



**NeWater**

## **DELIVERABLE 1.3.4:ASSESSING ADAPTIVE MANAGEMENT**

**Development of the framework for assessing  
transboundary river basin management regimes**

**Report of the NeWater project -  
New Approaches to Adaptive Water Management under Uncertainty**

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## **Preamble**

This research was executed as part of the NeWater project (Contract no 511179, 6th EU framework program). We would like to thank all who cooperated in the research, and the European Commission and the Water Resources Centre Delft who supported the research financially.

This deliverable is for 95% based on an article that was published in the online, open access journal *Ecology and Society* (2008). We added a discussion of how the conceptual framework that is presented in this paper was further developed and used as an analysis tool by other researchers (Huntjens, Pahl-Wostl et al. 2008), how stakeholders in the Orange basin perceived and used the framework, and how presentations of the paper were received at two conferences. A previous version of (parts of) this article was presented at the AWRA conference about Adaptive Management of Water Resources (Raadgever, Mostert et al. 2006).

Tom Raadgever

January 2009

## Policy summary

River basin management is faced with complex problems that are characterized by uncertainty and change. In transboundary river basins, historical, legal, and cultural differences add to the complexity. The literature on adaptive management gives several suggestions for handling this complexity. It recognizes the importance of management regimes as enabling or limiting adaptive management, but there is no comprehensive overview of regime features that support adaptive management. This chapter presents such an overview, focused on transboundary river basin management. It inventories the features that have been claimed to be central to effective transboundary river basin management and refines them using adaptive management literature. It then collates these features into a framework describing actor networks, policy processes, information management, and legal and financial aspects. Subsequently, this framework is applied to the Orange and Rhine basins. The paper concludes that the framework provides a consistent and comprehensive perspective on transboundary river basin management regimes, and can be used for assessing their capacity to support adaptive management.

The framework has been further developed and applied to assess the regimes in eight basins and to link regime characteristics to the content of water management policies. Since the content of the policies reflects the policy learning that occurred, this was a test of the relation between regime characteristics and policy learning. The analysis demonstrated that such a link exists: more adaptive regimes, in particular better integrated cooperation structures (including non-governmental stakeholders, governments from different sectors and different hierarchical levels) and advanced information management (including joint/participative information production, consideration of uncertainties, and broad communication), resulted in higher levels of policy learning. Furthermore, the framework was presented to policymakers in the Orange basin. The policymakers involved in the transboundary commission ORASECOM discussed and adapted the original conceptual framework, so that they could use it for continual assessment and improvement of the transboundary regime in the Orange basin. They emphasized the relevance of the political process, benefit-sharing, effective funding, workable stakeholder representation, the capacity to implement legislation, excellence in planning, and high-quality information. In addition, the framework was applied at the transboundary and national level to assess and improve the preparedness to address the challenge of climate in the Orange basin. Finally, the framework was received well by scientists and water managers alike at multiple conferences. Various suggestions were made to improve the framework, specifically the concept of adaptable legislation was considered to be weakly defined.

All in all, the framework has proven to be a useful analytic framework for scientific analysis, and some empirical evidence that the described regime supports adaptive management has been collected. At the same time, the framework has been received well by policymakers and has been used as a normative framework for assessing and improving river basin management regimes. We recommend further exploring the potential of the framework for assessing and improving regimes, under consideration of the suggested additions and refinements.

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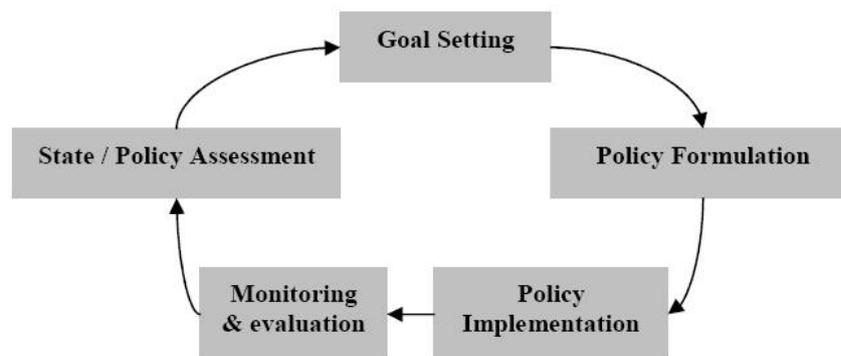
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## 1 Introduction

In the past, river basin management was often the exclusive realm of hydraulic engineers, who managed the river for a single purpose only, such as navigation or hydropower. Nowadays, river basin management is often multi-purpose and basin-wide, and involves many more actors (cf. Ridder, Mostert et al. 2005). Moreover, river basin management has to deal with increasing rates of human-induced change and increasing concerns about the causes and consequences of these changes (Pahl-Wostl 2004; Toffler 1980). In transboundary river basins, differences in legal frameworks, historical and cultural backgrounds, and technical capabilities add to the complexity (Timmerman and Langaas 2005).

Adaptive management has been proposed as a way of dealing with uncertainty and change (Holling 1978). It aims at developing robust and flexible management strategies that perform well under different possible futures and can be modified if necessary. It acknowledges that current knowledge will never be sufficient for future management (Pagan and Crase 2004). Therefore, policies are treated as hypotheses and their implementation as experiments to test them (Gunderson 1999; Walters and Holling 1990). Adaptive management requires a process of active learning by all stakeholders, and continuous improvement of management strategies by learning from the outcomes of implemented policies (Geldof 1995; Pahl-Wostl 2004; Pahl-Wostl 2007). The learning process is not a matter of random trial and error, but a structured, cyclical process, involving 1) integrated assessment of current problems and possible solutions as perceived by different stakeholders, 2) setting goals, 3) formulation of policies that are hypothesized to contribute to reaching the goals, 4) implementation, to test the hypotheses, through 5) systematic monitoring and evaluation of policy outcomes, including surprises (Figure 1). In practice, these are not distinct stages, as the system pulses through alternating spurts of learning and implementing.



**Figure 1. The adaptive management cycle (Pahl-Wostl 2007)**

By involving all relevant stakeholders in the assessment and goal-setting stages, an overview of relevant technical knowledge, values, and interests can be obtained. Such an overview allows for designing “experiments” that minimize the risk of degradation of the ecosystem, in particular irreversible change, and failure of ecosystem services. Furthermore, joint policy formulation, implementation, and evaluation may improve learning and increase support for policy changes. One strategy to avoid unnecessary risks is to use simulation models to develop system knowledge and inform the debate (Lee 1999).



