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## A Comprehensive Literature Review

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**Abstract**: International watercourses, transcending the boundaries of nation states, are of great importance for the socioeconomic development of societies but are, at the same time prone to international collective action problems calling for cooperative international solutions. This paper reviews the existing literature on the governance of international watercourses. In a first part, the origins of hydropolitics, that is, the study of conflict and cooperation in international watercourses, are introduced. The following sections then focus on the emergence as well as on the effectiveness of institutionalized mechanisms that have been established for the governance of international watercourses. In addition, an outlook on emerging and future fields of study is provided in the last chapter of the paper. It is argued that only an integrated theoretical approach that goes beyond disciplinary divides and the sole focus on case studies can provide adequate theoretical means and thus policy concepts and strategies to cope with persistent collective action problems in international river and lake basins.

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# 1. Introduction

Freshwater serves a variety of purposes that are essential for human life and the development of societies. However, the use of water resources by one actor necessarily affects the opportunities of other actors, leading to collective action problems. If watercourses[1] transcend the boundaries of nation states, these collective action problems become international. With 263 international rivers in the world covering 45% of the world's surface and inhabiting 40% of its population, such transboundary watercourses are of great socioeconomic and political importance. Therefore, the question whether shared water resources lead to conflict among riparian states or rather trigger cooperation and how the latter one can be established and sustained is of high academic as well as political relevance.

However, research on international watercourses emerged only slowly in the last decades, starting with a path breaking study in 1977 (LeMarquand 1977), but then followed by comprehensive studies only since the early 1990s (refer, for instance, to Biswas 1992, Biswas 1993, Bulloch/Darwish 1993, Gleick 1993, Lowi/Rothmann 1993, Dinar/Wolf 1994, Kliot 1994, Lowi 1995, Wolf 1995). With these studies, the field of hydropolitics, understood as "the systematic study of conflict and cooperation between states over water resources that transcend international borders" (Elhance 1999: 3) had emerged. Recent years have seen developments in various directions, ranging from the analysis of regime formation on international watercourses to the study of the impact of the 1997 UN Convention on the Non-Navigational Use of Transboundary Watercourses and from the examination of power structures in international river basins to the integration of groundwater into hydropolitics research.

This Hertie School of Governance Working Paper provides a comprehensive review of the literature on international watercourses, aiming at understanding past and present developments in the academic debate as well as on the policy level. Systematically studying existing and emerging branches of hydropolitics research does not only help the academic debate taking stock of past achievements and identifying areas of future research need, but also provides policy makers with an overview of concepts available for the sustainable governance of shared water resources.

The remainder of the paper is structured as follows: A first part summarizes the debate on which the discipline of hydropolitics originated by presenting the different branches of thought on conflict and cooperation over shared watercourses. A following section takes a closer look at the different ways cooperation is institutionalized and traces the different determinants researchers have identified to account for whether or not International Water Treaties (IWTs) are signed and River Basin Organizations (RBOs) are established. With regard to the literature of the two former research areas, it is found that despite the use of case studies, that have so far dominated hydropolitics research[2],

[1] The term watercourses includes rivers as well as lakes, based on common sense in water-related research, the term (international) river includes lakes as well, while the term (international) lakes refers to the specific case of lakes only.

[2] Intensively studies basins include rivers in the Middle East, such as the Jordan (e.g. Lowi 1993, Kliot 1994, Wolf 1995, Dombrowsky 1998, Soffer 1999, Dolatyar/Gray 2000, Amery 2002, Zeitoun 2008) and the Euphrates-Tigris (for example Slim 1993, Elver 2002, Kibaroglu 2002, Scheumann 2003, Medzini/Wolf 2006, Daoudy 2009); basins in Africa, including the Nile (e.g. Howell/Allan 1994, Tafesse 2001, Waterbury 2002, Whittington et.al. 2005) and various Southern African rivers (e.g. Almeida 2002, Henwood/Funke 2002, Nakayama 2003, Ashton/Turton 2004, Turton/Earle 2005, Heyns et.al. 2008); European watercourses (for instance Dupont 1993, Nachtnebel 2000, Nolkaemper 2005, McCaffrey 2006, Lindemann 2008); and Asian watercourses such as the Ganges and the Indus Rivers in South Asia (Biswas 1996, Subedi 1999, Biswas/Uitto 2001, Zawahri 2008a and 2008b), the Aral Sea in Central Asia (e.g. Kloetzli 1997, O'Hara 2000, Dukhovny/Sokolov 2002,

more comprehensive research on both water interactions and institutionalized cooperation mechanisms is needed in order to generate generalizable and parsimonious hypotheses and findings that can inform policy makers. In a next step, the question whether and to what extent institutionalized cooperation mechanisms actually matter for the sustainable governance of shared watercourses is elaborated and factors identified by hydropolitics research as determinants of effectiveness are summarized. It is found that the study of the effectiveness of institutionalized governance of international watercourses is still in its infancy and despite important insights gained so far, much more needs to be done to understand what actually determines whether RBOs make a difference in water resources governance and what could be done to improve their effectiveness.

## 2. The Origins of Hydropolitics Research – Conflict or Cooperation over Shared Watercourses

The study of hydropolitics originates from the question whether the fact that watercourses are often shared by several nation states with diverging interests in how to use, exploit or protect water and related resources necessarily leads to conflicts or even violence or can be mitigated through cooperation. Two main branches of thought can be distinguished: A neo-realist or Malthusian approach, focusing on the conflictive potential of transboundary watercourses and an institutionalist or Cornucopian branch, emphasizing the cooperative potential of water.

### 2.1. The Water War Thesis – The Conflictive Potential of Shared Watercourses

Based on concepts of non-traditional and environmental security (e.g. Homer-Dixon 1994, Bächler et.al. 1996, Gleditsch 1998) as well as on more general (neo-)realist theories of International Relations, the Malthusian branch of hydropolitics argues that the great importance of water for human life and the socioeconomic development of societies, combined with the fact that water transcends the boundaries of nation states and therefore eludes the absolute sovereignty of the respective states leads to conflict. Malthusian authors (such as Starr 1991, Falkenmark 1992, Bulloch/Darwish 1993, Gleick 1993, Myers 1993, Naff 1994, Bächler et.al. 1996, Butts 1997, Gleditsch 1997, Gleick 1998, Homer-Dixon 1999, Soffer 1999) have pointed out that the scarcity of a natural resource such as water makes states vulnerable, especially if they depend on water that originates from outside their national border, and creates interdependencies that are perceived as threats, making states vulnerable. Vulnerability then necessarily requires state action, that is, the defense of water resources and thus of the development potential of the respective states. If all states sharing an international watercourse act in this way, collective action problems emerge that lead to conflict. Such conflict is then expected lead to so-called water wars. This 'water war'-thesis became particularly prominent in the early 1990s, when the end of the Cold War led to the emergence of a new understanding of security that moved beyond purely military issues and was very much related to natural resources and the competition for them among nation states.

These arguments have mainly been derived with regard to specific river basins that have experienced conflict in the past. This has led to a strong focus on the Middle East, particularly on conflicts between Israel and its neighbors (e.g. Beaumont 1991, Starr 1991, Bulloch/Darwish 1993, Myers 1993, Naff 1994, Soffer 1999). Soffer (1999), for instance, argues that there has already been water

Boisson de Chazournes 2006), and – as the only well-studied river basin in East Asia – the Mekong River Basin (for example Browder 2000, Öjendal 2000, Backer 2006, Goh 2006).

war between Syria, Lebanon and Israel (the 1968 War) and derives the hypothesis that more of such wars are to come. Similar arguments are put forward by Myers (1993), who emphasizes the connection between water and war in the Middle East in the past and forecasts similar events for the future. Besides the Jordan River, water war arguments have also been derived from the Euphrates-Tigris Basin, often considered as one of the most conflictive basins and thus likely to experience war in the future (Starr 1991).

