



World Water Council
World Water Forum



Perspectives on water and climate change adaptation

Adapting to climate change in transboundary water management



This Perspective Document is part of a series of 16 papers on «Water and Climate Change Adaptation»

‘Climate change and adaptation’ is a central topic on the 5th World Water Forum. It is the lead theme for the political and thematic processes, the topic of a High Level Panel session, and a focus in several documents and sessions of the regional processes.

To provide background and depth to the political process, thematic sessions and the regions, and to ensure that viewpoints of a variety of stakeholders are shared, dozens of experts were invited on a voluntary basis to provide their perspective on critical issues relating to climate change and water in the form of a Perspective Document.

Led by a consortium comprising the Co-operative Programme on Water and Climate (CPWC), the International Water Association (IWA), IUCN and the World Water Council, the initiative resulted in this series comprising 16 perspectives on water, climate change and adaptation.

Participants were invited to contribute perspectives from three categories:

- 1 **Hot spots** – These papers are mainly concerned with specific locations where climate change effects are felt or will be felt within the next years and where urgent action is needed within the water sector. The hotspots selected are: Mountains (number 1), Small islands (3), Arid regions (9) and ‘Deltas and coastal cities’ (13).
- 2 **Sub-sectoral perspectives** – Specific papers were prepared from a water-user perspective taking into account the impacts on the sub-sector and describing how the sub-sector can deal with the issues. The sectors selected are: Environment (2), Food (5), ‘Water supply and sanitation: the urban poor’ (7), Business (8), Water industry (10), Energy (12) and ‘Water supply and sanitation’ (14).
- 3 **Enabling mechanisms** – These documents provide an overview of enabling mechanisms that make adaptation possible. The mechanisms selected are: Planning (4), Governance (6), Finance (11), Engineering (15) and ‘Integrated Water Resources Management (IWRM) and Strategic Environmental Assessment (SEA)’ (16).

The consortium has performed an interim analysis of all Perspective Documents and has synthesized the initial results in a working paper – presenting an introduction to and summaries of the Perspective Documents and key messages resembling each of the 16 perspectives – which will be presented and discussed during the 5th World Water Forum in Istanbul. The discussions in Istanbul are expected to provide feedback and come up with suggestions for further development of the working paper as well as the Perspective Documents. It is expected that after the Forum all documents will be revised and peer-reviewed before being published.

Adapting to climate change in transboundary water management

Jos G. Timmerman, RWS Centre for Water Management, P.O. Box 17, NL-8200 AA Lelystad, The Netherlands, jos.timmerman@rws.nl.

Francesca Bernardini, Convention on the Protection and Use of Transboundary Watercourses and International Lakes, United Nations Economic Commission for Europe, Palais des Nations, 8–14 Avenue de la Paix, 1211 Geneva 10, Switzerland

Adapting to climate change in transboundary water management

A large part of the world's freshwater resources is contained in river basins and groundwater systems that are shared by two or more countries. As climate change is expected to raise the number of extreme situations of flooding and drought, both in frequency and in duration, transboundary management of these water resources becomes more essential to reduce the impact of these extremes.

Transboundary water management is in essence more complex than national and sub-national water management because the water management regime (the principles, rules and procedures that steer water management) usually differ more between countries than within countries. Transboundary water management therefore requires coordination over different political, legal and institutional settings as well as over different information management approaches and financial arrangements. Joint bodies are usually instrumental in achieving such coordination. Next to that, riparian countries should look for commonalities in the water management problems they face and should look for solutions that are mutually beneficial.

The UNECE Convention of the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) provides a common legal basis for countries to cooperate. The Water Convention is based on equality and reciprocity between countries. Its provisions offer the basis upon which countries can build their activities. The implementation programme under the Water Convention supplements those provisions by offering a range of guidelines for practical implementation as well as good practices. Under the Water Convention, the Protocol on Water and Health is established that aims to protect human health and well-being by improving water management, and preventing, controlling and reducing water-related disease. The Protocol on Water and Health is an important tool to address climate change impacts, in particular the impacts on human health caused by the effects of climate change on water resources and water services, such as water supply and sanitation.

In view of the expected impacts of climate change on water management, currently a Guidance on Water and Climate Adaptation is developed, to be

finalised by the end of 2009. The objective of the Guidance is to support cooperation and decision-making in transboundary basins on a range of relevant or emerging issues related to climate change. For this purpose, the Guidance addresses adaptation to possible impacts of climate change on flood and drought occurrences, water quality and health related aspects as well as practical ways to cope with the transboundary impacts through, inter alia, integrated management of surface and groundwater for flood and drought mitigation and response. An important aspect of the Guidance is recognition of potential benefits of floods such as increased water availability and improved ecological status of floodplains. The Guidance illustrates steps and adaptation measures that are needed in order to develop a climate-proof water strategy, starting from the transboundary context. It focuses on the additional new challenges for water management deriving from climate change: what are the impacts of climate change on water management planning and how should this planning be modified to adapt to climate change.

The Guidance addresses the central elements of transboundary regimes; policy setting, legal setting, the institutional setting, information management, and financing systems and provides recommendations to incorporate and accommodate them. The Guidance also distinguishes 5 different types of measures to adapt water management to climate change that together form the so-called safety chain; prevention measures, measures to improve resilience, preparation measures, response measures, and recovery measures.

The Guidance aims at encourage mutual understanding between, and within, countries as well as between scientists and decision-makers. This understanding is best built through intensive cooperation. Moreover, by jointly working towards climate adap-

tation, riparian countries can achieve cost-effectiveness because measures can be implemented where they are most effective, irrespective of the national boundaries. The Guidance provides a structured approach towards developing such measures.

Nevertheless, in all the work towards adaptation to climate change, the major challenge for politicians is to have a vision of how to implement the ideas, as well as the courage to withstand criticism and to share power with other actors.

Introduction

Observational evidence from all continents and most oceans shows that many natural systems are being affected by anthropogenic climate changes. One of those affected systems is the hydrological cycle which encompasses water availability and water quality as well as water services (IPCC, 2007). Adaptation to climate change is, consequently, of urgent importance. The impacts will certainly vary considerably from region to region and even from basin to basin. This poses serious challenges for water resources management.

A particular challenge for water resources management is connected to the fact that many river basins and groundwater systems are transboundary; i.e. the basin is shared by two or more countries. Recent studies identify a total of 279 international river basins (Bakker, 2006), covering almost half of the world's total land surface (Wolf et al., 1999).

