in transboundary monitoring is directed towards water quality monitoring. One important effort in this respect is the Transboundary Environmental Analysis project. A review of the experiences during this project will be performed to consolidate the experiences and formulate recommendations for further actions. Recommendations from this evaluation may form part of an initial action agenda for water quality management in the Nile Basin (Timmerman 2005).

It can take a long time before certain issues are considered for decision-making in the ICPR. After the ICPR working groups have studied certain issues or new information, they can translate the results of the study into policy recommendations. These recommendations are usually formulated in a feasible way and are therefore often adopted by the official national delegations. Similar processes occur within the ICPE. Sufficient implementation of the recommendations can, however, take a long time. The effort the ICPR puts in monitoring changes, evaluating policies and follow-up (e.g. changing policies) is little compared to the effort that is put in developing new policies. Some more attention to evaluation and change of policy might be appropriate (Stoks 2005).

7.5 Incorporation of uncertainty and change

Uncertainty and change play a role in all river basins. The hazard of extreme events (floods and droughts) will for example be influenced by climate change and the impact will be influenced by socio-economic developments. Still, the great importance of dealing with uncertainty and adapting to change is not always reflected in the institutional setting.

The water management network in the Orange basin is obliged to consider extreme events as a main issue in water resource management, due to the comparatively high periodicity of droughts and floods in the area, and the “closed” nature of the basin, i.e. the total allocation of surface water resources in it. However, no specific initiatives confronting change or decreasing predictability of extreme events have been identified within this network. Research analysing the interaction between climate change and the water sector in southern Africa is being carried out in the region, but no large-scale research programme has been identified. A recently approved GEF project, which will develop and implement a Strategic



Action Programme for the Orange-Senqu River Basin, plans to incorporate climate change as a major factor within this strategic programme. Uncertainties of measurements and forecasts are only dealt with to a limited extent. (Kranz, Interwies and Vidaurre 2005).

In transboundary management on the Elbe, uncertainty and decreasing predictability are considered to some extent. In the GLOWA-Elbe project nineteen formal and informal parties cooperate to develop integrated river basin management strategies for the Elbe basin. This project is very forward-looking, as it explores the long term situation. The strategies that are developed have to deal with climate change and resulting socio-economic changes and therefore the project considers uncertainty and change.

In the Rhine basin future changes are taken into account by most actors. Long-term visions have been developed, considering autonomous development and desired responses and priorities are based not only on current but also on future problems. There is a great uncertainty connected to the development of 'emerging problems' which are based on multiple trends, like climate change and population growth. A strategy to deal with this type of problems is to prepare for different potential futures by keeping the options for future measures open (Raadgever 2005a, 2005b).

8 Evaluation adaptive management

Recapulating the analytical framework of chapter four, one of the main goals of this report is to answer the following question:

To what extent do current regimes and information management in the NeWater basins support adaptive river basin management?

A framework for evaluation that supports a structured answer to this question, using criteria and indicators, has been formulated. In this chapter the NeWater regimes will be evaluated using this framework. A summary of how well the case study regimes perform on different groups of criteria is presented in section 8.6.

8.1 Formal actors and informal networks

The characteristics of the formal and informal actor networks in a basin are of major importance for determining the extent to which a regime supports AM. In transboundary management, effective cooperation across the national administrative boundaries is a central requirement for AM. Vertical cooperation between administrative levels is necessary to make sure that international agreed management strategies are adjusted to lower level needs and are implemented. Furthermore, horizontal cooperation between different policy sectors is of importance in dealing with complex River Basin Management problems concerning water management, spatial planning, agriculture and/or energy production. A fourth criterion for formal and informal networks to support AM is a broad involvement of stakeholders and the public in the policy process. Below is described how well the NeWater basins comply with these criteria.

8.1.1 Cooperation across administrative boundaries

In all studied basins some form of cooperation has been established between the upstream and downstream countries. In the Elbe, Orange, Nile and Rhine basin, international river basin commissions have been established at basin level (the ICPE, ORASECOM, Nile-COM and ICPR). The Amu Darya and Tisza are part of the larger basins of the Danube and the Aral Sea, in which also international river basin commissions have been established (the ICPDR and ICWC). Transboundary management at sub-basin level of the Tisza is hindered by the fact that the ICPDR does not consider all issues at the sub-basin scale. Organising communication on the sub-basin level, like the Tisza Water Forum, might contribute to solving this scale issue. In the Amu Darya sub-basin a regional Basin Water Management Organisations (BVO) has been established as executive part of the international institutional structure. The CADC concerns cooperation in five transboundary basins on the Iberian Peninsula, among which the Guadiana basin.

Not all riparian countries are represented in the commissions. Most non-participating countries occupy only a very small part of the basin and have a limited interest in transboundary cooperation, e.g. Poland and Austria in the Elbe basin. An exception is Afghanistan that does not take part in the ICWC and BVO Amu Darya. Besides the riparian countries, the EU is a contracting party in the ICPR, ICPE and ICPDR.

In all basins international agreement has been established on the structure and aims of the basin organisations. The ICPR, ICPE, ICPDR and Nile-COM are based on a structure consisting of permanent working groups that prepare recommendations for the periodically assembled official national delegations, both supported by a secretariat. More specific legal agreements or policies concerning strategies and measures for operational management of the river system have mainly been established in the framework of the ICPE, ORASECOM



and ICPR. However, even when agreements have been reached on the institutional structure or operational management in a basin, implementation often is a problem. Transboundary cooperation can only support AM when there is a strong commitment to the agreements and when the agreements are enforced. Basin-wide cooperation in the Aral Sea, Orange and Nile basin is to a large extent driven by external donors and the riparian countries often show little commitment. As a result international agreements are often limited to very general goals without the inclusion of any concrete steps to ensure their implementation. In the Orange basin this problem is limited by the fact that national water laws point to the relevance of international agreements for national water strategies. Another barrier to effective transboundary cooperation is the existence of a history of conflicts, as can be found in the Nile basin. The most concrete actions concerning multiple issues have been undertaken in the framework of the ICPR where trust and commitment of the riparian countries have had the time to grow for many years.

In addition to the basin organisations, many bilateral agreements and organisations exist, in particular in the Orange, Nile and Tisza basin. Finally, not only national, but also lower administrative levels interact in transboundary issues. Spanish and Portuguese regional and local administrations cooperate intensively in transboundary projects. Another example is the regional cooperation between the Dutch Province of Gelderland and the German *Land* Nordrhein-Westphalia in the Dutch-German Working Group on Flood Management.

8.1.2 Cooperation between administrative levels

In the basin organisations only national governments are directly involved in transboundary decision-making. The extent of deliberation with lower level government in the preparation and the implementation of transboundary policies differs between the basins and between individual countries.

Government structures in the Amu Darya, Orange, Nile and Tisza basin are traditionally rather top-down. However, in the Orange, Nile and Tisza basin changes to a more decentral water management are occurring, at least on paper. The NBI for example explicitly includes requirements for involvement of local communities and local governments. In the Orange basin there is an increasing awareness that local levels should be stronger involved in international planning processes, because establishing cooperation of these levels is crucial for reaching consensus at the national level. In all Tisza countries there is a general trend towards decentralisation. At the moment there is, however, still a general lack of institutional, technical and financial capacities at the lower governments. Thus, most of the changes so far have not influenced practice and the cooperation between administration levels is consequently still underdeveloped.

Although there are some differences in the degree of decentralisation, lower level governments in all Rhine and Elbe countries are involved in (at least) the implementation of transboundary policy.

8.1.3 Cross-sectoral cooperation

Cross-sectoral cooperation at the basin level is limited in the case study basins. Most river basin organisations are aimed only at water management (integrated or not) and it depends on the task field of the involved national ministries whether other topics are in the range of discussion. At the Elbe and Rhine basin level, water management does not involve other sectors, although there are multiple disciplines involved in the various working groups. Adjustment of water policies to agricultural and spatial planning policies takes (to some extent) place at national or lower levels. In most countries in the Tisza basin, there is inter-ministerial competition between the policy areas of water management, agriculture and environment, although developments in the direction of a more holistic approach are

ongoing. Law and policy of the European Commission is very much aimed at specific sectors, but in the WFD some conditions for sectoral integration are included.

Developments towards more sectoral integration at the various administrative levels can also be noticed in the African and Asian basins. At the international Orange basin level, under the framework of the SADC protocol as well as other agreements, the integration of water issues with other sector policies is strongly promoted. National developments follow a similar trend. Actual implementation of the integration is however only proceeding very slowly, as old structures and mechanisms are still quite dominant. In many of the countries in the Nile basin, the policy fields of land, water and environmental management, as well as agriculture and hydropower, are combined in the national ministries. Still, cross-sectoral cooperation at transboundary level is only in a developing stage. In the Amu Darya basin, as well as in the Orange and Nile basin, agriculture and hydropower generation are the main water users. The agricultural sector is very dominant in Central Asian and decisions in the water and energy sector are in many cases taken independently from each other. This observation holds true for the national as well as the international level. A step towards more integration was made when, after the initiation of negotiations about shared transboundary resources, the energy sector was added to the discussion in order to mitigate potential upstream – downstream disputes.