In this context, different authors have identified factors that are believed to induce water conflicts or even wars. The most important factors identified as contributing to conflict over shared waters are the degree of scarcity, the extent to which water is shared by more than one state, the relative power of riparians and their access to alternative water resources (Gleick 1993: 84 ff.). Furthermore, Gleick (1998), for instance, points out that especially mismanagement and misallocation of water resources in various regions in the world contributes to the persistence of water conflicts and is reinforced by the related existence of protracted collective action problems. Lowi and Rothmann (1993) emphasizes the relation between water conflicts and non-water-related high politics issues (such as statehood, security or territory), making the solution of water conflicts only possible when high politics issues in the respective basin are solved as well. Homer-Dixon (1999), on the other hand, limits the outbreak of water wars to specific conditions, namely the existence of a downstream hegemon that has vital interests in protecting its water resources and the political and economic means to do so through violence. This leaves the Nile Basin with Egypt as downstream hegemon as only case for potential water wars in the future.

Besides scholarly research, the 'water-war-thesis' has received particularly high attention from policy makers at the international level: The World Bank's Vice President for Sustainable Development, Ismail Serageldin, for example, warned in 1995 that "the wars of the next century will be fought over water" (Interview with the New York Times, 10 August 1995), and Wally N'Dow, Director of the UN Centre for Human Establishments cautioned that "many political and social conflicts of the twenty-first century will focus on water". More recently, UN Secretary General Kofi Annan pointed out in a speech given at the 97$^{th}$ Annual Meeting of the Association of American Geographers in March 2001 that "the fierce competition for freshwater may well become a source of conflict and wars in the future".

### 2.2. Learning from Reality in International River Basins – The Prevalence of Cooperation over Shared Watercourses

Despite the prominence of the 'water-war-thesis', reality in international river basins has proven it wrong. Empirical research conducted at the Oregon State University in the context of the Transboundary Freshwater Dispute Database (TFDD) has revealed that most of the events in international basins have been cooperative in nature, while only one third of all 1831 events coded for the years 1948 to 1999 were conflictive in nature (Wolf 1998, Wolf et.al. 2003, Delli Priscolli/Wolf 2009). Among the latter ones, only 37 involved any form of violence, all below the threshold of war. Moreover, 109 out of the 263 international watercourses in the world have experienced the signature of IWTs, while in 62 of them cooperation was institutionalized even further through the establishment of RBOs (Wolf et.al. 2003: 45). A recent update of the TFDD confirms these findings, with cooperation continuously outweighing conflict (DeStefano et.al. 2010): 2000 to 2008, only 33% of the events captured in the TFDD were conflictive in nature (compared to 28% 1948-1999), leaving the vast majority of events as neutral or, even more often, cooperative (DeStefano et.al. 2010: 6).

Moreover, the vast majority of conflictive events rank low on the BAR-scale, usually taking values between -1 and -3, while the state of formal water war (-7) has never been reached.

Other, more case study oriented analyses have supported these findings (e.g. Wolf 1995, Beaumont 1997, Brooks 1997, Elhance 1999 and 2000, Turton 2000, Allan 2001, Alam 2002, Allan 2002, Canter/Ndegwa 2002, Uitto/Wolf 2002, Jägerskog 2003, Van der Zaag/Vaz 2003, Kalpakian 2004, Metawie 2004). Elhance (1999 and 2000), for instance, has provided a comprehensive analysis of conflict and cooperation in international river basins in developing countries and concludes that political, economic, environmental or geographic interdependences between riparian states can, indeed, trigger conflict, but are much more likely to be solved in a cooperative manner. Similarly, Canter and Ndegwa (2002) use the Lake Victoria as a case study for demonstrating how severe environmental problems trigger cooperation rather than conflict: Although environmental problems on the lake are severe and affect the development of riparian communities and entire states and historically cooperation among Lake Victoria riparian states has often failed while institutions remain weak, violent conflict never emerged while instead inter-state cooperation did indeed continue to exist. Van der Zaag and Vaz (2003) come to similar conclusions when analyzing the Incomati River Basin, where tensions over shared waters always existed but never turned into conflict but cooperation. In a case study of the Nile River Basin, Metawie (2004) has demonstrated that Nile riparians are deeply committed to cooperation despite ongoing water resources problems in the river basin, which can be proven based on the long history of at least informal cooperation in the basin. And even in regions such as the Middle East, where water wars have been forecasted and water conflicts are believed to be particularly severe, no incidents could so far be observed and all disputes having occurred so far have been either minor skirmishes and/or remained on a sub-national level (Wolf 1999 and Wolf/Hamner 2000) – mainly due to the fact that incentives for cooperation still outweigh the benefits of violence (Brooks 1997).

Besides empirical findings, hydropolitics scholars have also derived a variety of theoretical arguments in favor of the cooperative potential of water (see, for instance, Wolf 1999, Elhance 2000, Wolf/Hamner 2000, Lonergan 2001, Postel/Wolf 2001, Hamner 2002, Swain 2004, Dinar 2007, Zawahri 2008a, Delli Priscolli/Wolf 2009, Dinar 2009). From a strategic point of view, it is found that states are more likely to choose cooperation over conflict: The chances for success of water-related violence are very limited, while costs are extraordinarily high (including long-term costs of occupation and restoration). Conflictive strategies would only be promising in very specific geographic settings with vulnerable but powerful downstream states. Such settings are extremely rare and would, if violence would be employed, harm the downstream state itself if, for instance, an industrial setting upstream is dismantled or a dam destroyed (Delli Priscolli/Wolf 2009: 21). In addition, riparian states often share common interests and are politically, economically and culturally interdependent, so that going to war over water would harm their national interests in issue-areas other than water (Delli Priscolli/Wolf 2009: 22).

Moreover, it is argued that water itself creates interdependencies among states sharing a transboundary watercourse which often goes as far as creating joint institutions for the management of the shared resource, themselves acting as a trigger for further cooperation: “Once cooperative water regimes are established, they turn out to be tremendously resilient over time, even between otherwise hostile riparians and even as conflicts is waged over other issues” (Wolf 1998: 194). This holds true even in times of derogating relations between involved states, which could be shown by Kalpakian (2004: 161 ff.) for the case of India and Pakistan, where cooperation on the basis of the

Indus Treaty prevailed despite of the Indo-Pakistani wars, and for the Mekong River Basin, where cooperation in form of the Mekong Committee and the Interim Mekong Committee prevailed despite ongoing ideological confrontations and the Indochinese Wars.

More recently, hydropolitics scholars have tried to define conflict and cooperation more precisely (e.g. Postel/Wolf 2001, Bernauer 2002, Sadoff/Grey 2002, Uitto/Wolf 2002, Wolf et.al. 2003, Zeitoun/Mirumachi 2008, Zawahri/Gerlak 2009). It has thereby been acknowledged that conflict and cooperation are not necessarily contradictory, but can occur simultaneously in a basin. Scholars such as Sadoff and Grey (2002), Zeitoun and Mirumachi (2008) and Zawahri (2008a) have therefore proposed to focus on water interactions rather than conflict or cooperation only. Water interactions then refer to a continuum ranging from all sorts of conflict to neutral relation and to the signature of IWTs, the establishment of RBOs or even as far as the integration of water policies among states. This continuum of conflict and cooperation is spelled out in more detail by the Basins-at-Risk(BAR)-scale, developed in the context of the TFDD. It distinguishes seven degrees of conflict (-1 to -7) and seven degrees of cooperation (1 to 7), which allows for a more detailed understanding of the level of water interaction in a specific basin (Wolf et.al. 2003, DeStefano et.al. 2010).