Similarly, there are also internationally shared groundwater resources hidden beneath the ground surface around the world. Two UNECE surveys of Europe have indicated that there are some 200 transboundary aquifers in the UNECE region alone (Almássy and Buzás, 1999) and an overview of internationally shared aquifers in Northern Africa shows that these aquifers underlie a substantial part of the land surface (Puri et al., 2001). A study done by UNESCO has identified 273 shared aquifers worldwide¹.

The amount of water resources, both surface and subsurface, shared by two or more countries is con-

sequently substantial. This makes transboundary water resources management one of the most important water issues today.

Freshwater supplies are limited. Increasing water scarcity and depletion of natural resources, partly as a consequence of climate change, leads to a potential increase in water conflicts between countries that share transboundary waters (Yoffe et al., 2004). This water scarcity is, however, caused not only by natural processes but also by inadequate and inefficient water management and competition between water uses (Wester and Warner, 2002).

But water scarcity is not the only problem confronting neighbours who share transboundary waters. A recent study on floods in a transboundary context concluded that although only 10 percent of all river floods are transboundary, these floods represent a considerable amount of the total number of casualties, displaced/affected individuals and financial damages worldwide (Bakker, 2006). The situation is compounded by the inherent difficulties in managing floods that cross borders.

From the above it follows that where water resources management is complex, water management in a transboundary situation is even more complicated, in particular when this management has to account for the consequences of climate change. Given the abundance of water resources that are shared between countries, transboundary water management is an essential element to consider in sustainable water resources management and adaptation to climate change worldwide.

This paper addresses adaptation to climate change in transboundary water resources management. It discusses the theoretical background of transboundary water management and describes the UNECE Guidance on Water and Climate Adaptation as an important tool to guide countries in putting water adaptation to climate change into practice. The Guidance is currently under development within the framework of the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention).

Water management regimes

Water management is based on certain (implicit or explicit) principles, rules and decision-making procedures that enable convergence of stakeholders'

¹ World-wide Hydrological Mapping and Assessment Programme (WHYMAP).
<http://typo38.unesco.org/en/about-ihp/associated-programmes/whymap.html>

expectations. Such a set of principles, rules and procedures is called a regime. Transboundary water regimes usually include formal rules such as international water conventions, statutes of transboundary water commissions, cooperative agreements adopted by national governments aimed at coordinating national water management activities in transboundary water basins, and relevant national laws and procedures. Regimes also include informal rules such as, traditional ways of using natural resources (traditional ways of transport or fishing, for example) that are informally accepted in transboundary water basins but are not documented as formal norms in agreements or contracts (Roll et al., 2008). Prevention and resolution of (potential) conflicts between water uses in riparian countries, and avoidance of severe effects of floodings, droughts, accidents, etc., especially in transboundary waters, compels countries sharing a water resource to reach agreement on common rules and procedures of cooperation to jointly manage these water resources (Nilsson, 2006). This cooperation is a component of the overarching term 'water governance' which depicts a change in thinking about the nature of policies. The notion of government as the single decision making authority has thus been replaced by a more contemporary, multi-scale, polycentric governance. Governance takes into account that a large number of stakeholders in different institutional settings contribute to policy and management of a resource. Governance differs from the old hierarchical model of government in which state authorities exert sovereign control over the people and groups making up civil society. Governance includes the increasing importance of basically non-hierarchical modes of governing, where non-state actors (formal organisations like NGOs, private companies, consumer associations, etc.) participate in the formulation and implementation of public policy. Governance thus encompasses a broad range of processes related to the coordination and steering of a wide range of stakeholders by formal and informal institutions. The water management regime is consequently a pivoting point in achieving a well organised water governance system which supports adaptive management of water resources (Timmerman et al., 2008).

Where water is sometimes used as a tool and argument for conflict, shared waters can also be a source of cooperation. In fact, initiatives aiming at river basin management regimes and institutions

committed to bilateral and/or multilateral cooperation regarding transboundary water resources prevail (UNEP, 2002). Such cooperation often starts with exchanging information between countries. Over time, cooperation may come to pass on different water management issues like joint projects and even joint planning (Enderlein, 1999). It should be noted, however, that while many initiatives are in place to jointly manage surface water resources, the same cannot be said about transboundary aquifers which are usually less developed. By its nature, the beneficial use of groundwater is more particularly subject to socio-economic, institutional, legal, cultural, ethical and policy considerations than surface water (Puri et al., 2001). Its national development nevertheless seems to be hampered by weak social and institutional capacity, and poor legal and policy frameworks. In a transboundary context, this can be even further amplified because of contrasting levels of knowledge, capacities and institutional frameworks on either side of many international boundaries.

Thus far, different elements of management and use of water resources have been mentioned. These elements are structured here into five central elements that describe transboundary regimes: policy setting, legal setting, the institutional setting including the actor networks, information management, and financing systems (Anonymous, 2001; Raadgever et al., 2008).

Water policies that are in place in a country can be found in the formal documents which contain current and future water management strategies. They refer to the goals of government, or other organizations and strategies to reach those goals. As policies have a strategic character, especially in view of climate change, they should have a long-term time horizon: current management should actively prepare for future changes. Policy strategies should fulfil current needs and have the ability to perform well in multiple possible futures. Because today's information is not sufficient to identify all possible futures, strategies should be flexible and keep as many options open as possible (Raadgever et al., 2006). To promote effective implementation, policies should be tailored toward the specific interests and resources of the involved parties. From the perspective of adaptation to climate change in water management, policies become hypotheses and the consequent management actions become experiments to test those hypotheses. This requires continuous

monitoring of progress toward achieving policy objectives as well as learning from the results of management actions (Raadgever et al., 2008).

A major challenge in managing transboundary waters is that the waters must be managed in the context of potential inconsistency and conflict of policies when no single government has control. Transboundary water management is faced with the task of solving complicated problems dependent on the specific conditions created by the interaction of two or more political systems (Gooch et al., 2003). As transboundary water management requires dealing with different policies, learning between the stakeholders becomes even more important. Harmonisation of policies is needed to prevent situations in which management actions in one country neutralise or counteract management action in other countries. In such situations, communication and exchange of policies and plans is imperative.