Despite its popularity, adaptive management is still under debate. First, the meaning of adaptive management is not fixed. Within the literature, two interpretations of adaptive management can be distinguished: “scientific adaptive management,” which focuses on experimentation as a means to learn more about the social ecosystem, and “adaptive co-management,” which emphasizes the importance of stakeholder involvement (cf. McLain and Lee 1996; Olsson, Folke et al. 2004). Secondly, although the number of examples of adaptive management is increasing (e.g., Gilmour, Walkerden et al. 1999; McLain and Lee 1996; Tompkins and Adger 2004), these examples often remain limited to small scales and to modeling instead of experimentation (Lee 1999; Walters 1997). One explanation given for this in the adaptive management literature is that current institutional settings are often too constraining and inflexible to allow continuous improvement (e.g., Folke, Hahn et al. 2005; Gunderson 1999; Johnson 1999; Walters 1997). Yet, this literature does not provide us with a comprehensive overview of institutional factors that support adaptive management (cf. McLain and Lee 1996).

This paper sets out to provide such an overview in the form of a framework for assessing the adaptive capacity of transboundary river basin management regimes. First, it identifies the features of transboundary management regimes that are mentioned in water management literature as central to effective management. Second, it complements and refines these features using adaptive management literature and elaborating on it. These features are subsequently collated into a framework for assessing the adaptive capacity of transboundary river basin management regimes. Finally, the paper applies the framework to two selected regimes—the management regimes of the Orange Basin in Southern Africa and the Rhine Basin in Western Europe—in order to test whether it can be used for describing and assessing actual regimes. The paper concludes with a discussion of the framework and recommendations for further research.



## 2 Key features of transboundary management regimes

There are presently some 260 transboundary river basins around the world, covering 45% of the land surface of the earth (Wolf, Natharius et al. 1999). Unilateral action in these basins is often ineffective, inefficient, or simply impossible, e.g., a dam on a boundary stretch of a river. Moreover, it can harm the other basin countries (UN ESCAP 2003). For this reason, transboundary cooperation is necessary.

Transboundary cooperation is shaped by, and contributes to, the development of transboundary management regimes. According to Krasner (1983), a transboundary regime consists of “implicit or explicit principles, norms, rules, and decision making procedures around which actors’ expectations converge in a given area of international relations.” Consequently, river basin management regimes are defined as the principles, norms, rules, and decision-making procedures around which actors’ expectations in (transboundary) river basin management converge.

In this paper, we focus on five central regime elements: actor networks, water law, water policy, information management, and financing systems (Figure 2). Key elements are the -relatively stable but not unchanging - actor networks. The actor networks make the laws and policies, which in turn influence their activities (cf. structuration theory: Giddens 1984). Management regimes can be distinguished from operational management: the technical measures and the regulatory, financial, and communicative instruments that directly intervene in the physical river basin system, or directly address the users of the river and the river basin. Moreover, management regimes can be distinguished from the general institutional and political context and from regimes in other policy fields (see Figure 2). This section summarizes the main features of transboundary river basin management regimes that are mentioned in literature as being central to effective management.

### *Actor Networks*

Transboundary cooperation can be institutionalized by the establishment of international river basin commissions (Dieperink 1998). Ideally, they should support an interdisciplinary and intersectoral approach (Wolf 1998). International river basin authorities with decision-making 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). Non-governmental organizations (NGOs) and donors can play a valuable role in transboundary river basin management as well. Although this may take more time initially, involvement of NGOs and the general public can support cooperation and enlarge the acceptance of proposed measures (Huisman, de Jong et al. 2000).

### *Legal Framework*

Transboundary river basin management can be analyzed in terms of the development and implementation of international “agreements,” such as treaties, protocols, gentlemen’s agreements, tacit understandings, etc., including binding laws and non-binding policies (Bernauer 2002; Mostert 2005). To conform to international law, agreements should reflect the relevant principles of equitable and reasonable utilization, the obligation not to cause significant harm, and the duty to notify and exchange information (Mostert, van Beek et al. 1999). Another important aspect is how the legal framework deals with information exchange and communication across different legal and institutional frameworks, cultures, and languages (Gooch, Stalnacke et al. 2006). Finally, the likelihood and intensity of dispute decreases as treaties, as well as water management bodies, have the capacity to absorb rapid physical or institutional change (Wolf, Yoffe et al. 2003).