8.1.4 Broad stakeholder participation

In the Rhine and Elbe basin there are many formal and informal ways in which stakeholders and the public as well as the scientific community are involved in water management and a high degree of organisation and cooperation between the various actors has been established. In the ICPR a large group of mainly environmental NGOs have observer status and in the ICPE a small group of NGOs has taken the opportunity to become involved as observers. Furthermore, public and private partners cooperate in research projects like IRMA and GLOWA-Elbe. Structural involvement of the scientific community has been established in organisations like the Commission for the Hydrology of the Rhine and the European Environmental Agency. Formal procedures for participation in decision-making and access to information are well-established in the riparian countries. The accessibility to information is for all EU member states also regulated in European law. Other institutionalised forms of participation can be found in the French *Agences de l'Eau*, the German water management associations and the Dutch water boards, in which representatives from several water user or stakeholder groups participate in decision-making. When there are no formal ways to participate, stakeholders often make themselves heard via more informal ways, like lobbying and disseminating information to the media, or even via juridical actions.

Legal provisions for broad stakeholder participation have also been established in the Orange, Nile, Guadiana and Tisza basin, but implementation is still limited. The lack of participation in the Tisza basin is caused by the lack of powerful stakeholders, which constitute a weak informal actor sector. In transboundary management, mainly international NGOs have an advisory, supportive or observer role. In the Guadiana basin some provisions for PP have been included in the Albufeira Convention, but they are not yet put into practice. At the national scale in Spain and Portugal participation is limited. In Portugal legal requirements are limited to involving selected stakeholders in the late stages of the policy process, and in Spain the main participatory body, the River Basin Water Council, has only limited influence on actual decision-making. The participation initiated by the Nile Basin Initiative means a huge step forwards for this regime. The NBI aims at broad access to information and participation in decision-making and is defined in a way that supports good cooperation and establishes networks between formal and informal actors. A large number of NGO's that can possibly cooperate in the process is identified and several stakeholder meetings were established. However, although the NBI supports participation in theory, it



does not yet function to its full extent in practice, mainly due to the cultural and socio-economic setting of the basin. The same is true for the Orange basin, where new water laws and water resource strategies have been emerging on the national and international level, but the extent to which these provisions are put into practice is still limited. This might be related to the developing stage of the new provisions, but also to lack of adequate methods for communication with the relevant stakeholders groups, particularly in rural areas.

The Amu Darya basin shows a somewhat different picture. The participation of non-governmental stakeholders in water management is very limited and legal provisions for public participation have not been established yet. Particularly at the national level, gaining access to decision-making and planning processes is extremely difficult for user groups as well as NGOs, because they are in many cases marginalised by old networks of government officials. International donors and NGOs have played a role in shaping the negotiations about water resources at the international level over the past years.

8.2 Legal framework

8.2.1 Appropriate legal framework

At the international level, the legal framework for water management in the case study basins consists of agreements on basin scale, other multi- and bilateral agreements and some international legal principles. The international legal principles are quite abstract and of limited use in specific water management issues. In the EU an additional level of transboundary law exists. The main European water law is the Water Framework Directive, which includes many requirements for river water quality as well as for the organisational structure of water management. There is no European law about flood management, but the European Commission works on the development of a European Directive on floods.

The legal agreements as developed in the ICPR are limited to institutional rules and to chloride and chemical pollution. In (not legally binding) policy documents additional management strategies have been recorded, e.g. concerning water quality and flood management. The legal framework of the ICPE is even less comprising than that of the ICPR, but again Action Programmes provide the opportunity to record more specific agreements. Furthermore, the international legal framework is elaborated in and completed by comprehensive systems of national and lower level law.

International law in the Orange basin consists of the SADC Protocol on Shared Watercourses and the legal framework around the ORASECOM, as well as several bilateral agreements. The entire international cooperation process is expected to provide ample scope to develop a common understanding of the most pressing water management issues among the countries. All countries aim to tailor national water law and water resource strategies to address the growing water scarcity and increase available water resources through more sustainable water management practices. The link to transboundary water management issues is explicitly created in some of the legal provisions.

In the Central Asian region a legal framework for the management of transboundary water resources has been set-up by the international joint bodies. The framework is however far from being complete, as many issues remain unresolved, and far from being fully implemented, which results in continued bilateral conflicts.

The transboundary legal framework in the Guadiana basin is also limited. Until recently agreements only covered hydropower generation, but since 1998 the Albufeira Convention broadened the legal framework significantly. The Convention includes the provision to prepare annual reports evaluating the progress on the transboundary level and the implementation of agreed measures on the national level. However, no annual reports have been produced so far.



The existing legal agreements in the Nile basin are largely focusing on water quantity and water division issues and do not see water management as an integrated resources management issue. The 1959 Nile Water Agreement between Egypt and Sudan is for instance still the major legislative fundament for negotiations about the allocation of water between the two countries.

8.2.2 Adaptable legislation

The establishment, implementation and change of international legal agreements requires a lot of time and effort. Recently, national laws of all EU members had to be changed to comply with the WFD. The ICDPR for example started the implementation of the WFD in 2002 and plans to have realised the new legal structures in 2009. How well the present institutions are able to adapt cannot be judged yet. The WFD requires that water programmes are reviewed every six years. At present however no legal requirements exist for evaluation and change of the transboundary policies of the ICPR and the ICPE. In most Rhine and Elbe countries changes in water law, regulation and policy are possible and in some cases periodical adaptation is even obligatory.

Legal structures for cooperation in the Amu Darya, Orange and Nile basin have been established and further developed over the past years, while the main challenge of implementing the agreements to the full extent remains. International donors and other organisations have considerably contributed to this process. In the Amu Darya basin substantial changes to existing agreements, such as the adjustment of the water allocation quotas, will be very difficult. Also the NBI takes on the position that it will work around the existing legal agreements. National water laws, master plans or strategies in the Orange basin have undergone several adjustments and updates over the past years and some have included provisions for a periodical update.

8.3 Policy development and implementation

The analysis of policy development and implementation focuses on the main transboundary issues: flood management in the Rhine, Elbe and Tisza basin and water allocation in the Nile, Orange, Guadiana and Amu Darya basin.

8.3.1 Full consideration of possible measures

The measures that are considered and implemented in the flood policies in the Rhine and Elbe countries, the ICPE and ICPR and the EU Flood Initiative cover a wide range of small and large scale, structural and non-structural measures.

In the Nile and Orange basin water management has traditionally been concentrated on large scale measures, like dams and water transfer pipelines, tailored towards meeting short-term demands of individual countries in the basin. Currently, the range of possible measures discussed is expanded with some new alternatives, without excluding the large scale measures. In the Nile basin some smaller scale experiments are executed, like for instance application of improved, water-efficient irrigation methods. In the Orange basin demand management has become a viable option for addressing the threat of water scarcity in all four basin countries at a small-scale level.

Because regional agriculture in Central Asia is concentrated on irrigated cotton monoculture, most water management decisions are guided by the needs of this specific sector. The collapse of the Soviet structures did not lead to more diversified agricultural structures, which would have provided incentives for a more balanced water management.

In the Guadiana basin, quantitative water management is also largely seen as an agricultural problem and an integrated perspective is missing.



In the Tisza basin there is not a lot of strategic planning. Economic interests often prevail over sustainability interests and most measures are ad-hoc decision.

8.3.2 Long-time horizon

Water management in the Central Asian region is very much oriented towards the short term needs of the agricultural sector, while not taking into account the long-term effects on the environment and the welfare of the population. Environmental conditions will continue to decline if the current management regime is continued. To a lesser extent this is also the case in the Guadiana basin, where policy supports consumptive water use, mainly for irrigation, and environment, fisheries and tourism are neglected.

Some changes in the management paradigm have already occurred in the African basins. In the Orange basin the awareness of possible negative implications of large scale infrastructure projects, which might occur in the long-term in addition to the anticipated positive results, is increasing. Furthermore, the NBI explicitly aims at a sustainable water management situation. Projections are made of developments in the demographic, economic and hydrologic situation in the future to be able to account for future challenges and consequently have a longer term horizon.

In the Tisza basin policies mainly have a short time horizon of about five to ten years. Because several programs are only in their initial phases and aimed at solving actual problems, there often is a lack of appropriate financial and organisational structures and political commitment to address problems with a long-time horizon.

The Rhine and Elbe regimes put some more effort into addressing long-term problems. The planning horizon of the ICPR flood policy is the year 2020 and for the ICPE flood policy this is 2015, indicating relatively long term planning. In the flood management strategy of the ICPR, as well as the ICPE, the planned measures will serve short-term as well as long-term flood management interests. The 'room for the river' strategies are typical long-term strategies that often contradict short-term interests of other activities in the floodplains. Furthermore, in several research programmes, scenario studies have been executed that explore the far future in the Rhine and Elbe basin.

8.3.3 Flexible measures, keeping options open

The planned non-structural measures in the Rhine, Elbe and Tisza basin, like improving flood warning systems and developing citizen awareness, do not limit future management options. The structural measures do limit future management options to some extent, because their construction often requires large investments and reversing these measures would be very costly. Furthermore, taking structural today might increase the costs for creating more room for the river in the future, due to developments in the protected areas. A considerable part of the current measures is already aimed at creating more room for the river, which is a more robust strategy than dike heightening, because it provides more opportunities to facilitate changing discharges without increasing the damage potential of dike failure. In particular in the Tisza basin lack of political commitment to sustainable solutions, which are often more costly on the short-term, can endanger their implementation.

The construction of massive infrastructure for the generation of hydropower and also for the diversion of water is still a possible option in the Amu Darya and the Guadiana basin. This type of measure offers only a very limited potential for re-adjustments to changing conditions (e.g. shifting water demands). As stated above, in the Nile and Orange basin large scale as well as small scale measures are considered. The most important improvement in the Orange basin is that the degree to which the decision to construct large-scale infrastructure is based on ex-ante assessments and deliberations is much larger than before. Options



concerning several riparian states are discussed among the affected parties, while at the same time national interests still prevail in the background.

