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Conflict and Cooperation over Domestic Water Resources in the Mediterranean, the Sahel Area, and the Middle East: Drivers and Structural Alternatives for Conflict-Reducing Management

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Theresa Margarete Tribaldos

MSc UZH, University of Zurich
MA in Geopolitics, Territory and Security, King's College London

born
1 March 1981

citizen of
Lenzburg, Canton of Aargau

accepted on the recommendation of

Prof. Dr. Thomas Bernauer, examiner
Prof. Dr. Andreas Wenger, co-examiner
Prof. Dr. Eran Feitelson, co-examiner

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Abstract

This dissertation examines domestic water-related conflict and cooperation using a mixed-method design. First, I investigate the drivers of conflict and cooperation in an econometric analysis in 35 countries in the Mediterranean, the Sahel and the Middle East from 1997 to 2009. Second, I analyse the processes behind conflict and cooperation in three case studies focusing on Morocco, Portugal, and Israel. I suggest frameworks that revolve around institutions which can address water-related conflicts in an efficient and effective way. Water-related conflict is defined as low-level and low-intensity conflict, where one or several actors engage in activities that have a negative (conflictive) effect on water quality or quantity. In the case studies, I further extend this definition to activities that run against the official strategy of water management. Accordingly, water-related cooperation refers to activities that have a positive (cooperative) effect on water quality or quantity.

For the statistical analysis, we[1] constructed a new dataset. We collected and coded data on domestic water-related conflict and cooperation from news media items stored in the BBC Monitoring archive. From around 78'000 retrieved media items, we identified 10'352 items that were relevant and built up the WARICC (water-related intrastate conflict and cooperation) dataset. 18% of these items are of conflictive nature, 35% of cooperative and the rest is neutral, i.e., water-related but neither conflictive nor cooperative. The quantitative analysis builds on theory of supply, demand and restraint factors and their impact on water-related conflict. We hypothesise that supply and demand side factors should have a conflict-increasing effect while restraint factors should have a conflict-decreasing effect. While we find evidence for a positive relationship between demand factors and conflict[2], the data does not suggest that conflict is related to supply side factors[3]. The demand side factors, i.e. agricultural productivity and population density, are less robust across different models. In turn, the supply side factors are not statistically significant. Restraint factors such as democracy and political stability deliver statistically significant results.

Furthermore, the comparative case studies on Morocco and Portugal look at decentralised water management. Morocco is on average the most cooperative country in the WARICC dataset while Portugal is on average among the most conflictive countries. I build a framework that analyses suitable institutions to address water-related conflict both efficiently and effectively. More concretely, I examine institutional features that are helpful in decreasing the intensity and number of water-related conflicts. I find that such features are best organised in decentralised water

[1] The first part of this dissertation was embedded in the CLICO project (Climate change, hydro-conflicts an human security), financed by the 7th Framework Program of the European Union. Our team at ETH Zurich, Thomas Bernauer, Tobias Böhmelt and I, collaborated with Nils Petter Gleditsch, Halvard Buhaug, and Gerdis Wischnath from the Peace Research Institute in Oslo (PRIO).

[2] We consider GDP per capita, agricultural productivity, and population density.

[3] We consider a 30-year moving average of temperature and precipitation.

management institutions with participatory mechanisms for stakeholders, oriented along river basins, and provided with the necessary control and sanctioning powers.

In the Israeli case study, I focus on stakeholder leverage in terms of water management. By comparison with Morocco and Portugal, Israel has a strongly centralised water management system and there are hardly any official opportunities for stakeholder involvement or participation. In order to gain leverage at the national decision-making level, different stakeholder groups choose different strategies. These depend on the ability of stakeholders to organise and have different conflictive or cooperative implications. Consequently, some groups are more successful in influencing central decision-making while others have difficulties to be heard. Based on the findings of this case study, I conclude that more participatory mechanisms could minimise conflictive strategies and would support a more equitable water allocation in the long run.