The legal framework consists of the full set of national and international laws and agreements. Legal frameworks can support transboundary water management in various ways. First, law should be complete and clear and contain sufficient detail to offer guidance and support without being too restrictive. A complete water law reflects the principle of integrated water management and includes requirements for public participation and access to information. Furthermore, water laws can establish or influence formal networks, structures for information management and financial aspects of water management. Water management planning and implementation should be based on the existing legal framework and in turn may influence the legal framework. In addition, transboundary legal framework should support enforcement of management policy and include liability aspects as well as dispute settlements provisions. Finally, law should not limit management options but should provide incentives to alter management actions to changing circumstances. This can be achieved by including regulations for (periodical) review and change of laws and regulations including changes in the institutional setting, information management and financial systems (Raadgever et al., 2008).

Water management in literature is currently described in terms of complexity where problems are termed wicked (Rittel and Webber, 1973) or persistent (Van der Brugge et al., 2004). In complex water management issues, a wide range of governmental

and non-governmental stakeholders should be actively involved (Ridder et al., 2005). All stakeholders in this approach should be invited to share and discuss their perspectives in the subsequent stages of the policy process and develop a process of active learning. These interactions can promote constructive conflict resolution which can result in inclusive agreements that the parties are committed to. In addition to formal networks, informal multi-level actor networks can enhance information flow, ensure collaboration across scales and provide for social memory (Raadgever et al., 2006). This participation in transboundary water management can be realised by the establishment of joint bodies responsible for the management of shared waters, either surface or subsurface. These joint bodies should support an interdisciplinary and intersectoral approach, and include stakeholders in their water management planning and implementation strategies (Raadgever et al., 2008).

As stated above, information is needed to develop understanding of the possible futures, but it is also needed to monitor policy progress. This information should be collected based on an understanding of the need for information for policymaking and policy evaluation. Decision-makers should therefore be closely involved in specifying information needs (Timmerman et al., 2000). Moreover, a broad range of governmental and non-governmental stakeholders should therefore be provided with an opportunity to express their perspectives in the decision-making process and should provide sufficient information to support their opinions. They should also be invited to articulate their information needs and influence the production of information. To be truly integrative, information should not only reflect multiple perspectives, but also consider current and future uncertainties. Furthermore, an infrastructure to exchange and discuss data, information, and viewpoints should be developed to support cooperation and participation within, but even more importantly between, countries. Only then can information production and exchange result in the use of information in policy debates, and influence water management decisions (Timmerman and Langaas, 2004). This also requires clear communication about the interpretations and assumptions used to produce the information and critical (self-)reflection by the producers (Ridder et al., 2005). Especially in the transboundary context, information management faces

the challenge of exchanging comparable information of sufficient quality.

Because water management also requires involvement of local communities and local stakeholders, special attention should be given to the information channels used to inform and involve these groups. Communication on the local level often takes place through local newspapers, some of which are distributed free of charge. Next to that, local meetings are important in developing a dialogue with local authorities and inhabitants. The use of Internet is not yet commonplace in many communities but access is growing. Internet is therefore a potentially important vehicle to share information with local entities. (Roll and Timmerman, 2006).

Sufficient resources should be available to ensure sustainable water management. Transboundary river basin management faces 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). Resources for this should come from public as well as private sources. Financial as well as ecological sustainability can be improved by recognising water as an economic good and recovering the costs as much as possible from the users. Cost recovery from the users of the resource is an important funding source which can be directly linked to the intensity of use. This makes the users aware of the consequences of their activities and helps to avoid overexploitation. While water pricing can reduce excessive water use, access to clean water and sanitation should be offered to all humans at an affordable price (GWP-TEC, 2003). The cost of providing affordable public goods can be financed from national taxes. International donors and banks often bear the management costs of negotiating an international treaty, but they may also finance river basin commissions and projects for a longer time, and give loans for specific projects. However, too much dependence on donors and banks makes management vulnerable and not sustainable on the long term. The challenges confronting financing system for 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 outcomes cost money, in the long run they may prevent costly delays and construction

of unnecessary, expensive infrastructure. And financing systems are most robust when they can rely on multiple sources (Raadgever et al., 2008).

Ideally, decision making, financing, and benefiting should be in one hand. This promotes the integral assessment of measures and ensures implementation of agreed-upon measures. It also minimizes the potential for overuse when others pay the bill – literally or metaphorically. A perfect match would be impossible to attain. Consequently, river basin management should not become too complex. Authorities should be able to take loans and depreciate their assets. This facilitates making long-term investments and ensures that assets can be replaced in time (Raadgever et al., 2006).

Assets and limitations in transboundary water management

Several factors exist that will support or hinder cooperation between countries in transboundary water management. First, the characteristics of a given problem will influence the likelihood of successful cooperation; if the cooperation incentives are largely symmetric and the problem pressure is high, the prospects for effective cooperation are good. Second, cooperation between countries in collecting data and performing joint projects builds trust at the technical level and enhances cooperation on political levels. Thirdly, a clear institutional setting that is problem-oriented, flexible and equipped with a centralised organisation structure enhances cooperation. Joint bodies can be instrumental in this regard. Economic-technological capacities in the national water sectors as well as political stability are important factors for the development of joint water management. Finally, international context is essential: if bilateral relations characterised by mutual trust and cooperation, exist, effective transboundary water management will be possible (Lindemann, 2006).

Transboundary water management nevertheless heavily depends upon circumstances at the national level. Weak social and institutional capacity, poor legal and policy frameworks, and bad management practices bear great consequences in the transboundary context where they are even more amplified by differences between riparian countries. Improving transboundary cooperation is therefore enhanced by promoting development and implementation of

(formal or informal) transboundary agreements, accounting for different political and cultural settings in the riparian countries, and involving major stakeholders (different national government bodies, regional and local governments, international governments and donors, the media, civic society, individual water users and/ or influential individuals) to maximise the likelihood of agreement (Mostert and Barraqué, 2006). It is clear, however, that the method of achieving this goal is context-specific – there is no single template that can be applied to all situations.