8.3.4 Experimentation

Policy experimentation can take place in the form of computer simulation and pilot projects. On a transboundary level in the Rhine, Elbe and Tisza basin, experimentation mainly takes place in the form of computer simulation, aimed at simulating and predicting system behaviour. Pilot projects are usually executed at regional or local level. The Elbe-Labe Project (ELLA) project is for example aimed at realisation of pilot projects in which the integration of interests regarding flood management (e.g. risk reduction, spatial planning, and housing) is elaborated in detail for selected regional plans.

Monitoring changes, evaluating the consequences and adapting policies accordingly, can also be seen as a form of policy experimentation. A good example of policy experimentation is the annual review of strategy perspectives for individual water management areas in South Africa. By incorporating constant adaptation and revision in planning process, consistency with transboundary management issues and changing boundary conditions can be realised. On the basin level, however, efforts to evaluate and adapt policy are scarce. For example, the effort the ICPR puts in monitoring changes, evaluating policies and follow-up is little compared to the effort that is put in developing new policies (Stoks 2005).

8.3.5 Actual implementation of policies

In terms of the implementation of policies, there are quite a few shortcomings on the international level of the Amu Darya, Orange, Nile and Tisza. While in the Amu Darya basin the framework for collaboration is quite encompassing, the implementation of the policies for sharing international water resources is lagging behind. Rather than adopting new approaches and applying them in national context, former water management paradigms are dogmatically stuck to. Also in the Tisza basin the implementation of policies is only very much at the beginning and so far disappointing. In the Orange basin implementation occurs very slowly and in many cases only with support of the international donor community. The lack of integration among all existing bilateral and multilateral agreements might be a threat for the implementation of multilateral efforts. Still, expectations are high with regards to the possible positive outcomes of the multilateral planning under the auspices of the river ORASECOM could lead within the next years. In the Nile basin initiatives have so far hardly been translated to policies and plans, apart from several engineering plans. Thus, implementation of policies and plans is at the moment not possible.

The ICPE and ICPR policies contain specific goals and strategies and, although most recent policies are not legally binding, the commitment of national governments to the programmes is quite high. The riparian countries in general adjust their national policies to transboundary policies and implement the agreed measures. Nevertheless, in some cases sufficient implementation takes a long time. The implementation is evaluated on a regular basis, but it is not (clearly) determined if and how policy can be changed based on the evaluations. The progress report for the implementation of the general ICPE Action Programme of 1995 in the period of 2000-2002 acknowledged that progress had been made in reducing pollution, improving water quality and ecological recovery of floodplains. Furthermore, knowledge concerning flood protection measures had been developed.



8.4 Information management

8.4.1 Joint / participative information production

At the transboundary level a lot of information is collected or produced and analysed by the technical oriented working groups of the established commissions. In the framework of the ICPR and the ICPE the riparian countries exchange data, cooperate in research, exchange interests and points of view and cooperate in decision-making. National governmental actors participate in the production of information in the working groups, and some NGOs participate in the working groups (as observers). The Nile-COM is also assisted by several working groups, among which a working group on the water quality and quantity monitoring of the river basin, which will conduct a broad inventory of available monitoring and data, and information gaps. Looking at the DPSIR indicator framework, most of the monitoring effort goes to information on the Status of the water. Little attention goes to Impacts, while Driving forces, pressures and responses are not addressed. In the Tisza basin information production is to some extent coordinated (e.g. by ICPDR), but most information is still produced at the national level. Not all agreed co-production actually happens. Furthermore, joint information production has been initiated by Spain and Portugal in the framework of the CADIC after signing the Albufeira Convention.

The institutions for collecting and disseminating information that have been set-up at the international level in the Amu Darya basin have to work under difficult conditions. Inefficient data collection and monitoring, confidentiality of information and lacking transparency aggravate the conflicts already existing in the region.

Serious shortcomings in the production and exchange of information also exist in national and international water management in the Orange basin. Data on various issues of water management are collected at the national level and several research institutes and universities are involved in overseeing this process. However, although the need to develop exchange and integration of data has been clearly identified, no integrated data and information systems has been established as of yet.

8.4.2 Interdisciplinarity

In the ICPR and ICPE there are various, mainly technical, disciplines involved, but social and economic aspects receive less attention. Some NGOs have 'observer status' and are also to some extent involved in the working groups. In the Elbe-Labe project the link with other disciplines – in the spatial planning and housing sector – plays a central role. In the Tisza basin, research by different disciplines does take place, but there is still a lack of coordination between different programmes, joint analysis and agreed conclusions.

Monitoring in the Nile area focuses on physico-chemical elements and does not include biological or socio-economic elements. The focus is consequently very much on the traditional water quality monitoring efforts and is not focused on innovation. This is partly due to the little developed monitoring capacities in terms of staff and equipment.

In the Amu Darya basin the input of different disciplines is influenced by the fact that the downstream countries who dominated water management research over the past decades, have a strong focus on agriculture. This determines which disciplines are involved.

8.4.3 Elicitation of mental models / critical self-reflection about assumptions

Elicitation of mental models and critical self-reflection about assumptions can contribute to more effective communication between for example decisions-makers and researchers and to learning from each other. It is however hard to evaluate this criterion for a transboundary regime in general. However, the Amu Darya basin does not score so well on this criterion,



because there is a strong tendency towards strategic information management. Incidences where data gathered on the national level differed from that collected at the international level have occurred regularly. In the Tisza basin there are a lot of provision to improve the elicitation of mental models and the critical reflection on assumptions, but the relatively weak position of the nongovernmental sector prohibits effective communication with decision-makers.

8.4.4 Explicit consideration of uncertainty

Another criterion that is rather hard to assess for an entire basin regime is the extent to which uncertainty is considered explicitly. Still, some differences can be noticed between the studied basins. In the Amu Darya basin uncertainties in forecasts are seldom taken into consideration, although measurement intervals are long, which increases the likelihood of inaccuracies. In the Orange basin, where the implications of climatic variability are considered important, the data situation is not sufficient to conduct a comprehensive assessment of likely changes.

In one sub-project of the Nile Basin Initiative, dealing with Water Resources Planning and Decision Support Systems, uncertainties are taken into consideration. Nevertheless, there is little consideration of uncertainty, climate change and extreme events in planning documents in the riparian countries. In the Rhine, Elbe and Tisza basin uncertainties are mainly assessed in research projects. The GLOWA-Elbe is an example of a project that explicitly considers (and communicates about) change and uncertainty, but that is not formally linked to the policy process. Formal actors often only have an eye for urgent problems that can be solved on short-time notice.

8.4.5 Broad communication

The ICPR disseminates information via the website, which is accessible to all interested parties. Furthermore, there are legal obligations for national governments to make information accessible. Additionally, several governments have organised campaigns (e.g. the Dutch 'Living with water' campaign) to make the citizens aware of water management, using media like the internet, television, radio, newspapers etc. The dissemination of information by the ICPE to stakeholders and the public is more limited. (New) data and information are mainly exchanged between the involved public parties. In transboundary research projects much more public and private parties are involved. The ICPDR has a rather information-rich website, but further communication is limited due to financial constraints and the weak position of stakeholders and the public.

The NBI takes on the position that the available information must be widely disseminated, but momentarily the availability of data on for instance the internet is scarce. The same is valid for information dissemination in the Orange basin. Only limited information can be found on the web and it is unclear who has access to this data. Furthermore, information is only rarely used to actively reach out to relevant stakeholder groups. In the Amu Darya and Guadiana basin, information on water management is generally not (actively) disseminated to the public.

8.4.6 Utilisation of information

In basins like the Guadiana, Nile and Orange, where the production of relevant information for transboundary water management is still in the early stages of development, the utilisation of information is not yet an issue. The available data in the Nile basin are not fully used in analysis and reporting.

In the Amu Darya basin there was a strong system of information exchange during Soviet times, but that system has collapsed. The information needs of water management have not



changed and water management currently lacks most of the necessary information. New systems for information production and exchange are in the early stages of development.

The ICPR and ICPE working groups usually formulate feasible recommendations, which are often adopted by the official delegations and recorded in transboundary policy documents. It can however take a long time before new information, especially concerning emerging issues, enters the national and international policy debates. Because policy debates are nontransparent processes, it is hard to determine which information does and which information does not influence the final choice of management strategies. All actors to some extent select information that they can use as arguments for their own interests. In the Tisza basin flood related information is used in decision-making, but only to some extent.

8.5 Financial

The last group of criteria is used to analyse whether the regimes include financial incentives adaptation. An appropriate financing system would include sufficient (public and private) resources, costs recovery from the 'users' of water management, decision-making and financing in one hand and authorities that can take loans and depreciate their assets.

International cooperation

The work of the ICPE and the ICPR is financed from public resources by the riparian countries. The implementation of the laws and policies and financing this implementation, is also the task of the countries. Because the countries make decisions themselves, decision-making and financing are in one hand.

The financial involvement of the international donor community has enabled transboundary cooperation in the Orange, Amu Darya and Nile basin. These organisations have been quite instrumental in facilitating the process so far and continue to play an important role through providing financial support as well as know-how for introducing integrated water resource management practices. In the Orange basin financial contributions of international donors have had quite some leverage in the development of large infrastructural processes and have in many cases contributed to the introduction of environmental and social standards in the management of these projects. However, although quite some success has undoubtedly been achieved through the involvement of donors in several basins, at the same time their early involvement has also lead to a certain inertia among those in power, preventing more thorough reforms from happening. Currently, many donor activities in Central Asian water management have been ended and only sub-aspects are still funded by donors. The rest of the work of the ICWC and BVOs is financed by the states themselves.