## 3. Institutionalizing Cooperation – What Explains the Emergence of International Water Treaties and River Basin Organizations?

Besides the question whether shared water resources lead to conflict or cooperation, scholars have focused on the establishment of cooperation mechanisms. The analysis of the formation of institutionalized cooperation mechanisms relies on more general theoretical studies (refer, among others to, Durth 1996, Bernauer 1997, Dinar/Dinar 2000, Marty 2001, Bernauer 2002, Dinar 2007, Dinar 2008) as well as on basin-specific case studies (e.g. Browder 2000, Kibaroglu 2002, Jägerskog 2003) and, more recently, quantitative studies testing hypothesis on the institutionalization of cooperation on a large sample of cases (such as Spector 2000, Gleditsch/Hamner 2001, Gleditsch et.al. 2004, Song/Whittington 2004, Furlong et.al. 2006, Hensel et.al. 2006, Brochmann/Hensel 2007 and 2009, Tir/Ackermann 2009). Across these different methodological approaches, research can be distinguished in the study of treaty signature (accounting for most of current research) and the study of RBO formation, that is, the formal institutionalization of cooperation into a permanent body. Despite this important distinction, factors accounting for IWT signature and RBO formation are often similar and will therefore be treated in parallel in the following sections.

### 3.1. The Characteristics of the River Basin – Problem-Structural Approaches to International Watercourses Governance

A large number of scholars focus on the characteristics of the river basin as determinants for whether cooperation will be institutionalized (refer to Bernauer 1007, Spector 2000, Gleditsch/Hamner 2001, Dinar 2004, Song/Whittington 2004, Hensel et.al. 2006, Brochmann/Hensel 2007, Dinar 2009, Tir/Ackermann 2009). Based on the central argument that the river basin itself and the collective action problems related to the use of the river and its resources by different actors determine the way and the extent to which cooperation is institutionalized, hydropolitics scholars have identified a range of factors influencing the signature of IWTs or the establishment of RBOs.

Among such basin-specific determinants, water scarcity is the most commonly studied factor (e.g. Gleditsch/Hamner 2001, Gleditsch et.al. 2004, Dinar 2004, Hensel et.al. 2006, Brochmann/Hensel

2009, Dinar 2009, Tir/Ackermann 2009): The debate is driven by the idea that a high degree of water scarcity is linked to a high likelihood of severe collective action problems and thus a low likelihood of successful institutionalized cooperation (e.g. Hensel et.al. 2006). And indeed, particularly water scarce river basins such as the Jordan have demonstrated a history of collective action problems, underlining this hypothesis. However, more detailed studies have challenged this rather simplistic argument about a one-directional relation between water scarcity and conflict, arguing that more complex patterns link scarcity and the establishment of cooperation mechanisms (Dinar 2004, Dinar 2009). Dinar (2009) argues that when water is not scarce at all, riparian states of an international basin have little incentives to cooperate. As water becomes scarcer, incentives for cooperation increase up to a certain level until water is so scarce that cooperation is not possible anymore. The emergence of cooperation mechanisms over shared water will therefore "be greatest when scarcity is moderate, rather than very low or high" (Dinar 2009: 111).

Other hydrological factors have received less attention from scholars. Hamner (2009) has studied the impact of droughts on cooperation and conflict between states and points out that the signature of IWTs becomes more likely if all potential participants to the treaty experience a drought, both due to domestic reasons (in times of water crisis, populations are generally more willing to accept second-best negotiations outcomes; Hamner 2009: 4) and to international considerations (with states tending to be more interested in cooperation if they both face water scarcity; Hamner 2009: 6). Although transboundary droughts are increasingly acknowledged as important collective action problems, systematic research is still lacking and analyses often focus on single cases only (e.g. Hundertmark 2008 on the Mekong River Basin).

In addition, the significance of the river and its resources to the respective riparian states has been identified as an indicator for the likelihood of IWT signature and RBO formation (LeMarquand 1977, Espey/Towfique 2004, Brochmann/Hensel 2009). The central argument brought forward by proponents of this approach is that negotiations over institutionalized cooperation mechanisms are less likely to be successful if the river is considered as particularly important by at least one of the riparian states (Brochmann/Hensel 2009: 6). This is, for instance, the case if the respective country depends, to a large extent, on water resources originating from outside its territory that are provided by the river (e.g. Israel on the Jordan) or if a certain water resources use plays a prominent role in the national development strategy (e.g. hydropower development on the Mekong and its tributaries in the development strategy of Lao PDR).

In this context, it has also been investigated whether specific types of collective action problems on international watercourses are more or less prone to institutionalized solution (Bernauer 1997, Marty 2001, Klaphake/Scheumann 2006, Dombrowsky 2007). When focusing on the differences between transboundary rivers and lakes, it has been found that "externality problems are harder to solve than collective ones because, in general, only one party could gain from cooperation while the other will risk to lose" (Klaphake/Scheumann 2006: 4), making cooperation on international lakes often more easy than cooperation on international rivers.

Non-water-related characteristics of the river basin have also been included in the analysis of cooperation on shared watercourses. Wolf et.al. 2003 (43) argue, for instance, that "the higher the per capita GDP, or the lower the population density, the greater cooperation". However, the causal link between such non-water-related factors and the establishment of IWTs or RBOs is rather weak, cannot be traced consistently and is often only a proxy for other factors (such as regional

integration), making the contributions of such approaches to the study of institutionalized cooperation on shared watercourses rather weak and of little analytical importance.

### 3.2. The Constellation of Actors in International Watercourses – Situation-Structural Approaches to Watercourses Governance

The vast majority of researchers investigating the establishment of institutionalized cooperation mechanisms have focused on the specific constellation of actors in the river basin (Lowi/Rothmann 1993, Durth 1996, Just/Netanyahu 1998, Haftendorn 2000, Marty 2001, Mostert 2003b, Song/Whittington 2004, Zawahri 2008b, Gerlak/Grant 2009, Tir/Ackermann 2009). Often inspired by International Relations approaches on institutionalized cooperation, different constellations of actors have been identified that influence the signature of IWTs or the formation of RBOs.

The underlying geographical structure among riparians has been studied intensively, with a particular focus on upstream-downstream constellations and their impact on IWT or RBO establishment (e.g. Lowi/Rothmann 1993, Durth 1996, Haftendorn 2000, Marty 2001, Song/Whittington 2004, Dinar 2008, Zawahri 2008b, Gerlak/Grant 2009, Tir/Ackermann 2009). It is found that upstream states have no or only few incentives to cooperate over shared water resources since they are able to externalize negative effects of water and resources use and exploitation by flushing them downstream. Upstream states are therefore interested in maintaining a unilateral order in the basin and are reluctant to institutionalized cooperation. Downstream states, on the other hand, have a high interest in cooperation and the joint mitigation of negative water use effects and are therefore generally in favor of the establishment of IWTs and RBOs and will actively engage in the respective processes. This has been underlined, for instance, by the fact that states that have voted against or abstained from voting on the 1997 UN Convention on the Non-Navigational Use of International Watercourses have mainly been upstream states on strategically important rivers (China, Turkey voting against and, among others, Bolivia, Ethiopia, Mali and Tanzania abstaining) while countries that have not only voted in favor of but also already ratified the Convention are largely downstream states (e.g. Hungary, Iraq, Netherlands, Portugal, South Africa). These findings only how true for river basins though, with lake basins being characterized by common pool resources structures that distribute the interest in or the reluctance to institutionalized cooperation relatively equally.