Zusammenfassung

Diese Dissertation analysiert Hintergründe und Zusammenhänge von Konflikten und Kooperation in Bezug auf Wasserresourcen im Mittelmeerraum, der Sahelzone und im Mittleren Osten von 1997 bis 2009. Konflikte werden dabei als kleinräumige Aktivitäten definiert, die als Streitigkeiten auf niedriger Intensitätsstufe stattfinden und eine negative Auswirkung auf die Wasserqualität oder -quantität des jeweiligen Landes haben. In den Fallstudien wird diese Definition ausgeweitet auf allgemeine Opposition gegen das offizielle Wassermanagement des Staates. Folglich wird Kooperation als Aktivität definiert, die eine positive Auswirkung auf die Wasserqualität oder -quantität des jeweiligen Landes hat. Im ersten Teil der Arbeit werden die Ursachen von wasserbedingten Konflikten und Kooperation quantitativ im Untersuchungsgebiet analysiert. Im zweiten Teil gehe ich innerhalb von Fallstudien auf die genaueren Zusammenhänge und Prozesse, die zu Konflikten führen, im Detail ein. Dabei analysiere ich insbesondere, welche Institutionen sich eignen, um Wasserkonflikte effizient und effektiv anzugehen.

Für die statistische Analyse wurde zunächst ein neuer Datensatz erstellt. Wir[4] sammelten und kodierten Daten zu Wasserkonflikten und Wasserkooperation mit Hilfe der BBC Monitoring Mediadatenbank. Aus ca. 78‘000 gefundenen Medienmeldungen waren 10‘352 relevant für den neuen WARICC (water-related conflict and cooperation) Datensatz. 18% dieser Meldungen gehören in die Kategorie konfliktive Ereignisse, 35% sind kooperativ und der Rest ist neutral. Neutrale Ereignisse haben zwar einen Bezug zu Wasser, können aber weder als konfliktiv noch als kooperativ klassifiziert werden. Die statistische Analyse baut auf einem konzeptuellen Rahmen auf, der sich auf Angebots-, Nachfrage- und einschränkende Faktoren ausrichtet. Wir stellen die Hypothesen auf, dass Angebots- und Nachfragefaktoren einen konflikt-verstärkenden und einschränkende Faktoren einen konflikt-verringernden Einfluss haben. Als Angebotsfaktoren verwenden wir einen 30-jährigen gleitenden Temperatur- und Niederschlagsmittelwert. Für die Nachfragefaktoren verwenden wir das pro-Kopf Bruttoinlandprodukt, landwirtschaftliche Produktivität und die Bevölkerungsdichte. Einschränkende Faktoren beinhalten den Demokratiegrad und politische Stabilität. Während das pro-Kopf Bruttoinlandprodukt und die einschränkenden Faktoren signifikante Resultate liefern, verhalten sich die landwirtschaftliche Produktivität und Bevölkerungsdichte über verschiedene Modelle hinweg nicht robust. Die Angebotsfaktoren sind statistisch nicht signifikant.

Der Fokus der vergleichenden Fallstudien in Marokko und Portugal liegt auf dezentralisierten Wassermanagementsystemen. Während Marokko im Durchschnitt das kooperativste Land im

[4] Der erste Teil dieser Doktorarbeit wurde innerhalb des CLICO Projektes (climate change, hydro-conflicts and human security) in Zusammenarbeit mit dem Peace Research Institute in Oslo (PRIO) durchgeführt. An dem durch das 7. Rahmenprogramm der Europäischen Union finanzierte Projekt nahmen aus Zürich Thomas Bernauer, Tobias Böhmelt und ich teil, aus Oslo arbeiteten Nils Petter Gletditsch, Halvard Buhaug und Gerdis Wischnath mit.

WARICC Datensatz ist, gehört Portugal im Durchschnitt zu den konfliktivsten Ländern. Für diese Studie verwende ich einen konzeptuellen Rahmen, der Institutionen analysiert, welche wasserbedingte Konflikte effizient und effektiv behandeln. Genauer gesagt untersuche ich Institutionen, die es ermöglichen, Intensität und Anzahl von Wasserkonflikten zu reduzieren. Ich komme dabei zum Schluss, dass solche Institutionen gut in dezentralisierten Wassermanagementsystemen mit partizipativen Komponenten organisiert werden können, die sich an Flusseinzugsgebieten orientieren. Die nötigen Kontroll- und Sanktionsmöglichkeiten müssen dabei gegeben sein.