In the Tisza basin, there are so far no clear legal agreements between the countries about who pays what in case of (upstream) accidents or activities which negatively impact downstream countries.

National water management

On national level, the more collective water management issues (e.g. flood management) in the Rhine and Elbe basin are financed mainly from public resources, whereas the costs of water management connected to specific water uses and pollution are to a large extent recovered from the users and polluters. Switzerland, Germany, France, the Czech Republic and the Netherlands all use a combination of permits and charges to regulate abstractions and polluted discharges. The water supply sector has been partly privatised and domestic water prices reflect the production and supply costs. In Germany and Switzerland citizens can insure themselves against flood damage.

In the Tisza basin investment costs are mainly covered by the government and there are high fees for the (to some extent privatised) water supply and sewage. Damages are covered by local governments.

In Spain and Portugal water users pay only a limited share of the cost of water abstractions. Therefore, there is little incentive to decrease water use.

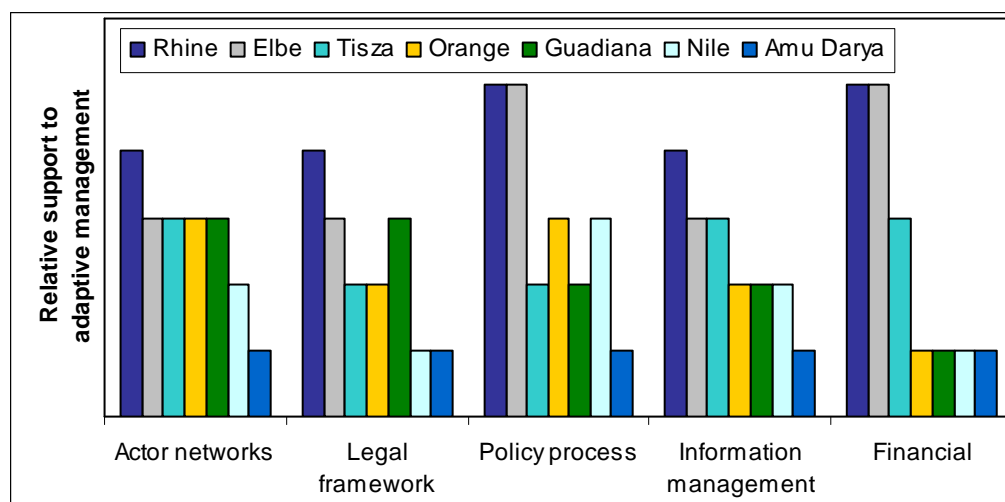
In most of the Central Asian countries market-based mechanisms for the use of water resources are considered. However, user charges are by no means enough to cover operation and maintenance of water management structures, not to mention the initial investment. Environmental and resource cost are not taken into account.

8.6 Overview

8.6.1 Current situation in basins

In Annex 2 an effort is made to translate the information about the basins into an indication of the extent to which they comply with the criteria developed in chapter four. Figure 14 summarises this overview. The ‘scores’ are indicative and meant to stimulate discussion. The overview expresses the relative support of the regimes to AM: a high score does not mean that the situation cannot be anymore improved and a low score does not mean that nothing is done yet. A major source of uncertainty is that the overview represents the perspectives of the authors of the basin reports, which are based on only limited information.

Figure 14. Indication of relative support regimes and information management to AM



It seems that overall the Rhine regime supports AM to the greatest extent, followed by the Elbe and the Tisza. The financial situation and policy processes in Rhine and Elbe are similar, but the actor networks, legal framework and information management have developed a bit further in the Rhine basin. The Tisza regime offers less support to AM than the Elbe regime, although the information management and actors networks are developed to a similar extent. In particular in the area of policy development and implementation the Elbe regime is better developed than the Tisza regime, because of the types of measures considered, the long-time horizon and the actual implementation of policies.

The African regimes, as well as the Guadiana regime, seem to be less adaptive. In the Orange basin, actor networks and policy processes are relatively suitable for AM, the legal and financial incentives for AM are less suitable and information management is rather unsuitable at the moment. In the Guadiana basin the actor networks and legal framework



offer average support to AM, but the policy processes, information management and financial incentives are less developed. This is caused by the fact that no transboundary policy has been established (yet), communication and use of information is limited and financial incentives for sustainable water use are very limited.

In the Nile basin, the legal framework is not comprehensive nor easily adaptable and the financial incentives for adaptive management are relatively low. Because under the Nile Basin Initiative many good activities are undertaken, policy development, information management and in particular the actor networks form a better support for AM. The Amu Darya regime is the least supportive to AM, because it scores relatively low on all groups of criteria. The financial situation in the Nile and Orange basin is relatively more appropriate, because in these basins donors still contribute a lot to transboundary management. Although the financing by donors might not be as appropriate as financing by the cooperating national governments, it does contribute to the availability and use of multiple resources.

8.6.2 Stages of transition towards adaptive management

A distinction can be made between (groups of) criteria on which all basins score relatively high, criteria on which all basins score relatively low and criteria with a large difference in basin scores. Based on this distinction some ideas on the stages of the transition towards AM can be hypothesised. This is only a first attempt of structuring the criteria for AM, and identifying a typical order in the transition process towards adaptive transboundary management.

Assuming that some form of transition towards AM has already started in the case study basins, the criteria that are fulfilled in many basins indicate regime changes that can be established relatively early in the transition process. Cooperation across administrative boundaries and joint information production would in this view be part of the early phases of the transition. The criteria which are not (or hardly) fulfilled in any of the basins indicate elements of AM that are most difficult to establish and that will probably only be realised in the late stages of the transition process. These elements include cooperation between disciplines, sectors and administrative levels and consideration of assumptions and uncertainties. Furthermore, proper utilisation of information and adaptable legislation are typically hard to establish (See Table 8).

Table 8. Criteria for AM in the order in which they are expected to be achieved

Early stages	Middle stages	Late stages
<ul style="list-style-type: none"> ▪ Cooperation across administrative boundaries; ▪ Joint information production. 	<ul style="list-style-type: none"> ▪ Broad stakeholder participation; ▪ Appropriate legal framework; ▪ Full consideration of possible measures; ▪ Long-term horizon; ▪ Flexible measures, keeping options open; ▪ Actual implementation of policies; ▪ Broad communication; ▪ Appropriate financing system. 	<ul style="list-style-type: none"> ▪ Cross-sectoral cooperation; ▪ Cooperation between administrative levels; ▪ Adaptable legislation; ▪ Interdisciplinarity, ▪ Elicitation of mental models / critical self-reflection about assumptions; ▪ Explicit consideration of uncertainty; ▪ Utilisation of information.

Some regime elements are well-developed in the Rhine (and Elbe) basin, offering good support to AM, but hardly developed in (many of) the other basins. A large difference between the basins might indicate that it takes considerable time and effort to develop that specific regime element.



In particular the group of criteria ‘policy development and implementation’ displays a large variability between the basins. Policy development and implementation is well-established in the Rhine and Elbe basin, whereas there is hardly any policy supporting AM in the Amu Darya and Guadiana basin. Other criteria with strongly varying scores are presented in the middle column of Table 8. It is hypothesised that the development and implementation of sustainable policies, broad communication and PP, a comprehensive legal framework containing provisions for policy adaptation and appropriate financing (use of multiple resources, cost recovery and decision-making and financing in one hand) take place somewhere in the middle of the transition towards more adaptive transboundary RBM.



9 Discussion of evaluative framework

As discussed in section 9.1, the framework for evaluation of the extent to which the regimes support AM contains many hypotheses about what constitutes AM. Remarks about the validity of these hypotheses, based on theoretical considerations, are presented in the first section of this chapter. Subsequently, the evaluative framework is compared with the guidelines for transboundary cooperation as described in chapter three.

By applying the criteria and indicators to the case study regimes, some insight has been created in their applicability for regime analysis, which will be discussed in the section 9.3. Subsequently, attention will be paid to the questions whether the evaluative framework is complete, whether the criteria overlap and whether the framework delivers a well-balanced evaluation of the 'adaptiveness' of the regimes. The discussion might be biased because the framework has only been applied to the NeWater basin.

Suggestions for refinement of the evaluative framework in future research, derived from the discussion, are presented in the last section of the chapter.

9.1 Validity of criteria

The evaluative framework is based on many hypotheses concerning what constitutes AM. The management strategies and their implementation are the most direct measures of the performance of a regime. Still, some of the criteria and indicators assume that certain situations, which might lead to problems in the implementation of strategies, support AM.

9.1.1 Decentralisation and public participation

The involvement of lower levels of government in decision-making by higher levels (or even decentralisation of authority) can be very useful in stimulating discussion, eliciting multiple perspectives and using multiple sources of information, as a result of which better strategies can be developed and commitment can be created for their implementation. On the other hand, there always is a risk that lower governments do not agree with higher level interests and slow down or block the process. A dominant central authority that is able to force the implementation of sustainable policies might thus perform relatively well. Besides involving lower level governments, public participation in decision-making is often also seen – in particular by authorities – as a risk for the development and implementation of management strategies.

9.1.2 Appropriate financing system

It is questionable whether decision-making and financing should always be in one hand. There is a certain tension between this idea and the idea that multiple (public and private) resources should be employed to support AM. Ideally national governments should finance transboundary cooperation themselves, because this ensures (to some extent) their commitment to the implementation of shared policies. However, in situations where otherwise no shared activities would be employed at all, financing of transboundary cooperation by donor organisations is beneficial for AM, because it ensures financial sustainability (no dependence on politics). Thus, in financing transboundary cooperation public financing should be preferred over private financing, but private financing over no financing at all.