Within this branch of thought, the specific power distribution between riparian states reinforces or counterbalances geographical structures and has therefore been integrated in the set of explanatory factors for institutionalization as well (Frey 1993, Lowi/Rothmann 1993, Durth 1996, Amery/Wolf 2000, Dinar 2008): Depending on whether the power is concentrated in the hands of an upstream or a downstream state, a unilateral order will be maintained or IWTs will be signed and RBOs established. Lowi and Rothmann (1993) argue that cooperation is unlikely to take place if the upstream riparian is in a hegemonic position since it does not only have no interest in cooperating, but also possesses the necessary means to resist demands for cooperation from downstream states. Durth (1996) follows this argument, but identifies conditions under which cooperation can be successfully institutionalized despite the existence of a generally cooperation-reluctant hegemon and concludes that integration beyond water matters. He has demonstrated that highly economically and/or politically integrated regions (such as Europe) are likely to overcome cooperation-impeding structures and integrate reluctant states into IWTs and RBOs, while regions without a history of cooperation (such as the Middle East) face more severe difficulties. In this context, the degree of unequal power distribution has been analyzed as well (Just/Netanyahu 1998, Hijri/Grey 1998,

Tir/Ackermann 2009): Some authors argue that unequal power distribution and extreme power asymmetries impede cooperation (e.g. Just/Netanyahu 1998: 9, Hijri/Grey 1998: 89). Following insights from the theory of hegemonic stability, others, however, emphasize the capacity of a hegemon in a river basin to set up a cooperative regime on the river basin and provide incentives to other riparian states to cooperate (e.g. Tir/Ackermann 2009, who find that power asymmetries are, indeed, conducive to the signature of IWTs). Based on the concept of benign hegemons, it is emphasizes that the existence of a hegemon with interest in cooperation significantly enhances the chances of IWT and RBO establishment. An example is the South Africa in Southern African river basins in the broader context of the SADC Protocol on Shared Water Resources, where South Africa is perceived as a "plus-sum hydro hegemon" (Turton/Funke 2008: 51).

The so-called 'London Water Research Group' (refer to Zeitoun/Warner 2006, Daoudy 2008, Warner/Zeitoun 2008, Zeitoun 2008, Zeitoun/Allan 2008) has investigated the relationship between water cooperation (or conflict) and power in more detail, applying a critical theory approach and combining constructivism, critical IR theory, discourse analysis and (critical) International Political Economy Approaches such as neo-Gramscianism. The most important notion is the concept of "hydrohegemony", defined as the particular hegemony active in international transboundary water settings (Zeitoun/Allan 2008: 3), achieved through water resources control (Zeitoun/Warner 2006: 435). It captures how basin riparians that are formally equal are in fact caught in relations determined by hegemonic power, both material and normative (Warner/Zeitoun 2008: 807), assuming that cooperation among riparians is therefore not always voluntary. A special issue of Water Policy (Water Policy 10, Supplement 2, 2008) has extensively covered hydrohegemony issues from a theoretical basis as well as through different case studies (Cascão 2008, Saleh 2008 on the Nile, Turton/Funke 2008 on the Orange and Wegerich 2008 on the Amu Darya).

Besides the geographical structure of a basin and the distribution of power among riparian actors, the degree of non-water-related integration among riparians has been found to determine the success of IWT signature and RBO formation as well. This importance of pre-existing (regional) cooperation mechanisms has been emphasized by various authors (e.g. LeMarquand 1977, Bernauer 1997, Bennett et.al. 1998, Beach et.al. 2000, Wolf et.al. 2003, Conca et.al. 2006): LeMarquand has first outlined the importance of general international relations for water cooperation, claiming that "the success of the policy in the international arena may depend greatly on the conditions that exist among the basin countries" (LeMarquand 1977: 15). Subsequently, pre-existing international cooperation has been regarded as a factor significantly increasing the likelihood of treaty signature or RBO establishment, since "countries which cooperate in general cooperate about water as well" (Wolf et.al. 2003: 43) and states are more likely to effectively manage a driver basin when they share a more cooperative general relationship (Brochmann/Hensel 2009: 9). Within this context, economic interdependence has received most attention and a high level of economic integration among riparian states is often considered as cooperation-conducive, thus facilitating the establishment of institutionalized cooperation mechanisms (Durth 1996, Neumayer 2002, Espey/Towfique 2004, Dosch/Hensengerth 2005, Tir/Ackermann 2009).

Pre-existing regional cooperation mechanisms such as regional organizations are considered as particularly conducive to institutionalized water resources governance: Europe and Southern Africa have received most attention with regard to pre-existing cooperation structures positively influencing cooperation over shared watercourses. In Europe, a high degree of institutionalized cooperation up to the supranational level has allowed for effective water resources management by

establishing and maintaining institutions. The EU Water Framework Directive (2000) has put this integration of water resources management on the European level to a new level, establishing binding requirements for the management of transboundary watercourses for all EU members, increasingly complied with by non-EU-members in the region as well. The fact that all transboundary European rivers are managed by an RBO clearly underlines this argument. Similarly, the Southern African Development Community (SADC) has significantly shaped water resources governance in the region, mainly by the SADC Protocol on Shared Watercourses (1995, in a revised form in 2000) that provides binding rules for the management of shared waters and calls for the establishment of RBOs in all shared watercourses (following on these provisions, RBOs have indeed been established in the region, e.g. the Limpopo Watercourse Commission, LIMCOM, in 2003 and the Orange-Senqu River Commission, ORASECOM, in 2000). Other authors have explored the importance of pre-existing and non-water-related cooperation mechanisms on the basis of case studies in other regions of the world (e.g. Dosch/Hensengerth 2005 on the Mekong).

Some authors have also emphasized the positive impact of cultural similarities and relations between riparian states (Deng 1993, Dupont 1993, Faure/Rubin 1993, Espey/Towfique 2004, Kalapkian 2004). Faure and Rubin (1993) were among the first to integrate cultural characteristics into the analysis of negotiations over water institutions. In an edited volume, different case studies on the Nile, the Euphrates-Tigris, the Jordan and the Rhine explore how pre-existing cultural pattern influence negotiations and how cultural differences drive water conflict (Deng 1993 on the Nile and Slim 1993 on the Euphrates-Tigris) or how cultural similarities facilitate the negotiation of even very complex collective action problems (Dupont 1993 on the Rhine). Similarly, Kalpakian (2004: 149 ff.) has demonstrated for the Indus River Basin how cultural, religious and emotional factors determine water conflicts, with roots of conflicts often being buried deep in the respective identities and going far beyond water. Such studies led to the insight that purely realistic and river-related factors cannot explain states' behavior over shared watercourses in all cases and under all circumstances.

Similarly, the idea that states sharing the same political system and the same values, ideally in the form of democracies, more easily establish institutionalized cooperation mechanisms on water has lately been explored, mainly in the form of quantitative studies (Neumayer 2002, Brochmann/Hensel 2007, Brochmann/Hensel 2009, Gerlak/Grant 2009, Kalbhenn 2009, Tir/Ackermann 2009). It has been argued that river-related collective action problems are more likely to be solved peacefully by democracies than by pairs of other states (Brochmann/Hensel 2009: 16). Based on a statistical analysis of various characteristics of democratic systems, Kalbhenn (2009) adds that the relationship between democracy and cooperation over shared watercourses is, however, non-linear, with the positive relationship only being observed up to a certain level.