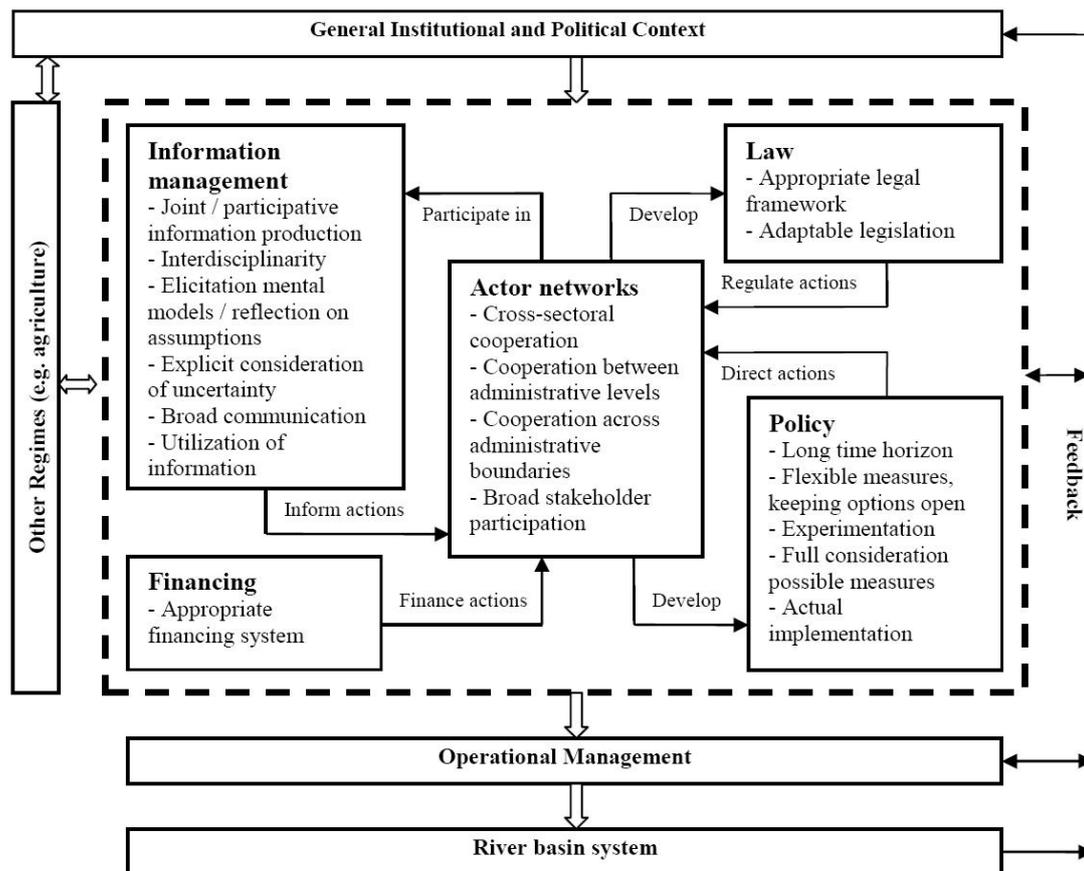


Figure 2. River basin management regime and criteria for an adaptive regime

### *Policy*

Policy refers to the goals of government, or other organizations, and the strategies to reach these goals. Policies can be recorded in formal documents or followed in practice. To promote effective implementation, policies should be tailored toward the specific interests and resources of the involved parties (Marty 2001). In addition, policies should be updated periodically to provide an opportunity to adapt objectives and measures to changing conditions and the opinions of society (Huisman, de Jong et al. 2000; Marty 2001).

### *Information Management*

Information management is the iterative process of determining information needs, and producing, exchanging, and using information. Cooperation in information management, e.g., joint monitoring, is often an effective way to start developing trust between riparian countries. Free access to information is an essential precondition for this (Mostert, van Beek et al. 1999; van der Zaag and Savenije 2000). National governments and transboundary commissions should exchange information and actively disseminate information to the public (Nilsson 2003). This can result in the development of an improved technical capacity, more mutual understanding, a shared vocabulary, and shared insights (Mostert, van Beek et al. 1999; van der Zaag and Savenije 2000). To broaden the knowledge base and prevent selective information use, institutional mechanisms should be put in place to ensure that all available information is used. These mechanisms include requirements for public participation, and offering possibilities for counter expertise (Timmerman 2004).



### *Financing*

Without a good financing system, transboundary river basin management is not viable in the long run. The costs of transboundary river basin management include the costs of producing a diverse set of public goods (e.g., flood protection) and market goods (e.g., hydropower), as well as the costs of the management process itself (e.g., travel costs). In so-called developing countries, international donors and banks often bear the management costs of negotiating an international treaty, but they may also finance river basin commissions and research projects for a longer time, and give loans for specific projects. The effectiveness of donor and bank involvement can be improved greatly when they coordinate their activities better (Mostert 2005; Mostert, van Beek et al. 1999; Wolf 1998). However, too much dependence on donors and banks makes management vulnerable. Financial as well as ecological sustainability can be improved by recognizing water as an economic good and recovering the costs as much as possible from the users (Global Water Partnership (GWP) 2003). Water pricing can reduce excessive water use, but at the same time, access to clean water and sanitation should be offered to all humans at an affordable price (International Conference on Water and the Environment (ICWE) 1992). The provision of public goods and the management costs can be financed from national taxes, such as general taxes or a tax per hectare. Governments should have a financing strategy to match income with costs (GWP 2003).

### *Cooperation Process*

In addition to regime features, literature on transboundary river basin management also contains many lessons for the international cooperation process. Probably the most important requirement for successful international cooperation is mutual trust, which can only be developed in small steps (Huisman, de Jong et al. 2000; Mostert, van Beek et al. 1999). Political cooperation can more easily be established when technical cooperation is already in place. To convince upstream parties of the need for cooperation, downstream parties often have to be alert and creative (Dieperink 1998; van der Zaag and Savenije 2000). It is also important to identify and solve conflicts before they escalate (Wolf 1998). Water management disputes can often only be solved through active dialog among the disciplines that are relevant for the issue at stake, and by involving policy sectors other than water, as this can open up new opportunities for win-win situations, e.g., through issue linking (Huisman, de Jong et al. 2000; Mostert, van Beek et al. 1999; van der Zaag and Savenije 2000). Other mechanisms that can be used for overcoming conflicting interests include financial compensation, and accepting less favorable agreements in the expectation that other countries will do the same (“diffuse reciprocity”, LeMarquand 1977; Mostert, van Beek et al. 1999).



### 3 Adaptive river basin management regimes

The literature on transboundary river basin management does not provide a satisfactory overview of institutional features that support adaptive management. Many articles are based on one or a few cases only, different theoretical approaches are used, e.g., institutional economics, politics, geography, and engineering, and, most importantly, the issue of uncertainty and change is addressed to a limited extent only. However, using the adaptive management literature, it is possible to complement and refine the insights gained, and develop a complete framework for assessing the extent to which transboundary river basin management regimes support adaptive management. The framework consists of a number of criteria for the different regime elements, and indicators for each criterion (Table 1). Although some of the criteria and indicators have been derived directly from the literature, others had to be developed by the authors themselves. The framework focuses on the international level, but it can also be applied at the national and sub-national levels, where many crucial decisions for transboundary management are made.

**Table 1. Framework for adaptive management regimes (Raadgever and Mostert 2005)**

| Criteria   | Indicators   |
|--|--|
| <i>A. Actor networks</i>                         |  |
| 1. Cross-sectoral co-operation                   | <ul style="list-style-type: none"> <li>- Sectoral governments actively involve other government sectors</li> <li>- Co-operation structures include government bodies from different sectors; many contacts generally</li> <li>- Conflicts are dealt with constructively, resulting in inclusive agreements to which the parties are committed</li> </ul>   |
| 2. Co-operation between administration levels    | <ul style="list-style-type: none"> <li>- Lower level governments are involved in decision-making by higher level governments</li> <li>- Co-operation structures include government bodies from different hierarchical levels; many contacts generally</li> <li>- Conflicts are dealt with constructively, resulting in inclusive agreements to which the parties are committed</li> </ul>  |
| 3. Co-operation across administrative boundaries | <ul style="list-style-type: none"> <li>- Downstream governments are involved in decision-making by upstream governments</li> <li>- International/ transboundary co-operation structures exist (e.g. river basin commissions); many contacts generally</li> <li>- Conflicts are dealt with constructively, resulting in inclusive agreements to which the parties are committed</li> </ul>  |
| 4. Broad stakeholder participation               | <ul style="list-style-type: none"> <li>- Legal provisions concerning access to information, participation in decision-making (e.g. consultation requirements) and access to courts</li> <li>- Co-operation structures include non-governmental stakeholders</li> <li>- Non-governmental stakeholders actually contribute to agenda setting, analysing problems, developing solutions and taking decisions (“co-production”)</li> <li>- Non-governmental stakeholders undertake parts of river basin management themselves, e.g. through water users’ associations</li> <li>- Governments take stakeholder input seriously</li> </ul> |
| <i>B. Legal framework</i>                        |  |
| 5. Appropriate legal framework                   | <ul style="list-style-type: none"> <li>- A complete and clear legal framework for water management exists (with sufficient detail)</li> <li>- Policies have to be reviewed and changed periodically</li> </ul>   |
| 6. Adaptable legislation                         | <ul style="list-style-type: none"> <li>- Laws and regulation can easily be changed</li> <li>- Water (use) rights can easily be changed / are not permanent</li> </ul>  |