The UNECE Water Convention and its implementation

The Convention of the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) that was done at Helsinki on 17 March 1992 is intended to strengthen national measures for the protection and ecologically-sound management of transboundary surface waters and groundwaters. Even if the Water Convention does not explicitly mention climate change, it represents one of the most essential legal frameworks in the UNECE region to cooperate on the transboundary aspects of climate change and on the development of adaptation strategies. Many of its provisions provide present the basis for such cooperation. In the first place, the Water Convention obliges Parties to prevent, control and reduce transboundary impacts which includes those related to adaptation to (or mitigation of) climate change. In fact, adaptation measures, such as the construction of dams and reservoirs, should be designed and managed to avoid negative transboundary impacts and to generate the best possible benefit for the whole river basin. Therefore, their development requires consultation between the riparian countries, as demanded by the Water Convention. Moreover, water quality objectives shall be set and best available technology used. Parties are required to follow the precautionary principle which implies, in the case of climate change, that action be taken even before adverse impacts are fully scientifically proven. This principle is especially important in climate change adaptation as high uncertainties exist regarding the exact impact on water and other ecosystems.

The Convention also includes provisions for exchange of information, common research and development, and joint monitoring and assessment: thus providing a framework for riparian countries to cooperate in the development of adaptation strategies. According to article 2 of the Water Convention, riparian Parties should cooperate on the basis of equality and reciprocity, in particular through bilateral and multilateral agreements, to develop harmonized policies, programmes and strategies for transboundary basins.

In addition, Parties should establish early warning systems and mutually assist each other. Finally, one of the most important provisions of the Convention is the establishment of joint bodies, such as river commissions, to jointly manage the shared water resources. These joint bodies are the most appropriate framework where integrated adaptation strategies, addressing all main environmental, social and economic impacts of climate change, should be designed and implemented. The Water Convention thus sets the provisions to develop and implement the elements of a transboundary water management regime as described above.

Under the Water Convention, the Protocol on Water and Health aims to protect human health and well-being through improvements in water management, and through implementation of processes to prevent, control and reduce water-related disease. The Protocol is the first international agreement of its kind adopted specifically to attain an adequate supply of safe drinking water and adequate sanitation for everyone, and effectively protect water used as a source of drinking water. To meet its goals, the Parties to the Protocol are required to establish national and local targets for the quality of drinking water and the quality of discharges, as well as for the performance of water supply and waste-water treatment. The Parties are also required to reduce outbreaks and the incidence of water-related diseases. Thus, the Protocol on Water and Health is an important tool to address climate change impacts, in particular the impacts on water resources and water services, such as water supply and sanitation, which affect human health. In fact, the process of setting targets and target dates in the areas of access to water and sanitation, health protection, and environmental and water management, as required by the Protocol, will be a useful tool to account for, and adapt to, the

impact of climate change on water resources and water services.

The implementation process of the Water Convention and its Protocol on Water and Health is ongoing. An extensive knowledge base is built through the development of guidelines and recommendations on several aspects of transboundary water management. These guiding documents are supported by studies and pilot projects. Important examples are the Guidelines on Sustainable Flood Prevention (UNECE, 2000), Strategies on Monitoring and Assessment of Transboundary Rivers, Lakes and Groundwaters (UNECE, 2006), as well as the Recommendations on payments for ecosystem services (UNECE, 2007b) which all describe approaches to implement policies and activities on the respective subjects. These documents aim at providing practical approaches towards implementation of the Convention's provisions on different aspects of transboundary water management. This knowledge base under the Water Convention provides countries with common approaches that do not need to be further negotiated. The focus can therefore turn to the practical implementation of the recommendations as documented.

Guidance on Water and Climate Adaptation

In 2006, the Task Force on Water and Climate was established under the Water Convention. This Task Force is entrusted with the development of a Guidance on Water and Climate Adaptation to be submitted to the Parties to the Water Convention in November 2009, for their possible adoption. The objective of the Guidance is to support cooperation and decision-making in transboundary basins on a range of relevant or emerging issues related to climate change. For this purpose, the Guidance addresses adaptation to possible impacts of climate change on flood and drought occurrences, water quality and health related aspects. It also addresses practical ways to cope with transboundary impacts through, inter alia, integrated surface and groundwater management for flood and drought mitigation and response. The Guidance acknowledges the beneficial aspects of floods including increased water availability and improved ecological status of waters (UNECE/WHO, 2008).

The Guidance utilizes the existing knowledge base as developed under the Water Convention and describes the stepwise approach towards climate proofing of transboundary water management. The work on the Guidance builds on the experiences from many national experts and experts from international organizations. It also builds on a questionnaire that was sent out in early 2008 to identify expected impacts of climate change on water resources as well as the adaptation measures planned or implemented in South-Eastern Europe, Eastern Europe, Caucasus and Central Asia. Moreover, the work on the Guidance builds on the outcomes of an international workshop that was held in Amsterdam on 1–2 July 2008 to discuss the first draft of the guidance document. Thus, the contents of the Guidance are ensured to reflect the state of the art in climate change adaptation, support the existing challenges that countries face and, through its comprehensive and integrative character, add to the existing water management practices.

The Guidance illustrates steps and adaptation measures that are needed to develop a climate-proof water strategy, starting from the transboundary context. It focuses on the additional new challenges for water management deriving from climate change: what are the impacts of climate change on water management planning and how should this planning be modified to adapt to climate change? Moreover, the Guidance promotes the integration of specific water management aspects in general national adaptation strategies.

The document begins from a transboundary context, but is intended to be relevant to national policy and planning strategies and to be based on measures developed for national purpose. The major target group for the document is decision makers and water managers, including those responsible for water management in the transboundary context. It will therefore primarily address issues relevant to the water management sector.

The Guidance is a roadmap towards climate proofing of water management which will focus on adaptation or coping options. The document follows a step-wise approach (Figure 1), which forms the basic structure of the document. The guidance thus addresses the five central elements of transboundary regimes: policy setting, legal setting, institutional setting, information management, and financing systems. The policy, legal and institutional settings

form a triangle and influence each other. Their interrelationships should be such that they create an enabling environment in which adaptation to climate change can be shaped. Whereas there is a general tendency to consider climate change as a self-standing issue – as was also shown by the survey questionnaire distributed by the Task Force – the Guidance promotes the integration of climate change adaptation into water management. Climate change can thus act as an important driver to improve water management strategies. In the Guidance, climate change information is the basic element upon which the vulnerability of communities in a basin is assessed. The criteria to determine vulnerability are subjective and politically sensitive. Therefore, meticulous consideration of the information needs is required because it steers the outcomes of the vulnerability assessment. Additionally, this information is needed to evaluate the effectiveness of measures as well as reflect upon the validity of the policy base under changing circumstances.