Drawing from what International Relations theory refers to as 2$^{nd}$-image analysis, domestic structures in riparian states have also been found to be an important determinant of IWT signature and RBO establishment (LeMarquand 1977, Elhance 1999, Dinar/Dinar 2000, Elhance 2000, Nishat/Faisal 2000, Giordano et.al. 2002, Hamner 2002, Kibaroglu 2002, Mostert 2003b, Dinar 2008). As it has been demonstrated for Turkish domestic and foreign policy in relation to Kurdish minorities in Iraq and Syria (Kibaroglu 2002, Scheumann 2003), domestic conflicts, for instance, are believed to determine relations of states to their neighbors as well and thus influence the solution of water-related problems.

The role of actors external to the river basin, most often in the form of development partners, has been explored as well (refer to Olem/Duda 1995, Duda/La Roche 1997, Jorgenson 1997, Kirmani/LeMoigne 1997, Krishna 1998, Nakayama 1998, Pitman 1998, Alaerts 1999, Mostert 2003b, Gerlak 2004, Hartje 2007, Zawahri 2009). It is argued that the involvement of development partners and organizations has been decisive for the establishment of institutionalized cooperation mechanisms in many river basins in the developing world. Especially in less developed regions, "extensive external financing may help in reaching an agreement or may even be essential, but in itself is not sufficient" (Mostert 2003b: 37). The GEF has been studied intensively, mainly for its involvement in the Danube, the Aral Sea, the Bermejo and the Lake Tanganyika Basins (Duda/LaRoche 1997, Jorgenson 1997, Gerlak 2004). The World Bank's contribution to international water management has been elaborated as well, both from an academic (e.g. Nakayama 1998, Hartje 2007) and, in particular, an intra-institutional perspective, with authors from within the World Bank assessing how the institution has been and should be involved in international water resources governance negotiations (Olem/Duda 1995, Kirmani/LeMoigne 1997, Krishna 1998, Pitman 1998, Alaerts 1999). The different UN institutions have, however, received less attention (see, for some of the few studies, Nakayama 1998 and Zawahri 2009).

### 3.3. Non-Political Concepts on Institutionalized Cooperation on Shared Watercourses – Integrating Findings from Economics and International (Water) Law

Besides the aforementioned hydropolitical approaches, economics and international law have also made important contributions to the study of institutionalized cooperation on shared watercourses and provided important insights into why and under which circumstances riparian states sign IWTs or establish RBOs.

Economics has provided important insights on how states shared water and related resources. Most commonly, economics approaches focus on the distribution of water resources among riparians, that is, on the allocation side of water resources governance (e.g. Kilgour/Dinar 1995, Ringler 2001). Research is thereby most often problem-driven, aiming at providing water allocation models that solve disputes among riparians and allocate water resources in a sustainable and, even more important, economically efficient way. Kilgour and Dinar (1995), for instance, develop an allocation model that takes into account the variability of flow rates, aiming at providing means for more stable water resources allocation in international river basins. Such concepts have been picked up by other scholars and applied to specific river basins, e.g. the Mekong (Ringler 2001) and the Okavango River Basin (Ashton 2003). However, no well-functioning water allocation model has so far been developed, not least due to the significant differences in water use and riparian interests across basins, impeding the development of a "one-fits-all"-model.

When focusing on water allocation, a large number of economists have focused on power differences among riparians and the different benefits to gain from cooperation over water, especially by applying game theoretic approaches (refer to Dufournaud 1982, Rogers 1991, Rogers 1993, Bennett et.al. 1998, Just/Netanyahu 1998, Kilgour/Dinar 2001, Wu/Whittington 2006, Ambec/Ehlers 2008). Dufournaud (1982), for instance, has emphasized the benefits that can be obtained from cooperation by analyzing the Mekong and the Columbia River Basin. Similarly, Rogers (1991 and 1993) has studied the Columbia, the Ganges-Brahmaputra and the Nile Basin from a comparative perspective and evaluated the costs and benefits related to institutionalized cooperation. Similarly, Wu and Whittington (2006) have analyzed incentives structures for cooperation in the Nile River Basin and

conclude that efficient benefit sharing mechanisms could significantly increase the willingness of riparian states to cooperate. The most comprehensive application of game theory to international river basins is provided in an edited volume (Just/Netanyahu 1998), applying theoretical approaches to different cases in different regions. However, it needs to be noted that such approaches are limited to water quantity issues, while other collective action problems occurring on shared rivers and lakes have largely been neglected or cannot be studied by a purely economic and efficiency-oriented approach.

Another interesting branch of economic analysis is the political economy study of the water sector (e.g. Saleth/Dinar 1999, 2000 and 2004, subsequently building a framework of analysis, O'Meally 2009), although most often focusing on the domestic water sector applicable to an international context as well. The study of structures, institutions and actors in the water sector provides important insights into whether and how cooperation is institutionalized and how such institutions change over time. In order to make full use of this approach, application to the international level and a more intensive study of specific transboundary watercourses is, however, needed.

International law concepts have played an important role as well when assessing the establishment of IWTs. Some authors have studied specific cases of international water law and its application in different basins (Kliot 1994 and Waterbury 1994 on Middle Eastern rivers, Salman/Uprety 2002 on South Asian rivers, Nolkaemper 2005 on European Rivers, Subedi 2005 on a comparison between Ganges, Mekong and Rhine, and Bearden 2009 on the Mekong). Kliot (1994), for instance, investigates the applicability of international water law principles to a particularly conflict-prone region and argues that, despite major conflicts, riparians tend to comply with international water law principles. Waterbury (1994) studies the application of international water law by each of the riparians to the Euphrates-Tigris, Jordan and Nile. Other scholars have, more recently, also turned towards broader international law principles, both customary and codified, that influences water resources governance at the basin level (Benvenisti 1996, Dellapenna 2001, McCaffrey 2001a, Akweenda 2002, Benvenisti 2002, McIntyre 2006, Rieu-Clarke 2010). For example, Lautze et.al. (2005) have analyzed how general international water law principles are integrated into specific river basin treaties, in developing regions most often under the auspices of external actors such as donor agencies and driven by non-regional policy considerations.

The 1997 UN Convention on the Non-Navigational Use of Transboundary Watercourses has received particular attention since the late 1990s (e.g. Barandat/Kaplan 1998, McCaffrey 1998, McCaffrey 2001b, Tanzi/Arcari 2001, Eckstein 2002, Schröder-Wildberg 2002, Conca et.al. 2006, McCaffrey 2007, Salman 2007). Both the complicated negotiations leading to the formulation of the Convention (Barandat/Kaplan 1998, Eckstein 2002, Schröder-Wildberg 2002) and its contents (McCaffrey 1998, McCaffrey 2001b, Tanzi/Arcari 2001, Salman 2007) have been studied intensively. Subsequently, the ratification (or the lack thereof) has been studied (Eckstein 2002, Salman 2007). Salman (2007) has looked into the reasons for the extremely low ratification rate of the 1997 Convention, arguing that there are six reasons, the most important ones being: First of all, the lack of a consensus of what is to be understood by principles and concepts integrated in the Convention, namely the principle of equitable and reasonable utilization and the obligation not to cause harm and the relationship between the two; the fact that the obligation of prior notification is insufficiently specified, especially with regard to the relationship between upstream and downstream riparians; the criticism the Convention does not sufficiently acknowledge existing regional or bilateral treaties; and finally, the problem that dispute-settlement mechanisms have been formulated to weak, not providing any

bindingness. Although not formally entered into force yet, the 1997 Convention marks a major turning point, since for the first time internationally agreed upon norms on the development of international watercourses have been codified.