| Criteria   | Indicators   |
|--|--|
| <i>C. Policy</i>   |  |
| 7. Long time horizon   | - Solutions for short term problems do not cause more problems in the (far) future (20 years or more)<br>- Already now preparations are taken for the (far) future (20 years or more)  |
| 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<br>- Alternatives include small and large-scale and structural and non-structural measures   |
| 11. Actual implementation of policies  | - Plans and policies are actually implemented<br>- 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 terms of reference and supervising the search, or at least consulted (interviews, surveys etc.)<br>- Idem for non-governmental stakeholders  |
| 13. Inter-disciplinarity   | - 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<br>- 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<br>- 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)<br>- New information influences policy  |
| <i>As to the issues on which information should be produced, communicated and utilized: see under C.</i> |  |
| <i>E. Financing</i>  |  |
| 18. Appropriate financing system   | - Sufficient (public and private) resources are available<br>- Costs are recovered from the 'users' by public and private financial instruments (charges, prices, insurance etc.)<br>- Decision-making and financing in one hand<br>- Authorities can take loans and depreciate their assets, to facilitate efficient use of resources and replacement of assets |

#### *Actor Networks*

A central requirement of adaptive management is active learning by all relevant stakeholders (Folke, Hahn et al. 2005; Pahl-Wostl and Hare 2004). Transboundary water management often centers around national governments, taken as unitary actors, but in addition, cooperation is needed between different government sectors and government levels, between government authorities, NGOs, and individual citizens, and between all these and the



experts. All these actors have different resources that are necessary for transboundary river basin management, such as information, expertise, funds, and legal competencies. To improve the legitimacy and efficacy of management, the views of all relevant stakeholders should be taken into account. This requires, first, that authorities, experts, and stakeholders realize that they depend on each other for reaching their own goals. Next, they need to start interacting, share their problem perceptions, and develop different potential solutions. This requires development of mutual trust, recognition of diversity, and critical self-reflection. Finally, the stakeholders need to make joint decisions and make arrangements for implementation (Gray 1989; Ridder, Mostert et al. 2005).

#### *Legal Framework*

The adaptive management literature does not contain many specifics concerning the legal framework. Reasoning from the logic of adaptive management, however, we hypothesize that water law should be complete and clear, enabling all stakeholders to express their concerns and provide input into management, and providing all legal tools for regulating the use of the environment, while still allowing sufficient freedom to experiment with new approaches. Developing such a framework is a difficult balancing act requiring a lot of skill and creativity. A complete legal framework should include arrangements for public participation, information management, financing, and planning, as well as many provisions concerning operational management, such as permitting (cf. GWP 2003). It should also contain provisions to regularly review and, if necessary, adapt policies. The framework itself should be adaptable as well. The legislative process should not be too time consuming and complex, and individual water rights should not be permanent, but subject to review, in order to adapt to changing circumstances and new insights.

#### *Policy*

As mentioned in the introduction, adaptive management acknowledges the uncertainty inherent in policy making, and therefore, advocates developing robust and flexible policies. This requires that the full range of possible measures is considered, and that these measures are assessed in different scenarios, such as “weak” or “strong” climate change and “weak” or “strong” economic growth (e.g., Carpenter and Gunderson 2001; van der Heijden 1996). Moreover, policies should keep as many options open as possible, and be flexible to change when new evidence comes up (e.g., Carpenter and Gunderson 2001). The reason for this is, first, it may be impossible to identify measures that perform well under all scenarios. Second, it is impossible to anticipate all eventualities: future developments may lie outside the scope of the scenarios considered. And third, even in the current situation, our knowledge of ecological and social systems is insufficient for predicting the effects of measures with complete certainty. For this reason, small-scale policy experiments could be conducted (cf. Gunderson, Holling et al. 1995). Generally, a long time horizon should be applied, and last but not least, policies should be implemented. This usually requires that the stakeholders responsible for, or influencing, the implementation of policies already participate in policy development (see the paragraph on Actor Networks, above).

#### *Information Management*

As active learning by all relevant stakeholders is central to adaptive management, information management should actively involve all important governmental and non-governmental stakeholders. Stakeholders should have the opportunity to express their information needs, direct information production, and exchange and discuss data and viewpoints to develop a shared knowledge base and mutual understanding of the system to be managed and the problems that occur (cf. Timmerman and Langaas 2005). The shared knowledge base should integrate technical, political, and process knowledge in order to facilitate informed decision making and avoid unnecessary risks. Moreover, the shared knowledge base should reflect the perceptions of all stakeholders in order to promote the



legitimacy and quality of the knowledge. This requires that stakeholder perceptions, or “mental models,” including those of the experts, are first elicited and then discussed. Experts should not impose their, often mono-disciplinary, view on the issues at stake, but reflect critically on their own assumptions, and be open to the expertise of other disciplines and the local population. Experts should also communicate uncertainties, and not assume that other stakeholders cannot cope with uncertainty (Wynne 1996). Transparency about information and its limitations decreases the risk of misinterpretations and strategic information use purely to legitimize policy, and maximizes the chances of real learning (cf. Weiss 1977). As implementation of policies often occurs at the local level, and the effects are often felt at this level, there is a need for effective information transfer between the transboundary and the local level.