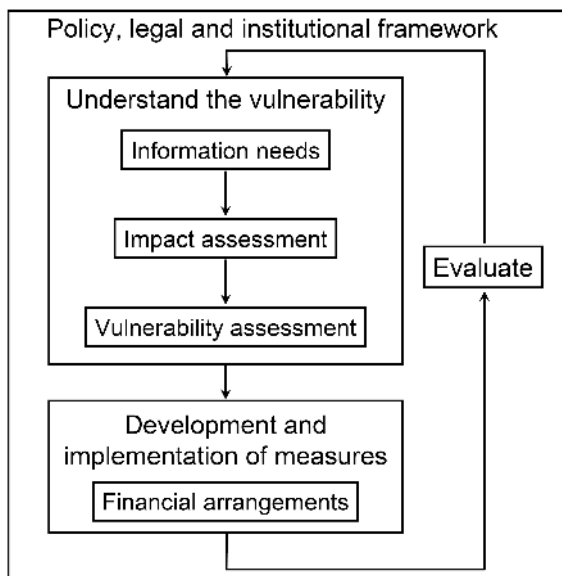


Figure 1: Development of an adaptation strategy.
(UNECE/WHO, 2008)

Regarding the financial arrangements, riparian countries should focus on generating basin-wide benefits and on sharing those benefits in a manner that is agreed to be fair. A focus on sharing the benefits derived from the use of water, rather than the allocation of water itself, provides far greater scope for identifying mutually beneficial cooperative actions. Payments for benefits (or compensation for costs) might be made in the context of cooperative

arrangements. Riparian countries can be compensated, for example, for land flooding as a consequence of water impoundment by another riparian. In some instances, it might be appropriate to make payments to an upstream country for management practices of the basin that bring benefits downstream (e.g. reduced flooding and sediment loads or improved water quality). This solidarity in the basin might entitle upstream countries to share some portion of the downstream benefits that their practices generate, and thus share the costs of these practices (Bernardini, 2007).

To enable climate proofing of water management, the guidance distinguishes 5 different types of measures that together form the so-called safety chain: prevention measures, measures to improve resilience, preparation measures, response measures, and recovery measures (see figure 2). All such measures are generally based on risk, hazard and vulnerability maps under different scenarios. Prevention measures are measures taken to prevent the negative effects of the climate change and climate variability on water resources management. This includes mitigation measures, designed to reduce the change in climate. Measures to improve resilience are those designed to reduce the negative effects of climate change and climate variability on water resources management by improving the coping capacity. Preparation measures are measures designed to reduce the negative effects of extreme events on water resources management. Response measures are those designed to alleviate the direct negative effects in the aftermath of extreme events. Recovery measures aim at restoring the societal system after an extreme event has taken place. Recovery measures include, for instance, reconstruction of infrastructure.

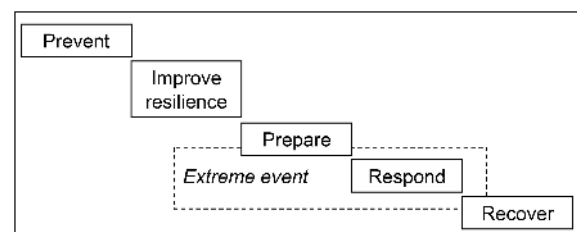


Figure 2: Different types of measures: the safety chain.
(UNECE/WHO, 2008)

Application of the Guidance

The Guidance is an important building block in the implementation of the UNECE Water Convention. It is expected that the Meeting of the Parties to the Water Convention will assist countries in applying the Guidance in development of their water management regime. Also, the Meeting of the Parties will promote application of the Guidance by assisting in the establishment of pilot projects under existing programmes as well as encouraging application of the Guidance in capacity building programmes.

Pilot projects are especially important because they illustrate how transboundary cooperation can grow. In initiating a pilot project, riparian countries must show their willingness to engage in dialogue and cooperation with other riparian countries. The size of this step is limited because it concerns a pilot project supported by international regulations. Performing a pilot project enables countries to collaborate on a working level that only at a later stage feeds into decision-making. As a result, in the longer term, the Guidance will support the revision of formal cooperation arrangements (such as bilateral and multilateral agreements, mandates and actions of joint bodies) to include adaptation to climate change.

Reflection upon the key questions

How can the gap between available knowledge and concrete decision-making be closed?

One of the essential elements in narrowing the gap between the available knowledge and concrete decision-making is creation of mutual understanding. Scientists need to share knowledge between different areas (e.g. hydrology and climatology). They also need to connect to the problems decision-makers are facing. They should, for instance, not try to explain what the models they use are capable of doing but rather explain why their predictions give a range of possible futures. Decision-makers on the other hand should try to connect to the limitations of science. They should, for instance, not expect an unequivocal answer but rather be satisfied with a limited range of possibilities. A one-time meeting between scientists and decision-makers will not achieve mutual understanding – it will require intensive cooperation

between the groups (Timmerman and Langaas, 2004).

In a transboundary context, the situation can become more complex as there may be differences between the available knowledge between countries. Countries usually use different techniques, approaches and models for their water management, which may result in different assessments of river basins and groundwater aquifers (Almássy and Buzás, 1999; UNECE, 2007a). This requires riparian countries to exchange information and come to agreements on the characteristics and forecasts of the waters they share upon which joint water management strategies can be built. All this depends on the willingness of actors to invest in improved understanding of the mutual differences as well as commonalities.

Where will climate change hit water resources and water services the hardest?

Given the differences in assessments between countries and the increased difficulty for countries to jointly manage their shared waters, impacts of climate change may hit water resources hardest in transboundary water management situations. The study of Bakker (2006) mentioned earlier showed that transboundary river floods, which only include 10% of the total number of worldwide floods in the period 1985–2005, are more severe in their magnitude and account for 32% of all casualties, almost 60% of all affected individuals and 14% of all financial damage. The study revealed that the institutional capacity in transboundary river basins is low and, even where joint bodies are in place, only few of these deal with transboundary flooding. The lack of transboundary cooperation in water resources management is consequently likely to aggravate the climate change impacts. Clearly, the need to establish joint bodies is imperative. Moreover, joint bodies should be mandated to deal with all aspects of transboundary water management.

How can climate change be drawn on to positively shape sector development?