In der Israel Fallstudie liegt der Fokus auf dem Einfluss, den einzelne Interessenvertreter auf das nationale Wassermanagement ausüben können. Im Vergleich zu Marokko und Portugal hat Israel ein stark zentralisiertes Wassermanagement mit kaum institutionalisierten Möglichkeiten für Interessenvertreter, ihre Meinung einzubringen oder an Entscheidungen teilzuhaben. Um dennoch Einfluss auf die nationale Entscheidungsebene auszuüben, wählen verschiedene Interessenvertretergruppen verschiedene Strategien. Diese Strategien hängen von den jeweiligen Fähigkeiten der Interessenvertretergruppen ab, sich zu organisieren. Sie haben dementsprechend auch verschiedene Auswirkungen auf Konflikte und Kooperation. Folglich sind einige Gruppen erfolgreicher als andere, wenn es darum geht, auf nationaler Ebene Einfluss zu nehmen. Ich rege daher an, mehr partizipative Mechanismen einzuführen, die längerfristig konfliktive Strategien reduzieren und eine unparteiischere Wasserverteilung fördern könnten.

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1. Introduction

1.1. Motivation

70 per cent of the earth's surface is covered by water but the distribution of freshwater resources on continents varies to a large degree. Whereas mid- and high-latitudes as well as the tropics receive plenty of precipitation in general, the sub-tropics and desert environments often endure water scarcity and extended drought periods. Freshwater is the most vital resource for human societies. Therefore, dry areas pose serious challenges to freshwater supply and a comprehensive water management including adequate treatment of wastewater. This situation is aggravated by several factors that threaten water quality and quantity. The most powerful of these factors is population growth (Vörösmarty et al., 2000) which can strain states' capacities to keep up with water infrastructure that often already presents deficiencies on its own. In particular, an appropriate treatment of sewage and wastewater is lacking in many parts of the world[5] which means that these products often end up unfiltered and untreated in rivers and the sea. Thus, pollution is the second factor that threatens water resources. In addition to inadequate sewage and wastewater disposal, many freshwater resources suffer from industrial and agricultural pollution (Seitzinger et al., 2005). Sewage and agricultural pollution leads to eutrophication, lower oxygen levels in the water, and the reduction of species living in there (Smith and Schindler, 2009). Another threat to aquatic species, and the third factor that threatens water resources, are large infrastructure projects such as water storage in dams for irrigation or hydropower generation and extensive drainage programs. Although these projects have uncontested benefits in terms of energy generation and irrigation, they also interrupt migration paths for fish and other species or destroy complete ecosystems (Egger et al., 2012; Ferguson et al., 2011). The last factor that becomes increasingly influential for water quantity and quality is climate change. Climate change, on the one hand, leads to altered runoff in the hydrological cycle. In practice, this means that certain areas will profit from more precipitation while others will suffer from less. Extreme weather events are also likely to increase in number (Meehl et al., 2007). Especially areas such as the Mediterranean, the Sahel, and the Middle East are likely to experience a precipitation reduction of between 15 and 30% (Meehl et al., 2007). Less precipitation accentuates challenges of water supply for households and irrigation even more. On the other hand, a reduction in runoff also weakens the self-purification mechanisms of rivers and aquifers because it takes longer to leach out the accumulated pollutants (Mimikou et al., 2000).

[5] The WHO and UNICEF joint monitoring programme for water supply and sanitation estimates that the percentage of treated wastewater is still small worldwide (North America 90%, Europe 66%, Asia 35%, Latin America and Caribbean 14%, Africa 0%). Source: WHO/UNICEF Global Water Supply and Sanitation Assessment 2000 Report.