A similar tension exist between the 'user pays' principle and the need for sufficient resources. Again a situation in which water management is financed (partly) by non-users might be better for AM than the situation in which no financing is available at all. General



taxes (public financing) can for example be a quite appropriate resource for flood management, although only a part of the tax-payers benefits from it.

9.1.3 Concluding

When a certain minimal capacity is already existent in a water management regime, all criteria for AM seem valid. However, when a management regime is still very traditional, some of the criteria and indicators might refer to unfeasible ambition levels. In such a situation it might be better to make sure that some useful management strategies are implemented, without running the risk that nothing happens at all while striving for an ideal adaptive regime. Still, progression towards a more adaptive regime can be made step-by-step.

9.2 Relation with guidelines transboundary cooperation

It might be interesting to see whether the criteria for support of AM correspond to the guidelines for transboundary cooperation as presented in chapter three.

At first, it should be noted that the framework for evaluating AM has a broader scope than just transboundary cooperation: it is also applicable to other scales of RBM. The guidelines for transboundary cooperation elaborate mainly on the formal cooperation across national borders, and could offer some additional indicators for this third criterion in the evaluative framework (e.g. adequate technical capacity and negotiation skills of involved actors).

A second, related remark is that the guidelines for transboundary cooperation are focused on the question how to develop institutions and information management in a situation in which they are not or hardly existent, whereas the framework for evaluating AM is aimed at identifying the potential for change in any situation. Three major groups of criteria for AM are not (or hardly) included in the guidelines for transboundary cooperation:

- Concerning the content and implementation of policies: full consideration of measures, long-time horizon, flexible measures, policy experimentation and actual policy implementation;
- Concerning information management: elicitation of mental models / critical self-reflection about assumptions, explicit consideration of uncertainty, broad communication and utilisation of information;
- Concerning financing: an appropriate financing system.

These criteria might gain in relevance after the initial development of transboundary institutions and are assumed to offer direction for further development of regimes.

9.3 Applicability of criteria

Some of the criteria and indicators were hard to use in the evaluation of transboundary regimes, mainly due to lack of information or lack of information that could be generalised to the transboundary scale of this analysis. This resulted in some gaps in the scoring effort.

Two criteria that were particularly hard to evaluate are 'Elicitation of mental models / critical self-reflection about assumptions' and 'Explicit consideration of uncertainty', both concerning information management. The extent to which these criteria are fulfilled differs for each case in which information needs are stated and information is produced and communicated. Proper scoring would require detailed analysis of some specific cases and even then it would be hard to generalise the answers to the transboundary scale.

Furthermore, it appeared to be hard to find an answer to the question whether authorities can take loans and depreciate their assets, to facilitate efficient use of resources and replacement



of assets. For international cooperation structures this indicator is, however, not as relevant as for national and lower level governments.

9.4 Completeness, overlap and balance

9.4.1 Completeness

The evaluative framework seems to be quite comprehensive and complete, because little information has come up in the analysis that could not be located under one of the criteria.

One aspect that is not explicitly included in evaluative framework, but that is of relevance to (adaptive) transboundary water management, is the power balance between the riparian countries. For example, in the Nile basin, Egypt is clearly one of the most powerful countries, but as downstream country more vulnerable. This provides a balance of power that enforces cooperation. In the Guadiana on the other hand, Spain is the most powerful country as well as the upstream country. This unbalance of power may be the most restrictive force leading to a non-adaptive water management situation. For the Guadiana the WFD may be an important force to bring more balance to the cooperation, but this may only become apparent in future.

Thus, the power balance significantly influences the cooperation between countries and it seems useful to include a criterion for the power balance in the evaluative framework. This criterion would be part of the group 'formal and informal actor networks'. The power relation could for example be indicated using the Gross Domestic Product, as indicator of economic power, and the position as up- or downstream country.

9.4.2 Overlap and balance

Some of the criteria and indicators do to some extent overlap. Between the criteria in the groups 'Information management' and 'Policy development and formulation' there is for example quite some overlap. Furthermore, stakeholder involvement is an important notion that comes back in the scoring on several criteria. The extent of overlap does, however, not seem to have a negative impact on the analysis. Moreover, the more specific information is available, the more the distinction between the criteria and indicators can be used to the full extent.

It is difficult to evaluate whether the list of criteria and groups of criteria is well-balanced. The criteria together form a complex, interrelated structure and it is at this moment impossible to say whether some criteria are more important than others. Therefore, the analysis has been qualitative and no weights have been assigned to the criteria.

9.5 Further research on evaluative framework

9.5.1 Further development of criteria and indicators

With developing insight in AM, new criteria and indicators might come up and be included in the evaluative framework, e.g. criteria concerning the power balance. It might be possible and useful to include quantitative indicators as well.

9.5.2 Relation criteria in evaluative framework

As discussed in section 8.6.2, there is still very little understanding of the relation between the criteria of the evaluative framework. To increase this understanding, future research can be aimed at studying the order in which the transition to AM takes place and the timescales of this transition.



It would be interesting to compare the stages of a the transition towards AM with the typical steps in a cyclic transition management process (Rotmans 2003; van de Kerkhof and Wieczorek 2005):

1. Organisation of a multiactor network (transition arena): problem definition, identification of stakeholders, establishment of preconditions for operation of the arena, definition of transition themes;
2. Development of sustainability visions: establishment and discussion of a common, long-term view and of differences in perception of the problem involved;
3. Exploration of transition pathways (pathways) through experiments and joint actions; development and implementation of effective instruments;
4. Evaluation, learning and monitoring of the progress, intermediate goals, and learning effects; adjustment of the agenda and visions; preparation of the next transition round.

9.5.3 Relation transboundary and national institutional development

In this report transboundary regimes and transboundary information management have been analysed. Institutions and information management at the national and lower levels are closely connected to the processes at the transboundary level. An interesting question is how the development of regimes towards more adaptive management is related at the different scales. It can be hypothesised that AM at national level is a precondition for AM at the international level. However, there are also situations imaginable in which transboundary RBM (e.g. initiated by donors) is the driving force behind the transitions towards AM at multiple levels.

The interaction between scales adds another dimension to the already complex problem of relating criteria to each other (and in time). Some insight in this problem could be gained from comparing the national evaluation of AM in NeWater Deliverable 1.2.1 (Huitema and Becker 2005) with the transboundary evaluation in this report. More reliable results could be achieved by focusing future research specifically on the relation between national and transboundary development of regimes and information management.



10 Conclusions & Recommendations

In this final chapter conclusions are drawn about regimes and information management in general and, more specifically, in the NeWater case study basins. Furthermore, the extent to which regimes and information management support AM in these basins is summarised. Additionally, some hypotheses about the stages of the transition towards AM will be posed. In the second part of the chapter recommendations are made about how to support the transition towards more AM in the studied basins (including recommendations for additional research).

10.1 Conclusions

10.1.1 State-of-the-art review on regimes and information management

Almost half of the land surface of the earth is covered by international river basins. To manage these transboundary river basin effectively, the development and implementation of joint strategies is essential.

A lot of research has been dedicated to the question how transboundary institutions and transboundary information management can be developed in order to support joint actions. Most authors agree that technical cooperation and information exchange form a good base for developing trust and political cooperation between the riparian countries. Involvement of multiple disciplines and sectors can open up a broad playing field with more opportunities for win-win situations and sustainable solutions. Involvement of NGOs and the public in transboundary management can increase the acceptance of proposed strategies and donors can support the initiation or financing of transboundary cooperation.

Agreements should be based on voluntary decisions and reflect individual interests and resources as well as the principles of equitable and reasonable use, the obligation not to cause significant harm, and the duty to notify and exchange information. Flexibility should be provided and plans should be updated periodically.

10.1.2 The case study basins

Transboundary issues

In the Amu Darya, Orange, Guadiana and Nile river basin transboundary issues are mainly related to water scarcity. Overexploitation of the river, mainly for irrigation purposes, and building dams, for storage and hydro power generation, result in (threat of) salinisation, desiccation and ecological degradation downstreams. In the Elbe, Rhine and Tisza basin, pollution and floods are the central issues.

Regimes

The transboundary regimes of the Amu Darya, Elbe, Guadiana, Nile, Orange, Rhine and Tisza basin can be characterised by many similarities and differences. The most obvious similarity is that in every basin some form of structural transboundary cooperation (e.g. a river basin commission) has been established. In the Amu Darya, Guadiana and Tisza basin the scale of the established cooperation structure is however larger than the studied basin. Furthermore, the tasks and responsibilities of the organisations differ strongly, as well as their functioning and effectiveness in reality. In the Rhine, Elbe and Guadiana basin, national governments have been the main initiating and financing parties. In the Amu Darya, Orange, Nile, and to a lesser extent also in the Tisza basin, international donors have played a large role in the initiation and financing of basin organisations. It occurs that in these institutions national governments are less committed and it is harder to develop and implement joint management strategies. Therefore, transboundary cooperation in the African and Asian

basins is at the moment mainly aimed at developing trust between the riparian countries and developing technical and institutional capacity. The role of informal actors in transboundary water management is in general limited due to both distrust by governmental actors and limited capacities of the stakeholders. Stakeholder participation is rather well-developed in the Rhine and Elbe basin.

Although many institutional changes have been made, the former communist regimes in the Amu Darya, Elbe and Tisza basin still influence today's water management. In particular in the Amu Darya basin many of the old hierarchical structures remained. In the Elbe, Guadiana, Rhine and Tisza basin, national and international river basin management is and will be strongly influenced by the EU Water Framework Directive. The WFD requires administration on the spatial scales of river basins (and sub-basin), including transboundary cooperation. National law, policy and actor networks of EU Member States and Candidates have to comply with the WFD.