Water related sectors, especially those that rely on large amounts of water, can be expected to face more

severe problems as a result of climate change impacts. This will require them to reconsider their current practices and improve them. The need for reconsideration alone can be considered an opportunity to improve sectors' performance. Moreover, climate change not only poses threats to water-related sectors, but may also include tendencies that can be advantageous to sectors, like protracted growing seasons or improved weather conditions for tourism. And the development of new technologies and approaches may become unique selling points for which a potentially global market is available. Climate change thus opens the need for sectors to critically review and adapt. In the transboundary context, climate change might be an incentive to find cooperative arrangements which benefit the whole basin, such as joint water conservation projects, joint flood protection management strategies and infrastructures.

Where and when to put your money and what is required to get money committed?

The Stern report clearly declares that it is important that action should be taken as soon as possible because delay will surely result in increased costs (Stern, 2007). This not only relates to mitigation but also to adaptation. The money, however, should be wisely spent. To determine the best options for taking measures, a vulnerability assessment should be performed to identify the most vulnerable areas. Planning of measures should target these most vulnerable areas. In a transboundary context, measures that support adaptation in one country might be more effective if they are implemented in another country. Prevention of flooding, for instance, might be realized by creating retention areas upstream and such areas may be located in an upstream country. Financing should be equitably shared, where the party that gains most, pays most.

As riparian countries may have different approaches towards developing adaptation measures, a common understanding of the situation between the countries and a common approach is needed. Existing international agreements provide directions in this respect and the Guidance will be supportive in developing measures that are not only effective in one country but will also benefit others. The Guidance, for instance, states that in general,

costs of implementation of adaptation measures should be borne by each country and governments should make efforts to include budgets and economic incentives in relevant bilateral and multilateral programs (UNECE/WHO, 2008). The poorest countries, that are often also most vulnerable to climate change, should be supported by more affluent countries in their development towards climate proofing of water management.

How can you identify and prioritize adaptation measures for climate change in the water sector and how can you design a portfolio of adaptation measures?

As stated above, identification and prioritisation of adaptation measures should be based on a vulnerability assessment. The Guidance provides a structure and in-depth advice on how a vulnerability assessment can be accomplished. It provides an overview of the various steps to perform to arrive at a portfolio of measures, starting from a policy, legal and institutional setting which provides an enabling environment wherein the vulnerability in a basin can be understood. The vulnerability assessment is based on the collection of relevant information and an overview of possible impacts. From this, measures can be defined in which the financial arrangements are essential. Finally, continuous evaluation is needed to ensure progress towards the objectives and to define additional measures if progress is not sufficiently realised.

Reflection upon the Political Principles

The global society is not a static one. Developments in Asia, for instance, lead to changes in demands for food and fuels. The price of oil is rocketing and the use of bio-fuels holds greater prospects, which in turn interferes with food production. Such developments have large implications for water management. The concept, for instance, of virtual water / water footprint (Hoekstra and Chapagain, 2007) tries to capture these implications by enabling comparison of such non-equivalent entities. Consequently, water management faces many challenges, among which climate change is an important one. But climate change adaptation should not be considered separately from other pressures and water manage-

ment measures. Climate proofing of existing water supply systems can, for instance, be done in combination with ensuring the basic human right to water to those that do not enjoy that right at present. The adaptation responses should be considered in the context of integrated water resource management (IWRM) on the basis of the river basin. In the case of a transboundary basin, this should be done in joint agreement between the riparian countries. Adaptation measures should include aspects such as spatial planning, water quality, regulatory and operational measures, capacity-building, financial instruments, awareness building and involvement of the public. In the transboundary context this also includes solidarity between countries.

As adaptation is part of overall water management, the MDGs (Millennium Development Goals) should also be considered in the context of climate change. Climate change and climate variability can be hampering factors in achieving the MDGs. Climate change should not be used as an excuse under which hides bad water management. As stated above, improving water management should take into account climate change. The added attention to climate change can be an important element in improving water management and thereby help in achieving the MDGs. It is, nevertheless, indispensable to take into account that water management is frequently a transboundary issue and countries should be willing to join forces to achieve the MDGs.

The principles of IWRM, if well-implemented, can be very supportive in adaptation to climate change. IWRM includes the water sectors in its approach and water sectors should adopt these principles. Water sectors rely on the availability of water resources but should be aware of their responsibility for these water resources as well. As climate change and climate variability affect the availability of water resources, water management and water use can no longer be driven by the demand for water resources (Allan, 2008). On the contrary, water demand should adapt to the possibilities for supplying water. This does not exclude the necessity to improve and safeguard the availability of water resources. Adaptation measures should therefore be explored that not only cover the water sector, but also include sustainable land management, both on the national and transboundary level.

In part, water and energy are two sides of the climate change issue. Water can be an important pro-

ducer of energy (for instance, hydropower) but can also be an important consumer of energy (for instance, desalinisation or pumping). Energy, on the other hand, is an important driver for climate change and thus complicates water management. Energy production and use also affects the aquatic community through infrastructure development and warming of water. Energy is nevertheless also necessary for adaptation solutions. The challenges for the water sector and the energy sector are therefore to find solutions that minimise the negative effects and maximise the possibilities.

The strategies to make water management climate-proof as developed in the political principles include: a) increase of storage space; b) increased and sustainable use of groundwater; c) revitalization of inland navigation; and d) more intensive use of hydropower potential. These strategies are generic and target many of the measures needed. They do not, however, account for additional, alternative options that may be needed at different levels. One essential strategy that is not included is management of water demand. Water use is often not efficient and is frequently wasteful, usually because the incentives to use water efficiently are not in place. In a transboundary water management situation, the upstream country often has control of the volume of water discharged to the downstream country. Using water inefficiently in the upstream country can result in water shortages in the downstream country. The strategies to make water management climate-proof should therefore also include water demand management on a basin scale.