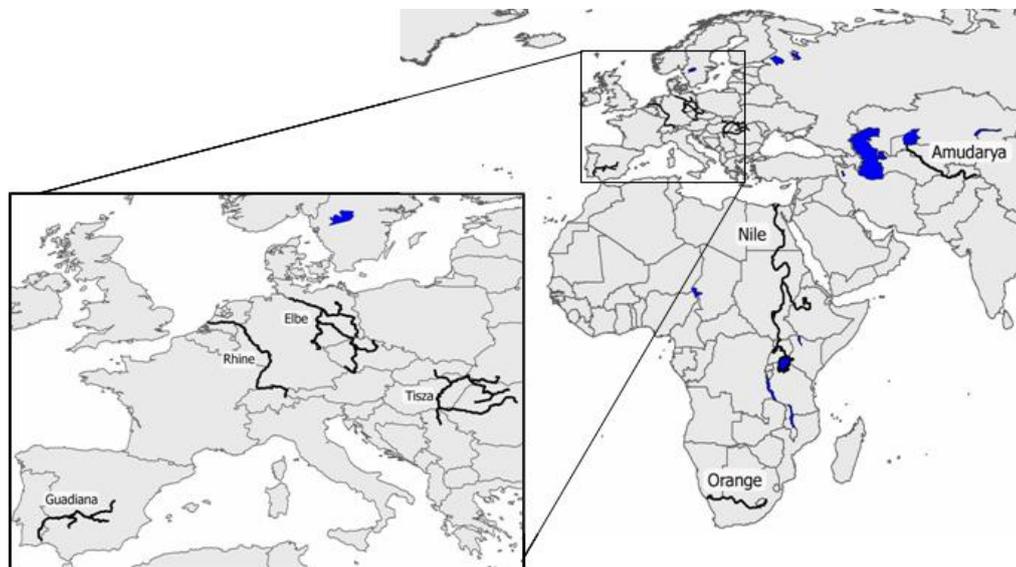
#### *Financing*

The challenges for the financing system of transboundary river basin management are to ensure sufficient funding, prevent perverse price incentives, and maximize learning opportunities. Moreover, the total costs should remain acceptable. Although participatory approaches, experimentation, and monitoring of the outcome costs money, in the long run they may prevent costly delays and the construction of unnecessary, expensive infrastructure (cf. Beierle 1998; Carnes, Schweitzer et al. 1998; Charnley and Engelbert 2005; Chess and Purcell 1999). Financing systems are most robust when they can rely on multiple sources. As stated before, cost recovery, e.g., by means of water pricing, adds to the robustness of the financing system by adding private funds, and may reduce water use and pollution. In addition, cost recovery may limit the construction of infrastructure. Infrastructure is often inflexible, as it cannot easily be adapted to changes, e.g., in water demand. Ideally, decision making, financing, and benefiting should be in one hand. This promotes the integral assessment of measures and the implementation of measures that have been agreed upon, and minimizes the chance of overuse because others have to pay the bill—literally or metaphorically (cf. Huitema, Egas et al. 2008). That being said, a perfect match usually is not possible, and river basin management should not become too complex. Finally, authorities should be able to take loans and depreciate their assets. This makes it easier to make long-term investments that would otherwise have to be financed in one year, and ensures that assets can be replaced in time.



## 4 Assessment of the Orange and Rhine regimes

The framework described in the previous section has been applied to seven transboundary river basin management regimes in Europe, Africa, and Asia in order to test whether it can be used for describing actual regimes and assessing their adaptive capacity (Raadgever and Mostert 2005; see Figure 3). For each basin, one or more researchers with experience in that basin first performed a literature study to describe the regime according to a common format (see the individual case study reports: Becker 2005; Kranz, Interwies et al. 2005a; Kranz, Interwies et al. 2005b; Raadgever 2005a; Raadgever 2005b; Timmerman 2005; Timmerman and Doze 2005). In the Rhine and Orange basins, additional interviews were conducted to capture less formalized knowledge. Secondly, the researchers scored “their” regimes for each criterion for adaptive regimes (cf. Table 1), using a three-point scale: 1) low, 2) average, or 3) high. Then, the scores for the different basins were compared and discussed to check whether all researchers had applied the criteria in the same way. This resulted in some small adjustments to the scores.



**Figure 3. Map of the seven studied river basins**

In this section, we present the results for two of the seven basins: the Orange and Rhine (Table 2, Figures 4 and 5). These basins have been selected because of the high availability of information. Even so, information on some of the criteria was limited, especially on criteria 14 and 15. The assessment of the two regimes revealed large differences between the two basins. The Rhine regime scores higher on the criteria for an adaptive regime than the Orange regime. A summary of the results can be found in Table 3 and more details can be found in the basin reports (Kranz, Interwies et al. 2005a; Raadgever 2005b).



**Table 2. Overview of main characteristics of the Orange and Rhine river basins**

| Basin  | Physical characteristics  | Countries   | Main river/water users   | Main issues   |
|--------|---|---|--|---|
| Orange | Basin area:<br>948 x 10 <sup>3</sup> km <sup>2</sup> †<br>River length: 2,200 km<br>Average discharge at mouth: 95 m <sup>3</sup> /s ‡  | South Africa<br>Namibia<br>Botswana<br>Lesotho  | - Irrigation / agriculture<br>- Environmental demands<br>- Power generation<br>- Industry<br>- Domestic use                                | - Water availability / allocation<br>- (Inter- basin) water transfers<br>- Droughts |
| Rhine  | Basin area:<br>198 x 10 <sup>3</sup> km <sup>2</sup> §<br>River length: 1,300 km<br>Average discharge at mouth: 2,200 m <sup>3</sup> /s | Germany<br>Netherlands<br>Switzerland<br>France<br>Austria<br>Luxembourg<br>Belgium<br>Liechtenstein<br>Italy | - Navigation<br>- Irrigation / agriculture<br>- Industry<br>- Power generation<br>- Domestic use<br>- Waste water disposal<br>- Recreation | - Pollution / water quality<br>- Floods<br>- Ecological restoration                 |

† Based on Wolf and Natharius et al (1999)

‡ Interpretation of graph of discharge at downstream location (Department of Environmental Affairs and Tourism (South Africa), 1999. National State of the Environment Report, [online] URL: <http://www.ngo.grida.no/soesa/nsoer/issues/water/state2.htm#rivers>)

§ 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), [online] URL: <http://www.kaderrichtlijnwater.nl/>)