Information management

The information needs in a basin are strongly related to the main issues in the basin. Without sufficient information, effective and fair discussion of the main issues leading to realistic agreements is hardly achievable. In particular in the Nile, Orange, Amu Darya and Tisza basin, the availability of information needed by formal actors to manage transboundary water resources is far from satisfactory. Thus, in all agreements concerning transboundary water management provisions have been included for better information exchange or even joint information production. In the framework of the ICPR, ICPE, ICPDR, Nile-COM and CADC several working or expert groups are aimed at this purpose. The ICWC has its own Scientific Information Centre and in the Orange basin, inter alia, the SADC-HYCOS contributes to information exchange and management.

In practice, the production and exchange of information between formal actors has not been well-established in the Amu Darya, Guadiana, Nile, Orange and Tisza basin. Dissemination of information to stakeholders and the public is in general even more limited. Relatively strong communication has been established between the (formal and informal) actors in transboundary river management in the Rhine and Elbe basin.

Finally, the utilisation of information in transboundary decision-making is in many basins very limited, partly because the information production and exchange are not yet or not any more in operation.

Adaptive management

The extent to which the regimes and information management in the studied basins support AM varies significantly. The Rhine regime currently offers the largest potential for AM, followed by the Elbe, Tisza, Orange and Guadiana.

The Nile and Amu Darya regimes offer the least potential for AM. Although a first step has been made by developing institutions for transboundary cooperation, implementation of the intended institutional structures is still ongoing. As long as the political setting is not ready for a real transition, there will be little determination for the further development and implementation of transboundary water laws and policies.

Stages of transition towards AM

Conclusions about the interrelatedness of criteria and a typical order of regime development in the transitions towards more adaptive forms of RBM can at the moment not be drawn. The analysis does however allow some hypotheses to be made. It can be hypothesised that cooperation across administrative boundaries and joint information production are typically part of the early phases of the transition. Somewhere in the middle of the transition the following criteria could be achieved; appropriate policy development and implementation, appropriate legal framework and financing system and a broad stakeholder participation and



communication. Aspects of AM that can be established only in the late stages of the transition would include cross-sectoral cooperation and cooperation between administrative levels, adaptable legislation, interdisciplinarity, elicitation of mental models / critical self-reflection about assumptions, explicit consideration of uncertainty and utilisation of information. It should be noted that, although certain typical, general patterns might exist, the specific order of regime development differs from basin to basin.

10.2 Recommendations

10.2.1 Transitions towards adaptive management

The activities that could be undertaken to stimulate the transition to more AM differ from basin to basin. It is obvious that some transboundary regimes have already developed much further than others. The transition has to be executed step-by-step and might take decades. Goals have to be adjusted to the current situation to make sure feasible activities are employed and the development is not blocked by the desire to do too much too soon. Because of limited understanding of the order of the transition towards more AM, it is not possible to specify exactly which activities to explore in which situation. Still, some general recommendation can be made for each basin:

- In the Rhine and Elbe basin the transboundary regime is rather well-developed. Efforts for more AM could be aimed at developing cross-sectoral cooperation and cooperation between administrative levels, adaptable legislation, interdisciplinarity, elicitation of mental models, critical self-reflection about assumptions, explicit consideration of uncertainty and utilisation of information;
- In the Tisza basin development of a comprehensive framework of law and policy for transboundary RBM is lagging behind other developments. In policy processes additional effort should be put in employing a long-time horizon, consideration of the full range of possible measure and in actual implementation of policies;
- In the Orange basin more effort could be put in developing information exchange and utilisation of information, and in developing a more suitable legal and financial structure, in which national governments play a larger role;
- In the Guadiana basin the transitions towards more AM would benefit from activities aimed at development and implementation of policies and at developing a more comprehensive legal structure and better financial incentives for water savings. The WFD can become an important driver for a fast transition towards more adaptive water management;
- Efforts to develop the Nile regime should be aimed at a better legal framework. However, because political support for change of the existing bilateral agreements is low, it might be better to first improve information management and actor networks and develop and implement policies (as planned in the NBI). This might create more trust between the riparian countries, which may in the end lead to an improvement of the legal framework;
- In the Amu Darya still a lot of work has to be done to develop a regime that supports AM. Following the lessons presented in section 3.3, it might be wise to start focussing on the development of technical cooperation (including information exchange) to create adequate technical capacities and mutual confidence.

10.2.2 Further research

The analysis underlying this report brought to light a lot of questions. Future NeWater activities should play an important role in answering these questions. Within Workpackage



1.3 of the NeWater project a research agenda has been developed, considering demands from the case study basins as well as recommendation from the more theoretical studies like this one (See Kranz, Interwies, Vorwerk et al. 2005).

Regimes and information management in case study basins

It is recommended to perform a more detailed analysis of relevant regime elements and information management in the basins studied. The current report includes only a basic analysis of transboundary regimes and the results of this analysis might be biased by the somewhat fragmented information that was available. By paying more attention to specific elements of the regime, more valid insights and more recommendations for specific activities supporting the transition towards AM in a basin could be developed. The relation between states strategies (in law, policy and information management) and the (lack of) actual implementation is one of the main aspects that require additional attention.

Besides from analysis on the international scale or national scale, it is recommended to perform specific case studies. On smaller scales it is easier to 'measure' criteria like elicitation of mental models, critical self-reflection about assumptions and explicit consideration of uncertainty.

In short, it is recommended to focus the research on the regime elements that are mentioned for each basin in the previous section. Research in case studies should be aimed not only at analysis, but at the same time at stimulating the transition towards more AM.

Evaluative framework

A major topic requiring more attention is the evaluation framework for AM. Although the list of criteria and indicators did not prove to be incomplete or to contain too much overlap in the performed analysis, it is open to improvements based on growing insight in the concept of AM. A major improvement would be to include the interactions between the criteria and to find out more about the order in which changes towards more AM occur. To obtain this type of knowledge, it is recommended to perform a more detailed analysis of occurred regime changes in the past, in a limited number of basins. This type of analysis could also create more insight into the relative importance of the various criteria and indicators. A limitation to this approach is that only the part of the transition can be studied that has already occurred, which is only a minor part.

Relation transboundary and national institutional development

A final subject that would be interesting to study is the relation between transboundary and national institutional development. Some insight in this problem could be gained from comparing the national evaluation of adaptive management in NeWater Deliverable 1.2.1 (Huitema and Becker 2005) with the transboundary evaluation in this report.



11 List of references

- African Development Bank (2003). Lesotho Country Strategy Paper (2002 – 2004).
- Anonymous (2005). A fact file about the Nile River.
- Aquastress (2005). Methodology and outcomes of the Stakeholders selection and of the stakeholder bodies' structure and function. Deliverable 1.1-1 of the Aquastress project.
- Barabba, V. P. and Zaltman, G. (1991). Hearing the voice of the market. Competitive advantage through creative use of market information. Boston, Harvard Business School Press.
- Becker, A. and Grunewald, U. (2003). "Disaster management - Flood risk in central Europe." Science **300**(5622): 1099-1099.
- Becker, G. (2005). NeWater Deliverables 1.3. Transboundary Regimes. Case study Tisza River Basin. IVM, Vrije Universiteit, Amsterdam.
- Boersma, J. and Blaauw, G. (1999). Kennis van water overbrugt wereldwijd. Groningen, Deloitte & Touche.
- Burnod-Requia, K. (2004). Rapid Environmental assessment of the Tisza River Basin, UNEP.
- CAWater (2005). Central Asian Water Information.
- Coördineringscomité Rijn (2005). Internationaal stroomgebiedsdistrict Rijn - Kenmerken, beoordeling van de milieueffecten van menselijke activiteiten en economische analyse van het watergebruik (Deel A = overkoepelend deel, stand 18-03-05). Rapportage aan de Europese Commissie inzake de resultaten van de inventarisatie conform de Richtlijn 2000/60/EG van het Europees Parlement en de Raad van 23 oktober 2000 tot vaststelling van een kader voor communautaire maatregelen betreffende het waterbeleid (Artikel 15 (2), 1e gedachtestreepje).
- Cosme, N., Sousa, S., Estrela, M. A., Álvarez, R., et al. (2003). Environmental data on a case study from the transboundary catchment of Guadiana River. Report of the Trancat project.
- Denisov, N. B., Rucevska, I., Lucas, B., Simonett, O., et al. (2004). Addressing environmental information efforts: the impact-of-information chain. In: Environmental information in European transboundary water management. Timmerman, J. G. and Langaas, S. (Ed.), London, UK, IWA Publishing.
- Dieperink, C. (1998). "From open sewer to salmon run: lessons from the Rhine water quality regime." Water policy **1**: 471-485.
- Doyle, J. K. and Ford, D. N. (1998). "Mental models concepts for system dynamics research." System Dynamics Review **14**(1): 3-29.
- Doyle, J. K. and Ford, D. N. (1999). "Mental models concepts revisited: some clarifications and a reply to Lane." System Dynamics Review **15**(4): 411-415.