Adaptation to climate change includes capacity building at all levels. Adaptation should be done in a participative way and this can only be achieved if all stakeholders involved have sufficient knowledge of the circumstances and the methods and tools that are used to develop possible futures. Moreover, they should have the available information at their disposal. Especially in transboundary water management situations, information is not always shared between countries. Moreover, information is sometimes collected and reported only because of the legal obligation to do so, without consideration of its actual applicability. Information can also be considered a hideout or safeguard where collecting information provides a sense of doing much useful work without actually having to implement solutions. Through this approach, information can be used to

postpone decisions. Evidence of climate change occurring is, however, conclusive. Postponing adaptation measures because the information is insufficient to prove beyond a reasonable doubt that change is occurring cannot be an option. Information can also be used as a 'weapon', by using it to direct blame at other parties and to validate claims that it is the other party who is polluting the water or causing floodings. Information is, in this sense, also used to direct decision-making. Information that supports the desired outcomes will be put to the fore, while information that counters the desired outcomes will be discarded. Ideally however, information is used to support decision-making; the available information is the basis for the decision taken, it guides and supports the decisions (Timmerman and Langaas, 2004). The latter use of information is the preferred one, as this supports the necessary participative approach towards adaptation. It nonetheless requires that information collection be tailored to the needs of the stakeholders, at local, regional, national, and international levels.

Vision on the Adaptation Agenda for politicians

Adaptation of water management to climate change is not a stand alone issue that needs to be tackled: it is an integral part of integrated water resources management. Starting from this premise, politicians should be aware that in addition to the approaches towards finding solutions for climate change effects already in place, there are five main approaches that need additional attention in the overall water management.

First is that collaborative governance in water management should be strengthened. Adaptation measures should be built on a joint effort of government, society and science to ensure that measures will be effective and sustainable. This requires building of trust and social capital to ensure the problem solving process takes place. As stated before, pilot projects can be very supportive in achieving this. It will also require improving disciplinary integration, on the technical as well as the policy level (e.g., inclusion of spatial planning in water management). The development of new governance and participation models is indispensable in dealing with transboundary water management situations.

This includes harmonisation of political, legal and institutional settings over administrative borders. Joint bodies are the obvious institutions to lead such changes, but often lack the mandate to implement such provisions. Improved information management is needed to support the processes on national and international levels.

Second is a paradigm shift from water supply management, where the water resources are managed in a manner designed to supply the needs for water, to water demand management, wherein the use of water is adapted to the availability of water. Use of water is often not efficient and as long as water management efforts are made to meet this use, for instance through redirection of flows, there is little need to modify existing use requirements. Measures should therefore focus more on improving efficiency of water use to ensure a sustained supply of water to the different uses in times when the resources become scarce. A specific issue in this regard is avoidance of conflict and contradiction between mitigation and adaptation strategies. Measures intended to increase water availability may also increase the use of energy (desalinization plants and pumping of groundwater, for example), thus adding to the emission of greenhouse gasses. Mitigation measures on the other hand, like development of bio-fuels, increase the need for water, thus aggravating water stress. Adaptation measures should therefore be evaluated for their energy-efficiency while mitigation measures should be evaluated for their water-efficiency.

Third is the need to look for non-structural adaptation measures. This relates to the need for demand management, where legal and policy agreements are needed to alter the use of water to improve efficiency. Also, incentives should be created to promote more sustainable use of water in not only agriculture and industry but in domestic use as well. Reduction of water use is, in this view, an essential adaptation measure. Next to that, human activities that increase vulnerability, like building settlements in flood-prone areas, should be discouraged through policy and legal actions. In all this, attention is specifically needed for subsurface water resources.

Fourthly, adaptation to climate change and other drivers of change such as energy and food prices, demographic trends, migration flows, and changing production and consumption patterns should be

viewed as a long-term, continuous exercise and not a 'one-off' set of measures.

Finally, financing of measures is an important element of adaptation. An important principle here is that the use of water resources comes with a price, for instance based on the valuation of the service provided by water and the water-related ecosystems. It should, however, be noted that such an approach may lead to unexpected and unwanted effects, particularly for the most vulnerable groups. Close attention is warranted to avoid such unintended consequences.

While all this may appear obvious, implementation of these recommendations are highly demanding and will have to overcome the inertia of traditional approaches and resistance from various actors. The challenge for politicians is to have the vision of how to put the ideas into practice, as well as courage to withstand criticism and to share power with other actors.

References

- Anonymous (2001).** *Transboundary Water Management as an International Public Good*. Study 2001:1 Ministry for Foreign Affairs, Stockholm, Sweden. 129 pp.
- Allan, J.A. (2008).** Knowing water and understanding why we use and consume it as we do. In 2008 Stockholm Water Prize Laureate Lecture, <http://www.worldwaterweek.org/Downloads/2008/SWP-Allan-Final.Final.pdf>.
- Almássy, E. and Buzás, Zs. (1999).** Inventory of transboundary groundwaters. Volume 1 UNECE Task Force on Monitoring and Assessment, Lelystad, The Netherlands. http://www.iwac-riza.org/downloads/task_force_vol1.pdf.
- Bakker, M.H.N. (2006).** Transboundary river floods: Vulnerability of continents, international river basins and countries. Oregon State University, Oregon, USA, 276 pp.
- Bernardini, F. (2007).** The UNECE Water Convention: A unique framework to foster transboundary water cooperation and security. In: *Second Preparatory Conference to the 15th OSCE Economic and Environmental Forum*, Zaragoza, Spain, 12–13 March 2007.
- Enderlein, R.E. (1999).** Paper presented at the UN/ECE Working Group on Water Management meeting held on 15 September 1999 in Bonn, Germany.
- Gooch, G.D., Höglund, P., Roll, G., Lopman, E. and Aliakseyeva, N. (2003).** Review of existing structures, models and practices for transboundary water management in Europe – The implementation of transboundary water management – identification of present problems and a design for future research. In: *Proceedings of the International Conference on Sustainable Management of Transboundary Waters in Europe*, 21–24 April 2002, Miedzyzdroje, Poland, (eds. Bernardini, F. *et al.*) pp. 285–293, Szczecin, Poland. <http://www.unece.org/env/water/meetings/conf2.htm>.
- GWP-TEC (2003).** *Poverty reduction and IWRM*. TEC Background papers no. 8 Global Water Partnership – Technical Committee, Stockholm, Sweden. <http://www.gwpforum.org/gwp/library/TEC%208.pdf>.
- Hoekstra, A.Y. and Chapagain, A.K. (2007).** Water footprints of nations: Water use by people as a function of their consumption pattern. *Water Resources Management* **21**, pp 35–48.
- IPCC (2007).** *Climate Change 2007: Synthesis Report*. Contribution of Working Groups I, II and III to the Fourth Assessment. Report of the Intergovernmental Panel on Climate Change IPCC, Geneva, Switzerland. 104 pp.
- Lindemann, S. (2006).** Water regime formation in Europe. A research framework with lessons from the Rhine and Elbe river basins. FFU-report 04-2006, Freie Universitaet Berlin, Berlin, Germany. 44 pp.
- Mostert, E. and Barraqué, B. (2006).** *Transboundary River Basin Management in Europe*. 2006/21 UNDP, 16 pp.
- Nilsson, S. (2006).** Managing water according to river basins. Information management, institutional arrangements and strategic policy support – with focus on the EU Water Framework Directive. Royal Institute of Technology, Stockholm, Sweden, http://www.lwr.kth.se/Publikationer/PDF_Files/LWR_PHD_1030.pdf
- Puri, S., Appelgren, B., Arnold, G.E., Aureli, A., Burchi, S., Burke, J., Margat, J. and Pallas, Ph. (2001).** Internationally shared (transboundary) aquifer resources management. Their significance and sustainable management. A framework document. Non Serial Document SC-2001/WS/40 UNESCO, Paris, France. 73 pp.