Besides truly global water law principles, scholars have also investigated the role of regionally codified water resources governance principles in shared river basins. The most common provisions are the EU Water Framework Directive (Holtzwarth 2002, Moellenkamp 2007) and the SADC Protocol on Shared Watercourses (Heyns et.al. 2008). The SADC Protocol on Shared Watercourses is of great importance for the governance of shared watercourses in Southern Africa and its legal provisions have clearly influenced the emergence of institutionalized cooperation mechanisms in the region as for instance Heyns (2008) has demonstrated for the Orange River Basin. Little knowledge has, however, been derived on how experiences from regional water law and the establishment and maintenance of institutionalized cooperation can be replicated in other river basins, thus providing policy-relevant concepts.

More recently, scholars have increasingly turned to the question what role treaties actually play in mitigating conflicts and maintaining cooperation over shared. The leading question has thereby been whether and to what extent treaties actually play a role in shaping state behavior over shared watercourses (Rieu-Clarke 2010). It has thereby been found that the role of treaties is rather limited, with most treaties being bilateral in nature (Wolf/Hamner 1998). This paper will therefore not focus on the pure signature of IWTs anymore, but move on to the question how RBOs, as the institutionalized form of cooperation often established through IWTs, can contribute to effective river basin governance by asking which factors have been found to actually account for the effectiveness of RBOs. This is based on the argument that it is not so much the question whether states solve collective action problems over shared watercourses through conflict or cooperation that matters today, but rather the question whether and to what extent existing mechanisms of cooperation are effective in governing the river basins at stake.

Regarding the study of IWT and RBO formation and the identification of determinants of successful institutionalization, it can be concluded that a variety of factors can be identified as determinants for institutionalized cooperation, with the type of the collective action problem and the valuation of it by riparian states as well as the specific constellation of actors including their respective power resources being of particular importance.

## 4. The Effectiveness of River Basin Organizations – Do RBOs really matter?

Influenced by International Relations research on whether and to what extent international institutions matter in shaping the international systems, hydropolitics scholars have more and more focused on the question whether RBOs are actually effective in governing the river basin they have been established in (refer to Bernauer 1997, Vinogradov/Langfrod 2001, Giordano/Wolf 2003, Mostert 2003b, Wolf 2004, Dombrowsky 2007, Bernauer/Siegfried 2008, Zawahri 2008a, Köppel 2009, Schmeier 2010a). Most research has thereby focused on limited aspects of effectiveness only and the discipline has so far not been able to measure or explain different degrees of effectiveness and draw generalizable inferences on what makes RBOs effective that could then feed into policy-relevant recommendations. The following sections therefore summarize the different factors that have been found to matter for RBO effectiveness in order to outline ways of future research that do not only overcome the conflict-cooperation-divide, but also contribute to the sustainable governance

of the world's water: When analyzing why some RBOs are more effective than others, different explanatory factors have been identified. Besides basin- and actor-specific factors similar to what has been described above as determinants for the establishment of institutionalized cooperation mechanisms and continuously influence the effectiveness of water resources governance once an RBO has been established, the institutional design of RBOs themselves has been identified as an important factor.

Analytically, it can be distinguished between general organizational characteristics of the RBO (4.1.) such as the organization's membership structure, its institutional scope, and the degree of institutionalization, and structures and mechanisms within the RBO, organizing the interactions of its members and the joint governance of the river basin at stake (4.2.).

### 4.1. Overall Organizational Characteristics of RBOs – The 1st Dimension of Institutional Design

One of the best researched institutional design characteristic is the membership structure of RBOs, that is, the question how many actors are involved in the institutionalized governance of a river basin and how this affects the success of the respective endeavor. Some authors, have pointed out that the inclusion of a high number of actors increases the complexity of cooperation and thus decreases effectiveness (Just/Netanyahu 1998, Verweji 2000). Just/Netanyahu (1998: 3), for instance, have argued that "large regional, especially international, organizations are less successful than small ones". Based on an empirical study of the Rhine River Basin, Verweji (2000) has shown that the International Commission for the Protection of the Rhine (ICPR) is very effective in governing the river basin despite or even because of its non-inclusive membership structure. On the other hand, scholars, especially those driven by IWRM concepts calling for the integration of all sectors and actors into the management of water resources, argue in favor of inclusive institutions (GWP 2000, Kliot et.al. 2001, Mostert 2003b: 37 ff., Backer 2006, Goh 2007, Gerlak/Grant 2009). Mostert (2003b: 37) points out that, although cooperation might be easier to achieve with less participants, "excluding basin states from the process can lead to conflicts with these states or to suboptimal solutions" and, similarly, Kliot et.al. (2001: 229) argue that "the success of institutions which were founded on basin-wide joint management lies in their territorial coverage". Backer (2006) and Goh (2007) demonstrate for the case of the Mekong River Basin that the absence of China in the Mekong River Commission (MRC) significantly decreases the RBO's effectiveness.

A similar debate can be observed regarding the functional scope of RBOs, that is, the question whether RBOs should focus on a limited sub-set of collective action problems in the river basin or govern an integrated set of problems at once (Bernauer 1997, Kliot et.al. 2001, Marty 2001, Dombrowsky 2007, Sadoff et.al. 2008). Based on IWRM assumptions on the integrated management of water resources, hydropolitics scholars (Kliot et.al. 2001, Dombrowsky 2007, Sadoff et.al. 2008) often argue that the integration of all (relevant) collective action problems is of great importance for the effective governance of the river basin at stake. Others scholars, however, have pointed out that in international river basins "the number of multipurpose institutions is small, and the number of multipurpose institutions with a record of effectiveness is even smaller" (Marty 2001: 25). So far, scholars remain skeptical whether integrated river management indeed performs better than single-issue management (Bernauer 1997: 184). Overall, there is no comprehensive analysis of the impact of the functional scope of an RBO on its effectiveness, but it is assumed that there is a trade-off between the fact that agreements with narrower scope are easier to reach and more effective in

terms of goal attainment, but their effectiveness with regard to the impact dimension is lower (Mostert 2003b: 39, Schmeier 2010a).

In addition, the legal status of an RBO and its degree of formalization and legalization have been identified as important for the respective organization's effectiveness as well (Vinogradov/Langfrod 2001, Giordano/Wolf 2003, Mostert 2003b: 34 ff., Dombrowsky 2007, Sadoff et.al. 2008, Köppel 2009). Sadoff et.al. (2008: 67) argue that the less legally defined an institution, the more it lacks clear guidance and binding rules that facilitate effective cooperation, and, similarly, Vinogradov and Langford (2001: 346) point out that a framework of cooperation – as examined for the case of the Aral Sea – needs to have an unambiguous legal status. Köppel (2009), on the other hand, points out that non-binding agreements are easier and faster to achieve and can thus provide important means of institutionalizing cooperation when more binding agreements and higher commitments cannot be concluded for political reasons. This claim is discussed for the case of the Rhine River Basin, where unbinding agreements on institutionalized cooperation (such as the 1987 Rhine Action Program) contributed as significantly to the reduction of water pollution as binding agreements (such as the 1976 Rhine Chemical Convention) did.

### 4.2. Water Resources Governance Mechanisms within RBOs – the 2nd Dimension of Institutional Design

Besides the pure legal status, the organizational set-up of an RBO has also been identified as an important factor for the effectiveness of water resources governance (Mostert 2003b: 26 ff., Schmeier 2010a). Although organizational structures of RBOs vary highly between extremely simple one-dimensional structures (such as the Permanent Indus Commission, PIC) and very complex multi-dimensional structures (as, for instance, the Organisation pour la Mise en Valeur du Fleuve Senegal, OMVS), no studies have been undertaken yet regarding the effectiveness-conduciveness of each of these structures. However, it has been hypothesized, based on experiences from international organizations in general, that the organizational set-up needs to reflect the functional scope the RBO deals with in order to allow for effective river basin governance (Schmeier 2010a).