**Table 3. Qualitative scores of basins on criteria for adaptive management (- = low, 0 = average, + = high)**

| Criterion  | Orange | Rhine |
|--|--------|-------|
| <i>A. Actors networks (Average 1-4)</i>                                      | 0      | 0 / + |
| 1. Cross- sectoral cooperation   | -      | 0     |
| 2. Cooperation between administrative levels                                 | 0      | 0     |
| 3. Cooperation across administrative boundaries                              | 0      | +     |
| 4. Broad stakeholder participation   | 0      | +     |
| <i>B. Legal framework (Average 5-6)</i>                                      | - / 0  | 0 / + |
| 5. Appropriate legal framework   | -      | +     |
| 6. Adaptable legislation   | 0      | 0     |
| <i>C. Policy (Average 7- 11)</i>   | 0      | +     |
| 7. Long time horizon   | 0      | +     |
| 8. Flexible measures, keeping options open                                   | 0      | +     |
| 9. Experimentation   | 0      | 0     |
| 10. Full consideration of possible measures                                  | 0      | +     |
| 11. Actual implementation of policies  | -      | +     |
| <i>D. Information management (Average 12-17)</i>                             | - / 0  | 0 / + |
| 12. Joint/ participative information production                              | 0      | +     |
| 13. Interdisciplinarity  |        | 0     |
| 14. Elicitation of mental models/ critical self-reflection about assumptions |        |       |
| 15. Explicit consideration of uncertainty                                    | 0      | 0     |
| 16. Broad communication  |        | +     |
| 17. Utilization of information   | -      | 0     |
| <i>E. Financing (18)</i>   | -      | +     |
| 18. Appropriate financing system   | -      | +     |



### *Assessment of the Regime in the Orange Basin*

The Orange basin regime scores average on the criteria, with a lot of progress in recent years (Kranz, Interwies et al. 2005a). Transboundary cooperation is still in an emerging state, as the Orange-Senqu River Basin Commission (ORASECOM) was only established in 2000. The development of transboundary institutions has been driven by donors, who have been involved in financing the establishment of the ORASECOM, financing participatory processes, and financing concrete research projects in the basin. Donor funding may not be the ideal financial source for adaptive management (see below), but it did contribute to the development of cooperation and more complete law. Integration of the water sector with other sectors is still low. Although government structures are traditionally top down, there is increasing awareness that local levels should be more intensively involved in international planning processes. Improving public participation has been identified as a major task of the ORASECOM, and serious efforts have been undertaken to fulfill this task, e.g., the development of a roadmap for public participation. In addition, provisions for stakeholder participation have been established in new water laws and policies—most prominently in South Africa—but implementation is still limited. This may be explained by the lack of adequate methods for communication with relevant stakeholder groups, particularly in rural areas.



**Figure 4.** Map of the Orange basin (South African Department of Water Affairs and Forestry, retrieved 22 August 2007 from <http://www.dwaf.gov.za/orange/images/rm017m6.gif>)

International law in the basin consists primarily of the Southern African Development Countries Protocol on Shared Watercourses, the legal framework around the ORASECOM, and several bilateral agreements. These do not yet constitute a comprehensive legal framework, but they are adaptive to some extent. The legal framework clearly refers to integrated water resources management (IWRM) as the guiding principle for water management. National water laws are explicitly linked to international agreements. They



have undergone several adjustments and updates over recent years, and some have included provisions for a periodical update.

Policy development in the Orange basin scores average, but policy implementation scores low. Water management in the basin has traditionally concentrated on large-scale infrastructure, such as dams and water transfer pipelines, tailored toward meeting short-term water demands of individual countries. Recently, there is a lot of discussion on the long-term adverse effects of large-scale infrastructure, and alternatives such as demand management, stricter regulation, and benefit sharing among riparian states have been advocated. Implementation of transboundary policies is very slow, but many stakeholders expect a lot from the multilateral planning under the auspices of the ORASECOM within the coming years.

The Orange basin scores average with respect to shared production of information between the riparian countries, but low with respect to information exchange and utilization. Several research institutes and universities are involved in data collection on various issues of water management. The need to develop, exchange, and integrate data has been clearly identified, as a key task of the ORASECOM. However, an integrated data and information system has not been established yet. The dissemination of information by the ORASECOM to stakeholder groups is limited.

The Orange basin scores low with respect to the financing system. Financial contributions of international donors have been quite instrumental in the development of large infrastructural works, which increased the availability of resources, but also increased dependence on third parties. Currently, donor efforts seem to be concentrating more and more on institutional capacity building, which is expected to support adaptive management by contributing to cooperation, law, and policy. In addition, the member states have been more and more involved in the financing of the ORASECOM, and have recently split the costs of the permanent secretariat among the four of them.

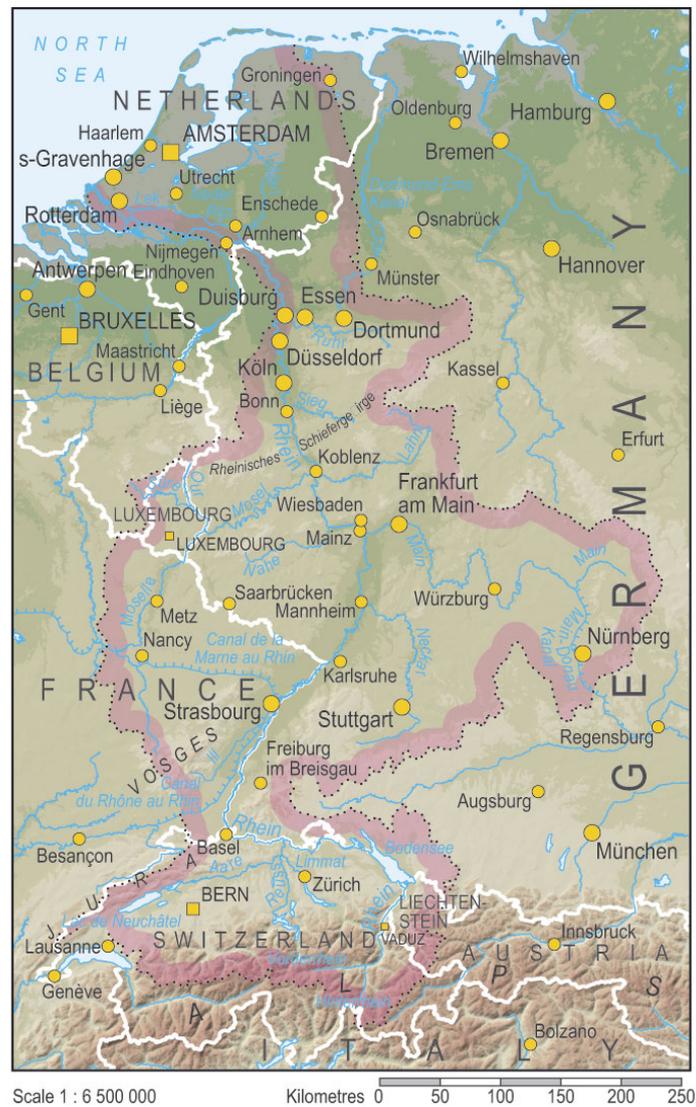
#### *Assessment of the Regime in the Rhine Basin*