- Economic Commission for Africa (2004). Assessing Regional Integration in Africa. Addis Ababa, Ethiopia, from <http://www.uneca.org/aria/>.
- EEA (1999). Environment in the European Union at the turn of the century, EEA, Copenhagen, 446 p.
- El-Sebae, A. H. (1989). Fate and undesirable effects of pesticides in Egypt. In: Ecotoxicology and Climate. Bourdeau, P. and others (Ed.), John Wiley & Sons Ltd: 359-372.
- European Parliament (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. 2000/60/EC.
- FAO (2003). Seminar on Integrated Water Management in the Tisza River Basin, FAO and SEUR.
- Fischhendler, I. (2004). "Legal and institutional adaptation to climate uncertainty: a study of international rivers." Water Policy 6: 281-302.
- Frijters, I. D. and Leentvaar, J. (2003). Rhine Case Study. Water Management Inspectorate, Ministry of Transport, Public Works and Water Management, the Netherlands.
- GEF (2005). Development and Implementation of the Strategic Action Programme for the Orange-Senqu basin, Project Development Facility, Request for Pipeline Entry and PDF Block B Approval.
- Geldof, G. D. (1994). Adaptief Waterbeheer. Deventer, Tauw Civiel en Bouw.
- Geldof, G. D. (1995). "Adaptive Water Management - Integrated Water Management on the Edge of Chaos." Water Science and Technology 32(1): 7-13.
- Glicken, J. (2000). "Getting stakeholder participation 'right': a discussion of participatory processes and possible pitfalls." Environmental Science & Policy 3: 305-310.
- Gooch, G. D. (2004). The communication of scientific information in institutional contexts: The specific case of transboundary water management in Europe. In: Environmental information in European transboundary water management. Timmerman, J. G. and Langaas, S. (Ed.), London, UK, IWA Publishing: 13-29.
- Gooch, G. D., Hoglund, P., Roll, G., Lopman, E., et al. (2002). Review of existing structures, models and practices for transboundary water management. Linköping University.
- Gooch, G. D., Stalnacke, P. and Roll, G. (2006). The way ahead for transboundary integrated water management? In: Integrated Transboundary Water Management in Theory and Practice. Experiences from the New EU Eastern Borders. Gooch, G. D. and Stalnacke, P. (Ed.), IWA publishing (in press).
- Hendriks, C. A. J. (1996). Institutional arrangements for sustainable management of transboundary river basins; the case of agricultural pollution in the Rhine basin. Delft, Delft University of Technology, Centre for Comparative Studies on River Basin Administration.



- Heyns, P. (2004). Achievements of the Orange-Senqu River Commission in Integrated Transboundary Water Resource Management. Paper presented at the General Assembly of the International Network of Basin Organisations.
- Hilders, M. and Slinger, J. (2005). Insights on institutional arrangements for the management of the transboundary Incomati River in Southern Africa. IAIA '05, 25th Annual Conference of the International Association for Impact Assessment "Ethics and Quality", 31 May - 3 June 2005, Cambridge Boston, Massachusetts, USA.
- Hofstede, G. (1991). Cultures and organizations software of the mind. London, McGraw-Hill.
- Holling, C. S. (1978). Adaptive Environmental Assessment And Management. Chichester, Wiley.
- Huisman, P., de Jong, J. and Wieriks, K. (2000). "Transboundary cooperation in shared river basins: experiences from the Rhine, Meuse and North Sea." Water Policy 2: 83-97.
- Huitema, D. and Becker, G. (2005). Governance, institutions and participation: a comparative assessment of current conditions in selected countries in the Rhine, Amu Darya and Orange river basins. Report to the NEWATER project (D121), Institute for Environmental Studies - Vrije Universiteit Amsterdam.
- ICPDR (2004). Action program for sustainable Flood protection.
- ICWE (1992). The Dublin Statement and report of the conference. International Conference on Water and the Environment: Development Issues for the 21st Century., Dublin.
- IKSE. (2005). "Website 'Internationale Kommission zum Schutz der Elbe'." Retrieved 01-06-2005, from <http://www.ikse.de/>.
- JRC. (2005). "Website of the Joint Research Centre of the European Union." Retrieved 22-04-05, from <http://www.jrc.cec.eu.int/>.
- Kliot, N., Shmueli, D. and Shamir, U. (2001). "Development of institutional frameworks for the management of transboundary water resources." International Journal of Global Environmental Issues 1(3/4): 306-328.
- Knight, J. and Sened, I. (1995). Explaining social institutions. Ann Arbor, University of Michigan Press.
- Kraemer, R. A. and Jäger, F. (1998). Germany. In: Institutions for water resources management in Europe Vol. 1. Nunes Correia, F. (Ed.), Rotterdam, Balkema.
- Kranz, N., Interwies, E. and Vidaurre, R. (2005). NeWater Deliverable 1.3.1. Review of transboundary regimes, Case study: Orange Basin. Ecologic – Institute for International and European Environmental Policy.
- Kranz, N., Interwies, E. and Vorwerk, A. (2005). NeWater Deliverable 1.3.1. Amu Darya Basin report, Ecologic – Institute for International and European Environmental Policy.
- Kranz, N., Interwies, E., Vorwerk, A., Timmerman, J. G., et al. (2005). Adaptive Water Management in Transboundary Context – A Common Research Agenda. Report to the



- NEWATER project (D1.3.2), Berlin, Germany, Ecologic – Institute for International and European Environmental Policy.
- Krasner, S. D., Ed. (1983). International Regimes. Ithaca, New York, Cornell University Press.
- Lindblom, C. E. (1977). POLITICS AND MARKETS; the world's political economic systems. New York, Basic Books.
- Majone, G. (1989). Evidence, argument and persuasion in the policy process. New Haven, Yale University Press.
- Marty, F. (2001). Managing international rivers: problems, politics and institutions. Bern; New York, Peter Lang.
- Mason, S. A. (2005). "Are we scorpions? The role of upstream–downstream dialogue in fostering cooperation in the Nile Basin." Mountain Research and Development **25**(2): 115-120.
- Maurel, P. (2003). Public participation and the European Water Framework Directive: Role of information and communication tools. Cemagref, Montpellier.
- Mostert, E. (2003). "Conflict and co-operation in international freshwater management - A global review." International Journal of River Basin Management **1**(3): 1-12.
- Mostert, E. (2005). How can international donors promote transboundary water management? Discussion paper published by the Deutsches Institut für Entwicklungspolitik, Bonn.
- Mostert, E., van Beek, E., Bouman, N. W. M., Hey, E., et al. (1999). River basin management and planning. International Workshop on River Basin Management, The Hague, the Netherlands, Unesco.
- Nachtnebel, H. P. (2000). "The Danube river basin environmental programme: plans and actions for a basin wide approach." Water Policy **2**(1-2): 113-129.
- Nakayama, M. (2003). International Waters in Southern Africa, United Nations. University Press.
- Nicol, A. and Shahin, M. (2003). The Nile: Moving beyond cooperation., from <http://unesdoc.unesco.org/images/0013/001333/133301e.pdf>.
- Nienhuis, P. H., Chojnacki, J. C., Harms, O., Majewski, W., et al. (2000). Elbe, Odra, and Vistula: reference rivers for the restoration of biodiversity and habitat quality. In: New approaches to river management. Smits, A. J. M., Nienhuis, P. H. and Leuven, R. S. E. W. (Ed.), Leiden, Backhuys Publishers: 65-84.
- Nile-COM (2001). Nile transboundary environmental action draft. GEF project brief.
- Nile Basin Initiative (2005). The Nile River.
- Nilsson, S. (2003). The role and use of information in transboundary water management. Department of land and water resources engineering. PhD, Kungl Tekniska Hogskolan.



- Nonaka, I., Takeuchi, H. and Takeuchi, H. (1995). The knowledge-creating company how Japanese companies create the dynamics of innovation. New York, Oxford University Press.
- North, D. C. (1990). Institutions, institutional change and economic performance. Cambridge, UK, Cambridge University Press.
- Nunes Correia, F. (1998). Institutions for water resources management in Europe Vol. 1. Rotterdam, Balkema.
- Olay, A., Gomes, R., Álvarez, R., Sousa, S., et al. (2004). Interaction between climatic conditions and water pollution: a case study from the transboundary catchment of Guadiana River. Report of the Transcat project., Palazzo Zorzi, Venice, Italy.
- Ostrom, E. (1990). Governing the commons: The evolution of institutions for collective action. New York, Cambridge University Press.
- Pagan, O. and Crase, L. (2004). Does adaptive management deliver in the Australian water sector? 48th annual conference of the Australian Agricultural and Resource Economics Society, Melbourne, Victoria.
- Pahl-Wostl, C. (2004). The implications of complexity for integrated resources management. iEMSs 2004 International Congress: "Complexity and Integrated Resources management", Osnabrück, Germany, June 2004, International Environmental Modelling and Software Society.
- Pahl-Wostl, C. (2005). Summary - WB1(WP1.1/1.7) Workshop, Osnabrück, 13-15.04.05. Draft version of workshop summary, compiled on 18th April 2005.
- Pahl-Wostl, C., Downing, T. E., Kabat, P., Magnuszewski, P., et al. (2005). Transitions to Adaptive Water Management: The NeWater Project. Article, submitted for publication in Water Policy.
- Peipsi Centre for Transboundary Cooperation. (2005, 05-04-2005). "About the project." from <http://www.mantraeast.org/about.php>.
- Raadgever, G. T. (2005a). NeWater Deliverable 1.3.1. Analysis of transboundary regimes - Case study basin the Elbe. RBA Centre, Delft University of Technology.
- Raadgever, G. T. (2005b). NeWater Deliverable 1.3.1. Analysis of transboundary regimes - Case study basin the Rhine. RBA Centre, Delft University of Technology.
- Rambaldi, G. and Callosa-Tarr, J. (2002). Participatory 3-Dimensional Modelling: Guiding Principles and Applications., Asean Regional Centre for Biodiversity Conservation.
- REC (2002). Tisza River Basin Integrated Sustainable Development Program Initiation phase.
- REC (2004). Tisza River Basin Sustainable Development Program, Regional Assessment of legal, Policy and Institutional Framework.
- Rittberger, V. (1993). Regime theory and international relations. Oxford, Clarendon.