Decision-making mechanisms among RBO members and within the different governance levels of RBOs have been studied as well (Mostert 2003b, Dombrowsky 2007). Although it has been argued that majority voting principles indicate a high power of the RBO vis-à-vis its members (Dombrowsky 2007: 111), the vast majority of existing RBOs takes decisions based on unanimity and consensus rules, suggesting that the precise design of decision-making mechanisms might not be as decisive for an RBO's effectiveness. Mostert (2003b: 40) adds that decision-making mechanisms should include other actors than RBO member states only, reflecting the recent trend towards more public participation in institutionalized river basin governance – although rarely realized on the ground.

Since decision-making is driven by data and information, the way they are exchanged within RBOs has been identified as an important factor as well (Chenoweth/Feitelson 2001, Burton-Molden 2005, Grossmann 2006, Sadoff et.al. 2008, Zawahri 2008a). While the need for data and information sharing has also been incorporated in international water law and namely the 1997 UN Convention (Art. 9 states that "states shall on a regular basis exchange readily available data and information on the condition of the watercourse"), the reality of data and information sharing in international river basins still falls short of expectations. As, for instance, Grossmann (2006) shows for the Senegal River, the lack of information on the effects of dams, related to a limited information exchange

within the OMVS and with Guinea, not being a member of the OMVS until 2006, has led to significant negative effects on ecosystems and populations in the basin. With data and information sharing being perceived as so decisive for effective water resources governance, researchers as well as policy makers have called for the improvement of existing mechanisms often regarded as insufficient and inefficient in many RBOs and/or the establishment of appropriate mechanisms where not existent yet. In addition, it has been emphasized that data and information sharing can provide a framework for developing patterns of cooperation even with regard to more contentious issues (Sadoff e.tal. 2008: 170).

If, nevertheless, disputes arise among the members of an RBO, dispute resolution mechanisms are perceived as particularly important for the effectiveness of river basin governance. This has been emphasized by proponents of hydropolitics (Vinogradov/Langfrod 2001, Giordano/Wolf 2003, Ochoa-Ruiz 2005, Sohnle 2005, Dinar 2008, Fischhendler 2008, Zawahri 2008a) as well as by international (water) law scholars (Compte/Jehiel 1997, Boisson de Chazournes 2002). Incorporating clear mechanisms for resolving conflicts is thereby perceived as a prerequisite for long-term effective management (Giordano/Wolf 2003: 79). Without a clear set of conflict resolution mechanisms, however, states have incentives to cheat or to completely defect (Zawahri 2008a: 466 ff.), which is demonstrated for the case of the PIC, where conflict resolution mechanisms have been outlined clearly and work well, and the Joint Water Commission (JWC) on the Jordan, which lacks such instruments. This has been demonstrated by Vinogradov and Langford (2001: 353 ff.) for the case of institutionalized cooperation mechanisms in the Aral Sea Basin, where the lack of well-functioning dispute resolution mechanisms is perceived as a fundamental challenge to effective transboundary water resources governance.

Another factor outlined by researchers as well as water policy practitioners is the importance of sustainable financing of RBOs (e.g. Bernauer 1995, Vinogradov/Langfrod 2001). Only RBOs that possess sufficient financial resources are able to contribute effectively to the governance of a river basin, while experiences from RBOs continuously lacking financial resources indicate tremendous effectiveness losses. Therefore, the importance of external contributions from development partners has been emphasized by some scholars, either coming from within donor organizations (e.g. Kirmani/LeMoigne 1997, Alaerts 1999, Salman 2009) or analyzing donor organization's engagement in specific river basins (Nakayama 1997, Gerlak 2004, Mostert 2005, Hartje 2007, Zawahri 2009). However, it needs to be noted that research has so far most often focused on third-party contributions to the establishment of RBOs (refer to section 3.2.), while the impact of donor engagement on the effectiveness of these organizations once they have been established has not yet been analyzed sufficiently.

Despite these promising approaches, research on the effectiveness of river basin governance in general and the contribution of RBOs in particular is still in its infancy. Approaches from different water-related disciplines as well as insights from more general International Relations research have not been integrated sufficiently and the identification of potential determinants of effectiveness is often based on case studies only, with causal links between a certain independent variable and a certain degree of effectiveness often being hard to trace consistently and even harder to measure.

# 5. The Way Ahead – Newly Emerging Challenges in International Watercourses Governance

With several new challenges emerging in international river basins and/or on the political agenda, scholars have turned towards new issues of watercourses governance. The following paragraphs briefly introduce the most important challenges ahead and provide an overview of emerging research, outlining future paths of scholarly research that need to be integrated into existing knowledge in order to develop policy strategies that allow for the sustainable governance of international watercourses.

Climate change will affect water resources in various ways (see Draper/Kundell 2007, IPCC 2008, Alavian et.al. 2009, DeStefano et.al. 2009). This has been recognized by hydropolitics scholars that have increasingly focused on the study of the impacts of climate change on conflict and cooperation in river basins and ways how institutionalized cooperation mechanisms can contribute to increasing resilience to climate change. Economic studies have also focused on the impact of climate change and related flow variability on the stability of cooperation, in particular in the form of treaties (Beard/McDonald 2007, Janmatt/Ruijs 2007, Ansink/Ruijs 2008, Ambec/Dinar 2009, Dinar et.al. 2010). Janmatt and Ruijs (2007) find that cooperation is generally larger in arid than in wet areas, but provides little gains if integration is not extended beyond water issues. Similar to what has been found for water scarcity and treaty formation, Dinar et.al. (2010) put forward the argument that there is a U-shaped relationship between water supply variability (as a proxy for climate change) and cooperation among riparian states in the form of IWTs (although tested for bilateral river basins only). Based on similar assumptions that climate change consequences influence institutionalized cooperation mechanisms, other scholars have emphasized the need for adaptation mechanisms (Bernauer 2002, Giordano/Wolf 2003, Fischhendler 2004, Drieschova et.al. 2008, Eckstein 2010). It is thereby argued that the manner in which water allocation is codified has significant implications for the resilience of agreements as resource conditions vary (Drieschova et.al. 2008: 288). Other scholars have examined specific climate change adaptation practices ongoing or required in particular basins, such as Conway (2005) for the Nile, emphasizing the need for embedding climate change adaptation policies into the broader hydropolitical and geopolitical context of the region; or Kistin/Ashton (2008) for the Orange, identifying existing and proposing additional flexibility provisions within the Orange-Senqu Agreement.

Besides climate change, groundwater and transboundary aquifers are increasingly moving up on the political agenda, namely on the global level, where important efforts are made by the UNESCO-led Initiative on Internationally Shared Aquifer Resources Management (ISARM), supporting the work of the International Law Commission (ILC) in developing international law principles for the management of shared groundwater resources. Accordingly, hydropolitics scholars focusing on groundwater (e.g. Biswas 1999, Freestone 1999, McCaffrey 1999, Salman 1999 in form of a comprehensive edited volume, Eckstein/Eckstein 2003, Kemper et.al. 2003, Eckstein 2004, Eckstein/Eckstein 2005, Scheumann/Herrpfahrt-Pähle 2008, Schmeier 2010b) have emphasized the need for integrated management of groundwater resources, so far largely neglected by policy makers. Based on their geophysical characteristics, Eckstein & Eckstein (2005) classify transboundary aquifers into different categories, each of them being related to a different likelihood of cooperation and joint management between states sharing this resources. Furthermore, water law scholars have investigated whether one can derive lessons from existing law on transboundary water resources or

existing surface water RBOs to the specific case of groundwater (McCaffrey 1999, Freestone 1999, Eckstein/Eckstein 2003, Schmeier 2010b). In the edited volume by Scheumann and Herrpfahrt-Pähle (2008), a number of authors apply these theoretically derived concepts of transboundary groundwater governance to different cases in Africa, a continent with more than 40 shared aquifers and thus of particular interest for this new field of analysis.