- Raadgever, G.T., Mostert, E., Kranz, N., Interwies, E. and Timmerman, J.G. (2008).** Assessing management regimes in Transboundary River Basins: Do they support adaptive management? *Ecology and Society* **13**(1), 14, <http://www.ecologyandsociety.org/vol13/iss1/art14/>.
- Raadgever, G.T., Mostert, E. and van de Giesen, N.C. (2006).** Measuring adaptive river basin management. In: *Proceedings of the AWRA 2006 Summer Specialty Conference 'Adaptive Management of Water Resources'*, (eds. Colosimo, M. and Potts, D.F.) American Water Resources Association (AWRA), Middleburg, Virginia, USA.
- Ridder, D., Mostert, E. and Wolters, H.A. (2005).** Learning together to manage together – Improving participation in water management. ISBN 3-00-016970-9, University of Osnabrück, Osnabrück, Germany. <http://www.harmonicop.info/HarmoniCOPHandbook.pdf>.
- Rittel, H.W.J. and Webber, M.M. (1973).** Dilemmas in a general theory of planning. *Policy Sciences* **4**, 155–169. http://www.uctc.net/mwebber/Rittel+Webber+Dilemmas+General_Theory_of_Planning.pdf
- Roll, G., Alexeeva, N., Interwies, E. and Timmerman, J.G. (2008).** Analysis of European IWRM research on transboundary regimes. Chapter 4 in: *The Adaptiveness of IWRM: Analysing European IWRM research*, p. 45–60. IWA Publishing, London, UK.
- Roll, G. and Timmerman, J.G. (2006).** Communicating with stakeholders and the public. Chapter 6 in: *Integrated transboundary water management in theory and practice: Experiences from the new EU Eastern borders*, p. 127–148. IWA Publishing, London, UK.
- Stern, N. (2007).** *The Economics of Climate Change*. The Stern Review. Cambridge University Press, Cambridge, UK. http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm
- Timmerman, J.G. and Langaas, S. (2004).** Environmental information in European transboundary water management. IWA Publishing, London, UK.
- 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.
- Timmerman, J.G., Pahl-Wostl, C. and Möltgen, J. (2008).** The adaptiveness of IWRM. Chapter 1 in: *The adaptiveness of IWRM; Analysing European IWRM research*, p. 1–12. IWA Publishing, London, UK.
- UNECE (2000).** Guidelines on sustainable flood prevention. MP.WAT/2000/7, 22 pp. <http://www.unece.org/env/water/publications/documents/guidelinesflood.pdf>.
- UNECE (2006).** Strategies for monitoring and assessment of transboundary rivers, lakes and groundwaters. ECE/MP.WAT/20 United Nations Economic Commission for Europe, Geneva, Switzerland. <http://www.unece.org/env/water/publications/documents/StrategiesM&A.pdf>.
- UNECE (2007a).** Our waters: joining hands across borders. First Assessment of Transboundary Rivers, Lakes and Groundwaters. Economic Commission for Europe, Convention on the Protection and Use of Transboundary Watercourses and International Lakes, Geneva, Switzerland. http://www.unece.org/env/water/publications/assessment/assessmentweb_full.pdf.
- UNECE (2007b).** Recommendations on payments for ecosystem services in integrated water resources management. ECE/MP.WAT/22 United Nations Economic Commission for Europe, Geneva, Switzerland. 64 pp. http://www.unece.org/env/water/publications/documents/PES_Recommendations_web.pdf.
- UNECE/WHO (2008).** Draft Guidance on water and climate adaptation. United Nations Economic Commission for Europe / World Health Organisation Regional Office for Europe, Geneva, Switzerland / Rome, Italy. http://www.unece.org/env/water/meetings/Water.and.Climate/workshop/Guidance%20on%20Water%20and%20Climate%20Adaptation_final_draft_amsterdam.doc.
- UNEP (2002).** Global environment outlook. Past, present and future perspectives. Earthscan Publications Ltd, London, UK. 155 pp.
- Van der Brugge, R., Rotmans, J. and Loorbach, D. (2004).** The transition in Dutch water management. *Regional Environmental Change* **5**(4), 164–176. <http://www.springer.com/sgw/cda/frontpage/0,5-40532-70-1136209-0,00.html>.
- Wester, Ph. and Warner, J. (2002).** River basin management reconsidered. Chapter 4 in: *Hydropolitics in the developing world: A Southern African perspective*, p. 61–71. African Water Issues Research Unit,

Centre for International Political Studies (CIPS),
Pretoria, South Africa.

Wolf, A.T., Natharius, J.A., Danielson, J.J., Ward, B.S. and Pender, J. (1999). International river basins of the world. *Water Resources Development* 15(4), 387–427.

Yoffe, S.B., Fiske, G., Giordano, M., Giordano, M., Larson, K., Stahl, K. and Wolf, A.T. (2004). Geography of international water conflict and cooperation: Data sets and applications. *Water Resources Research* 40.

Jos G. Timmerman

RWS Centre for Water Management, P.O. Box 17,
NL-8200 AA Lelystad, The Netherlands.
jos.timmerman@rws.nl

Francesca Bernardini

Convention on the Protection and Use of
Transboundary Watercourses and International Lakes,
United Nations Economic Commission for Europe,
Palais des Nations, 8–14 avenue de la Paix,
1211 Geneva 10, Switzerland.