In the Rhine basin, long-lasting institutional stability has created opportunities to develop trust and cooperation, and thus this region is closest to meeting the criteria (Raadgever 2005b). In the International Commission for the Protection of the Rhine (ICPR), the riparian countries have cooperated for many decades. The ICPR consists of a plenary commission, comprising national representatives, permanent multidisciplinary working groups, and a secretariat, supporting the plenary commission and the working groups. Adjustment of water policies with agricultural and spatial planning policies takes place, to some extent, at the national and sub-national levels. Lower-level governments are often involved in the implementation of (inter)national policy. Non-governmental organizations, citizens, and the scientific community are involved in many different ways in water management, and a high degree of organization and cooperation between various actors has been established. Formal procedures for participation in decision making and access to information are well-established in all basin states.

The legal agreements developed in the framework of the ICPR focus on institutional issues, and chloride and chemical pollution (cf. Dieperink 1998). Several, non-legally binding, policy documents, such as the Rhine Action Plan of 1987, contain additional provisions concerning water quality, ecology, and flooding. An influential legal document is the EU Water Framework Directive (2000/60/EC), which includes many requirements for river water quality, ecology, and the water management process. The international law and policy are elaborated in comprehensive systems of national and lower-level law. In most Rhine



countries, adaptation of water law, regulations, and policy are possible, and in some cases, periodic review is obligatory.



**Figure 5. Map of the Rhine basin (UNEP/DEWA/GRID-Europe, Retrieved 22 August 2007 from [http://www.grid.unep.ch/product/publication/freshwater\\_europe/images/map4.jpg](http://www.grid.unep.ch/product/publication/freshwater_europe/images/map4.jpg)).**

The ICPR policies contain a wide range of small- and large-scale, structural and non-structural measures, and usually have a long time horizon. The planning horizon of the ICPR flood policy (Internationale Kommission zum Schutz des Rheins (IKSR) 1998), for instance, is the year 2020. The national governments usually adjust their national policies to ICPR policies, and implement the agreed measures. Nevertheless, implementation may take a long time. For example, the ambitious goals of the Rhine Action Plan on Floods were not fully realized as planned (IKSR 2001). The implementation of ICPR plans is evaluated on a regular basis, but there are no legal sanctions in case of non-compliance.

The ICPR member states exchange data, cooperate in research, and exchange interests and points of view. National governmental actors participate in the production of information and in the ICPR working groups, and NGOs participate in the working groups as observers.



Uncertainties are usually assessed. Legal obligations to make information accessible have been established at several levels, and the ICPR disseminates a lot of information via its website. The ICPR policies reflect the information that is produced by its working groups, but it can take a long time before information on emerging issues enters national and transboundary policy debates.

The work of the ICPR, as well as the implementation of its policies, is financed out of public resources of the riparian countries. As they also make all the important decisions in the ICPR, decision making and financing are in one hand, and there is no reliance on third parties. At the national level, collective water management issues, such as flood management, are financed mainly from public resources, whereas the costs of water supply and wastewater treatment are to a large extent recovered from the users.



## 5 Discussion and conclusions

We set out to develop and test a framework for assessing the adaptive capacity of transboundary river basin management regimes. This framework hypothesizes what the actor networks, laws, policies, and information management and financing systems in a transboundary river basin should look like in order to support adaptive water management. As mentioned in the introduction, adaptive management could be useful for dealing with complex problems, uncertainty, and change. However, adaptive management may not be necessary in every situation (van Eeten and Roe 2002). Adaptive management involves high costs, including the high transaction costs of the necessary cooperation and integration (Dombrowsky 2007), and the costs and time needed for gathering the necessary technical information (Lee 1999). These high costs may not be justified when dealing with well-structured issues (cf. Johnson 1999), which are characterized by agreement about the goals to be achieved and sufficient technical knowledge. However, many water management issues are not well structured, especially in a transboundary context, and for these issues, adaptive management provides a useful conceptual model for dealing with complexity.

Our framework reflects one specific interpretation of adaptive management that values stakeholder participation and scientific experimentation equally, and combines them into one approach. In our view, the participatory and scientific aspects of adaptive management cannot be strictly separated, because even scientific knowledge is not value free, but influenced by the people involved in producing it (cf. Douglas 2005).

The hypotheses in the framework have not yet been tested in any strict sense. We have assessed the “independent variables,” regime characteristics, but not the “dependent variables,” operational water management. This would require the development of criteria and indicators for adaptive operational management. However, adaptive management as incorporated in the framework, as well as many other interpretations of the concept, leaves room for very different types of operational management. It does not provide complete answers to normative questions about who should adapt, for whom or for what, or how much it may cost. Adaptive management may result in solutions that benefit all interests involved, e.g., nature protection and economy, but often difficult choices remain. In theory, the concept offers little help in making these choices. In practice, however, people using or advocating adaptive management have their own preferences and may make their own, implicit and even subconscious choices. Our own ideal is for adaptive management to promote an open discussion of both the results and the means of river basin management, and to help stakeholders to make their own choices.

Although the framework has not been fully tested, it has been applied to the Rhine and Orange basins in order to test its potential for describing and assessing actual management regimes. This has resulted in a comprehensive description of the two regimes. Moreover, their (hypothetical) support for adaptive management has been assessed, and regime elements that require further development have been identified. The assessment of the regimes has been performed by researchers familiar with the respective areas, and has been checked by other researchers, but it remains to some extent subjective. To reduce this subjectivity, more objectively measurable indicators, e.g., scaled and/or quantitative indicators, for the different criteria should be developed.