With respect to watercourses governance principles, the inclusion of riparian populations and thus the civil society has gained importance (e.g. Bruch 2003, Mostert 2003a and 2003b: 30 ff., Delli Priscolli 2004, Bruch et.al. 2005, Curton 2005, Kranz/Vorwerk 2007). Mostert (2003a: 5 ff.) emphasizes the importance of integrating sub-national and non-governmental actors in the governance of transboundary watercourses, since international collective action problems over shared natural resources are often linked to domestic factors that need to be included in their solution as well. However, public participation is extremely limited in the governance of transboundary water resources (Mostert 2003b) and only very few RBOs allow for the participation of the civil society and NGOs in decision-making procedures (e.g. the International Commission for the Protection of the Danube River, ICPDR, and the ICPR) while more though not all integrate the public in their information sharing mechanisms (e.g. the Nile Basin Initiative, NBI). Kranz and Vorwerk (2007) prepare the ground for future public participation in water resources management by analyzing the main principles and legal provisions for public participation, with experiences drawn from Southern African and European watercourses.

One answer to upcoming challenges as outlined above has been the development of new concepts that capture the reality of transboundary waters in the world. One of the most prominent ones is the concept of 'virtual water' (e.g. Allan 1997, Earle 2001, Allan 2003, Kumar/Singh 2004, Horlemann/Neubert 2007): It takes into account non-territorial aspects of the global distribution of freshwater resources such as the fact that some countries import water via goods (such as agricultural products) from other, often water scarce countries, significantly influencing the overall distribution of freshwater resources. Linking the virtual water approach to more general analysis of international cooperation on transboundary waters is therefore of great importance for further advancements in the field of hydropolitics.

Another rather new concept that has been explored in order to find means for sustainably and cooperatively governing shared watercourses is the concept of benefit-sharing among riparian states (Sadoff/Grey 2002, Sadoff et.al. 2002, Sadoff/Grey 2005, Klaphake 2006, Qaddumi 2008, Sadoff et.al. 2008, Dombrowksy 2009). In the development of these concepts, water economics approaches have provided particularly important insights. As a first step, Sadoff and Grey (2002 and 2005) have distinguished four different types of benefits to be derived from cooperation on shared water resources – benefits to the river, benefits from the river, benefits because of the river and benefits beyond the river. Building on this distinction, different potential benefit-sharing mechanisms have been identified, ranging from direct side payments to compensation, from purchase agreements to joint project design and from financial agreements to institutional practices, and findings have been applied to specific river basins (e.g. Sadoff et.al. 2002, exploring the potential for benefit sharing in African transboundary river basins). In addition, the different prerequisites for successful benefit-sharing have been explored (Quaddumi 2008, Dombrowsky 2009). Quaddumi (2008: 3) identifies different factors determining whether benefit-sharing is promising in international basins, e.g. the type of goods involved, the number of actors involved, or the distribution of power means among participants of cooperation. Similarly, Dombrowsky (2009) distinguishes different types of problems

(mainly negative and positive externality structures) and explores their respective conduciveness for successful benefit-sharing among riparians of a shared watercourse. However, despite the extreme popularity of benefit-sharing concepts, their introduction into joint water resources governance is still in its infancy. Only very few RBOs have so far declared to develop benefit-sharing mechanisms (namely MRC, NBI and Volta Basin Authority, VBA) and even fewer RBOs have such mechanisms already in place (with the OMVS being the most prominent example, with the RBO organizing the sharing of benefits generated from jointly established infrastructure, namely dams for irrigation and hydropower purposes). As a consequence, research on benefit-sharing mechanisms in RBOs most often focuses on the development of concepts and strategies for benefit-sharing without actually examining how such concepts are translated into policies in specific RBOs (e.g. Sadoff/Grey 2002 and 2005, Dombrowsky 2009). While benefit-sharing is a promising approach for the management of shared water resources and shared natural resources in general, more research is needed to derive policy-relevant recommendations from so far very theory-driven approaches.

## 6. Conclusion

Overall, it can be concluded that hydropolitics research has made important advances in the last years. Scholars are now able to map the circumstances under which water conflict and cooperation emerge and analyze when and how IWTs are signed and RBOs formed and to identify factors that make the establishment of institutionalized cooperation particularly difficult. However, the translation of this knowledge into policy action is less promising, with many river basins still struggling with the absence of institutionalized cooperation mechanisms despite the existence of severe collective action problems: For instance, the Chiloango River Basin in Central Africa, shared by Angola, the Democratic Republic of Congo, the Republic of Congo/Brazzaville and thus situated in an extremely conflict-prone region, the Irrawaddy River Basin, hosting one of the world's most biodiversity-rich ecosystems, the Salween River Basin, facing an increasing exploitation of its resources, namely by China, or the Tarim River Basin, shared by China and several Central Asian Republics and facing severe environmental problems, have not yet seen any attempts of establishing cooperation mechanisms – neither on the initiative of riparian states nor based on support from external actors.

More recently, the effectiveness of institutions once they have been established has moved up on the research agenda and promises findings not only important for academic advances but also for policy-makers engaged in the governance of international watercourses. While more than 100 RBOs have so far been established in international watercourses, their effectiveness varies significantly not only across basins but also across sectors and issue-areas. Improved understanding of what determines the effectiveness of RBOs can therefore make important contributions to water resources governance. However, more research on the different potential determinants of effectiveness of institutionalized water resources governance is needed. As long as research is dominated by case studies focusing on very few river basins only or by purely quantitative studies testing hypotheses on a large sample of river basins, rarely going beyond the pure depiction of correlations, little can be done to translate findings into generalizable policy recommendations.

Moreover, issues so far neglected in the analysis of water resources governance have been integrated into the academic debate, providing additional insights and ensuring an integrated perspective on water resources governance. The integration of new issues (such as groundwater governance), now governance concepts (e.g. benefit-sharing) and new actors (namely non-

governmental actors) can help to move water resources governance to a truly integrated level, significantly improving the effectiveness of institutionalized cooperation mechanisms and thus ensure the peaceful and sustainable governance of shared natural resources in international river and lake basins on the long-term.

It can thus be concluded that only an integrated theoretical approach that goes beyond disciplinary divides and the sole focus on case studies can provide adequate theoretical means and thus policy concepts and strategies to cope with persistent collective action problems in international river and lake basins.

## Abbreviations

| | |
|---|---|
| BAR | Basins at Risk |
| EU | European Union |
| GDP | Gross Domestic Product |
| GEF | Global Environment Facility |
| GWP | Global Water Partnership |
| ICPDR | International Commission for the Protection of the Danube River |
| ICPR | International Commission for the Protection of the Rhine |
| ILC | International Law Commission |
| ISARM | Internationally Shared Aquifer Resources Management |
| IWT | International Water Treaty |
| JWC | Joint Water Commission |
| LIMCOM | Limpopo Watercourse Commission |
| MRC | Mekong River Commission |
| NGO | Non-Governmental Organization |
| OMVS | Organisation pour la Mise en Valeur du Fleuve Senegal |
| ORASECOM | Orange-Senqu River Commission |
| PIC | Permanent Indus Commission |
| RBO | River Basin Organization |
| SADC | Southern African Development Community |
| TFDD | Transboundary Freshwater Dispute Database |
| UN | United Nations |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| VBA | Volta Basin Authority |

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