- Roll, G. (2004). Generation of usable knowledge in implementation of European water policy. In: Environmental information in European transboundary water management. Timmerman, J. G. and Langaas, S. (Ed.), London, UK, IWA Publishing.
- Rotmans, J. (2003). Transitiemanagement: Sleutel voor een duurzame samenleving. Assen, the Netherlands, Koninklijke Van Gorcum.
- Rutherford, M. (2001). "Institutional economics: Then and now." Journal of Economic Perspectives **15**(3): 173-194.
- Saleth, R. M. and Dinar, A. (2004). The institutional economics of water a cross-country analysis of institutions and performance. Cheltenham, Elgar.
- Savenije, 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**: 9-45.
- Schnellmann, M. and Heimhofer, U. (2002). Case study Tisza River.
- Stoks, P. (2005). Interview conducted by Tom Raadgever at 15-07-05 in Nieuwegein, the Netherlands.
- Streeck, W. and Schmitter, P. C. (1985). Private interest government: beyond market and state. London [etc.], Sage.
- Sveiby, K. E. (1998, 22-02-2005). "What is information?" from <http://www.sveiby.com/>.
- Thompson, M., Ellis, R. and Wildavsky, A. (1990). Cultural theory. Boulder [etc.], Westview Press.
- Timmerman, J. G. (2005). NeWater Deliverable 1.3.1. Analysis of transboundary regimes - Case study basin the Nile. RIZA - Institute for Inland Water Management and Waste Water Treatment.
- Timmerman, J. G. and Doze, J. (2005). NeWater Deliverable 1.3.1. Analysis of transboundary regimes - Case study basin the Guadiana. RIZA - Institute for Inland Water Management and Waste Water Treatment.
- Timmerman, J. G., Gooch, G. D., Kipper, K., Meiner, A., et al. (2003). The use and valuing of environmental information in decision making process: an experimental study. Second International Conference on Sustainable Management of transboundary waters in Europe, Miedzyzdroje, UNECE.
- Timmerman, J. G. and Langaas, S. (2004). Environmental information in European transboundary water management. London, IWA.
- Timmerman, J. G. and Langaas, S. (2005). "Water information - what is it good for? On the use of information in transboundary water management." Regional Environmental Change **5**(4): 177-187.
- 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.



- Tompkins, E. L. and Adger, W. N. (2004). "Does adaptive management of natural resources enhance resilience to climate change?" Ecology and Society **9**(2): -.
- Turton, A. R. and Henwood, R. (2002). Hydropolitics in the Developing World: A Southern African Perspective, African Water Issues Research Unit (AWIRU).
- UN (1997). Convention on the Law of the Non-navigational Uses of International Watercourses.
- UN ECE (1992). Convention on the Protection and use of transboundary watercourses and international lakes, done at Helsinki, on 17 March 1992, Helsinki.
- UN ECE (1998). Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, done at Aarhus, Denmark, on 25 June 1998.
- UN ECE Task force on Monitoring & Assessment (2000). Guidelines on monitoring and assessment of transboundary rivers, RIZA.
- UN ESCAP (2003). Guidelines on participatory planning and management for flood mitigation and preparedness. New York, United Nations.
- UNCED (1992). Rio declaration on Environment and Development. The final text of agreements negotiated by governments at the UN Conference of Environment and Development., Rio de Janeiro.
- UNEP GRID. (2005). "Elbe." Retrieved 15-06-05, from http://www.grid.unep.ch/product/publication/freshwater_europe/elbe.php.
- UNEP GRID Europe. (2005). "Fresh water maps and figures." Retrieved 23-05-05, from http://www.grid.unep.ch/product/publication/freshwater_europe/illus.php.
- van de Kerkhof, M. and Wieczorek, A. (2005). "Learning and stakeholder participation in transition processes towards sustainability: Methodological considerations." Technological forecasting and social change **72**: 733-747.
- van der Zaag, P. and Savenije, H. G. (2000). "Towards improved management of shared river basins: lessons from the Maseru Conference." Water Policy **2**: 47-63.
- Verweij, M. and Douglas, M. (2000). Transboundary Environmental Problems and Cultural Theory the Protection of the Rhine and the Great Lakes. Houndmills, Palgrave.
- Wolf, A. T. (1998). "Conflict and cooperation along international waterways." Water Policy **1**: 251-265.
- Wolf, A. T., Natharius, J. A., Danielson, J. J., Ward, B. S., et al. (1999). "International River Basins of the World." 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**: 29-60.
- Working Group GIS (2002). Guidance document on implementing the GIS elements of the WFD. European communities, from



http://forum.europa.eu.int/Public/irc/env/wfd/library?l=/framework_directive/guidance_documents/guidance_outcome&vm=detailed&sb=Title.

World Commission on Dams (2000). Dams and development; a new framework. The report of the World Commission on dams., London and Sterling, Earthscan Publications Ltd.

WWF (2003a). WWF Water and Wetland Index - Critical issues in water policy across Europe, November 2003; Results overview for the Guadiana river basin (Portugal), World Wildlife Fund, Europe.

WWF (2003b). WWF Water and Wetland Index - Critical issues in water policy across Europe, November 2003; Results overview for the Guadiana river basin (Spain), World Wildlife Fund, Europe.



Annex 1. List of abbreviations

AM	Adaptive Management
ARGE Elbe	Arbeitsgemeinschaft für die Reinhaltung der Elbe
ASPB	Aral Sea Basin Programme
BVO	Basin Water Management Organisation (Amu Darya)
CADC	Commission for the Implementation and Development of the Albufeira Convention between Spain and Portugal
CHR	Commission for the Hydrology of the Rhine Basin
DPSIR	Driving forces, Pressures, State, Impact and Responses
DSS	Decision Support System
EU	European Union
FGG Elbe	Flussgebietsgemeinschaft Elbe
GEF	Global Environment Facility
GIS	Geographical Information System
HYCOS	Hydrological Cycle Observation System
ICPE	International Commission for the Protection of the Elbe
ICPDR	International Commission for the Protection of the Danube River
ICPR	International Commission for the Protection of the Rhine (against pollution)
ICWC	Interstate Commission for Water Coordination (Aral Sea basin)
ICWE	International Conference on Water and the Environment
IFAS	International Fund for the Aral Sea
IAWR	Internationale Arbeitsgemeinschaft der Wasserwerke im Rheineinzugsgebiet
IWRM	Integrated Water Resource Management
LAWA	Länderarbeitsgemeinschaft Wasser
LHWC	Lesotho Highlands Water Commission
NBI	Nile Basin Initiative
NGO	Non-governmental organisation
Nile-COM	Nile Council of Ministers
Nile-SEC	Nile Secretariat
Nile-TAC	Nile Technical Advisory Committee
ORASECOM	Orange-Senqu River Basin Commission
PP	Public Participation
PWC	Permanent Water Commission (Namibia, South Africa)



RAP	Rhine Action Plan
RSAP-IRWM	Regional Strategic Action Plan for Integrated Water Resources Development and Management (SADC)
RBM	River Basin Management
SADC	Southern African Development Community
SIC (ICWC)	Scientific Information Centre of the ICWC
SVP	Shared Vision Programme (Nile)
Tecconile	Technical Cooperation Committee for the Promotion of Development and Environmental Protection of the Nile Basin
TRB	Tisza River Basin
UNDP	United Nations Development Programme
UN ECE	United Nations Economic Commission for Europe
UNEP	United Nations Environmental Programme
WFD	Water Framework Directive
WMO	World Meteorological Organisations



Annex 2. Tentative overview ‘adaptiveness’ regimes

Table 9. Tentative scores basins on criteria for AM (- = low, □ = average, + = high)

Criterion \ Basin	Amu Darya	Elbe	Guadiana	Nile	Orange	Rhine	Tisza
1. Cross- sectoral cooperation	-	□	□	-	-	□	-
2. Cooperation between administrative levels	-	□	□	-	□	□	□
3. Cooperation across administrative boundaries	□	□	□	□	□	+	□
4. Broad stakeholder participation	-	+	□	□	□	+	□
5. Appropriate legal framework	-	□	□	-	-	+	-
6. Adaptable legislation	-	□	□	-	□	□	□
7. Long time horizon	-	+	-	□	□	+	-
8. Flexible measures, keeping options open	-	+	□	□	□	+	+
9. Experimentation		□	□		□	□	□
10. Full consideration of possible measures	-	+	-	□	□	+	-
11. Actual implementation of policies	-	+	□	-	-	+	-
12. Joint/ participative information production	□	+	□	□	□	+	□
13. Interdisciplinarity	-	□	□	-		□	□
14. Elicitation of mental models/ critical self-reflection about assumptions	-						□
15. Explicit consideration of uncertainty	-	□		□	□	□	□
16. Broad communication	-	□	-	-	-	+	□
17. Utilization of information	-	□	-	-	-	□	□
18. Appropriate financing system	-	+	-	-	-	+	□

Table 10. Scores basins on groups of criteria for AM (- = low, □ = average, + = high)

Criterion \ Basin	Amu Darya	Elbe	Guadiana	Nile	Orange	Rhine	Tisza
Formal actors and informal networks (average 1-4)	-	□	□	- / □	□	□ / +	□
Legal framework (average 5-6)	-	□	□	-	- / □	□ / +	- / □
Policy development and implementation (average 7-11)	-	+	- / □	□	□	+	- / □
Information management (average 12-17)	-	□	- / □	- / □	- / □	□ / +	□
Financial (18)	-	+	-	-	-	+	□