The assessment results indicate that the criteria for adaptive regimes have only been partially met in the case study basins. An interesting topic for further research is whether adaptive regimes are feasible. The situation in the Rhine suggests that many elements of an adaptive



river basin regime can be developed. The situation in the Orange basin suggests that not all elements of an adaptive management regime can develop when the general institutional and political context is not ready for it. However, the institutional and political contexts are not static, nor are the management regimes themselves. Regime development in general is a never-ending, long-term process. The development of international agreements usually takes 10 or more years, and sometimes even 100 years (Mostert 2005). Regime developments could be analyzed using collaboration theory (Gray 1989), focusing on the role of individuals (e.g., Majone 1989; Saleth and Dinar 2004) or on group processes (e.g., Ostrom 1990). Better insight into the order and time scale of regime development is needed to support the transition toward adaptive management regimes and to identify leverage points. For this purpose, detailed case studies of regime development over time, and more theoretical work on regime development, should be undertaken, each informing the other (Conca, Wu et al. 2006). The influence of contextual factors that could block or enable the functioning and formation of adaptive regimes, such as the distribution of power, costs, and benefits over the upstream and downstream countries, also needs additional attention.

#### *Discussion of recent applications of the framework*

After publication of this article, the presented conceptual framework has been applied by multiple researchers in the NeWater project, as an analytical framework for scientific analysis and as a normative framework for discussion with policymakers in the case study basins. These applications demonstrated that the developed framework is useful for scientific and for supporting management discussions. Furthermore, the applications of the framework provided an additional indication that the framework correctly describes a regime that supports adaptive management, although some elements of an adaptive management regime may be lacking or may not be described in sufficient detail. Therefore, we recommend to further explore the potential of the framework for assessing and improving regimes, under consideration of the suggested additions and refinements.

Huntjes et al (2008) took up the challenge to develop the framework further and to apply it for further comparative analysis. They aimed to relate characteristics of management regimes to policy learning about climate adaptation strategies. They used the adapted framework to assess the management regime in eight specific case-study areas in Europe, Asia and Africa. In addition, they assessed whether the adaptation strategies to deal with the impacts of climate change on floods and droughts reflected different levels of learning (single loop, double loop and triple loop learning). They added the categories agency, governance, awareness raising and education, risk management, and effectiveness of (international) regulation to the five regime elements that we used to describe a management regime in this article. The added categories can be seen as sub-categories of the five elements that we already captured in our framework, which receive more emphasis in the framework of Huntjens et al. Furthermore, Huntjens et al developed criteria and indicators for the added categories and adjusted some of the criteria and indicators in the original framework. Also, by developing a standardized interview (or questionnaire) and by using a formal technique, multi value qualitative comparative analysis, to find relations between the management regime and the levels of learning Huntjens et al improved the methodology for assessing regimes. Data for the assessment were obtained through 81 interviews with a broad range of stakeholders and analysis of documents on water policies and other project plans.

The results of the assessment suggest that there is a strong interdependence of the elements within a water management regime, and as such this interdependence is a stabilizing factor in current management regimes. For example, a lack of joint/participative knowledge production is an important obstacle for cooperation. Furthermore, the results suggest that, for large-scale, complex multiple-use systems, such as river basins, bottom-up governance and decentralization are not straightforward solutions. There will probably always be the need for



a certain degree of top-down governance (or centralization), for example in the area of transboundary issues, capacity building, setting of standards and conflict resolution. All the case-studies seem to be in a process of finding a balance between bottom-up and top-down governance. Nevertheless, Huntjens et al conclude that management regimes characterized by a high level of top-down governance are dominated by lower levels of learning (= single loop learning, or ad-hoc problem solving), reflected in less advanced adaptation strategies. Furthermore, analysis of the relation between regime characteristics and the levels of learning suggest that better integrated cooperation structures (including non-governmental stakeholders, governments from different sectors and different hierarchical levels), and advanced information management (including joint/participative information production, consideration of uncertainties, and broad communication) are the key factors leading towards higher levels of learning.

Furthermore, one of the authors this deliverable (Kranz) discussed the conceptual framework during her case study work in the Orange basin, with stakeholders involved in addressing tasks at the transboundary level within the framework of the international basin commission ORASECOM (Orange-Senqu Commission). Specific focus was placed on the set-up of the framework at the transboundary level. Participants stressed that in the case of the ORASECOM, the Commissioners and thus the riparian countries hold the main responsibility for any decision taken, while the secretariat of ORASECOM mostly fulfilled administrative functions. The commission discussed the possibility to derive key governance indicators based on the framework, in order to support the continual assessment and improvement of the transboundary regime in the Orange basin. Possible additions and refinements to the categories in the original conceptual framework included:

- Relevance of the political process: What is the political connection of the ORASECOM to the decision makers in the riparian countries? What are previous international experiences one can build upon? To what extent are decisions based on a democratic consensus? Are decisions based on the paradigm of sustainable development?
- Benefit-sharing: Is there a mechanism established in order to conceptualize and realize benefit-sharing?
- Effectiveness of funding: Does reporting on funding take place? What governance framework exists in order to coordinate donor activities?
- Workable representation: Are all levels of society represented? What skill level is required in order to have access to participative processes? Is there a gender-balance in the representation?
- Legal System: Is there enough capacity in the riparian countries as well as at the international level to implement legislation / international agreements?
- Excellence in planning: Are there quality control mechanisms established in order to assure long-term planning at the transboundary level and are these coordinated with planning cycles in the riparian countries?
- Information management: How is quality assured for the information used in decision-making processes?

In a second step, the framework was applied in order to assess the status of preparedness of ORASECOM to address the challenge of climate change at the transboundary level. The categories of the framework were applied to identify follow-up steps for integrating climate change as an integral element of policy at the transboundary level. ORASECOM is currently in the process of issuing project tenders to improve its information base on climate-related impacts on water management in the Orange. Furthermore, ORASECOM will investigate which changes to the governance framework at the international level are required.



The preparedness to address the challenge of climate change was also discussed with actors from the national water management administration in South Africa, as the dominating riparian. Discussions about the framework resulted in a better understanding of the coordinative challenges inherent to identifying a common approach and policy to climate change across the entire basin. Currently, the riparian countries are in the process of identifying their own climate change adaptation strategies. Coordination at the scale of the Orange has not yet taken place.

Finally, another author of this deliverable (Interwies) presented the article at two conferences, named 'Transboundary Dnieper River Basin Management and the EU-WFD' (Chisinau, 2008) and 'Fourth International Symposium on Transboundary Water Management' (Thessaloniki, 2008). Participants to these conferences were both scientists and water managers. The framework and the 'overall philosophy' of adaptive management were received well. The conference participants recognized the idea of 'not knowing everything', and were interested in how to deal with this in water management. Furthermore, the conference participants were interested in a further development of the framework. More specifically, they discussed the criterion 'adaptable legislation', which is part of the regime element 'legal framework'. The participants feared that such a flexibility regarding the legal situation is risky and can be misused. Therefore, they suggested specifying this criterion.



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