The importance of intact freshwater resources and their acute threats provoked prophecies of future conflict over those resources. During the last decade, the discussion developed around violent conflicts over water resources, sometimes referred to as "water wars". Social scientists from several fields contributed to the discussion as well as authors of popular literature who predict large-scale violent conflict over water in the future (e.g., Ward, 2002; Welzer, 2008) and played a key role in popularising the notion of "water wars". Social scientists arguing in favour of violent conflict over scarce resources in general (Hauge and Ellingsen, 1998; Libiszewski, 1996; Meier et al., 2007; Suliman, 1996) usually refer to Neo-Malthusian arguments. These arguments draw the link from increasing scarcity over increased competition to conflict over these resources (Homer-Dixon, 1999; Percival and Homer-Dixon, 1998). Cornucopian theory, in turn, has triggered contributions arguing against this path to conflict with reference to cooperative and technological solutions to scarcity problems (Katz, 2011; Simon, 1989, 1996).

Another group of scholars focuses more specifically on the links between water and large-scale violent conflict or civil war and come to different conclusions (Buhaug, 2010a; Esty et al., 1998; Gizelis and Wooden, 2010; Hauge and Ellingsen, 1998; Hendrix and Glaser, 2007; Koubi et al., 2012; Raleigh and Urdal, 2007; Theisen, 2008). While some studies find evidence that water might be related to conflict (Hauge and Ellingsen, 1998; Hendrix and Glaser, 2007; Raleigh and Urdal, 2007), others are unable to do so (Buhaug, 2010a; Esty et al., 1998; Koubi et al., 2012; Theisen, 2008). Studies looking at international conflict usually refer to existing conflict models in which they integrate water and climate variables such as precipitation, temperature, or freshwater supply among other socio-economic and political factors. These studies look at the relation between water and large-scale violent conflict or civil war. They take all conflicts into account, regardless of whether they are related to water or not although they do not consider small-scale non-violent conflicts. This fact might to some extent explain the ambiguity in the findings. Other studies concentrate on explaining the causes for conflict in general and argue that these causes are more prevalent than water or climate (e.g., Blattman and Miguel, 2010; Fearon and Laitin, 2003; Hegre and Sambanis, 2006). Bernauer et al. (2012a) and Deligiannis (2012) give detailed reviews of this literature.

Literature on transboundary water resources mainly relies on two different datasets: the "Issue Correlates of War Project's" (ICOW) River Claims Dataset[6] (e.g., Hensel et al., 2006; Mitchell and Hensel, 2007), and the Transboundary Freshwater Disputes Dataset (TFDD)[7] (e.g., Giordano et al., 2002; Gleditsch et al., 2006; Wolf et al., 2003b; Yoffe et al., 2003; Yoffe et al., 2004). The ICOW dataset contains disputes in international river basins and includes all cases where one or more

[6] http://www.paulhensel.org/icowriver.html
[7] http://www.transboundarywaters.orst.edu/

states make official claims regarding water quantity or quality of international rivers. Hensel et al. (2006) find that water scarcity not only increases the risk of militarized disputes but also the likelihood of peaceful third party settlements. Their results also imply that river-specific institutions reduce the risk of conflict. Mitchell and Hensel (2007) concentrate more on cooperation and also conclude that international institutions reduce the risk of conflict. The TFDD looks at different topics of international freshwater resources including historical and thematic categories, and case study structures but the focus lies strongly on transboundary river basins. Wolf et al. (2003b) identify basins at risk. They point out that institutions and good international relations in general play an important role for cooperative behaviour and that sudden changes in these institutional settings or the lack of good relations can facilitate conflict. Yoffe et al. (2003) analyse factors that drive international conflict and cooperation. They are unable to identify a single decisive factor but they again, state that institutional settings and rapid changes of circumstances have strong effects on water conflict. They also find that a large majority of water issues are of a cooperative nature. Yoffe et al. (2004) introduce different applications of the TFDD dataset linked to geographic information systems (GIS), event data, and other socio-economic, physical, and political variables. One of their main messages is that non-absorbable changes within river basins that exceed institutions' adaptive capacity increase the risk of conflict. Gleditsch et al. (2006) find that rivers crossing a boundary can be a source of conflict in water scarce regions but not when the river runs along the border. Additionally, the size of the river basin exerts a strong impact on conflict. All of these settings have in common that conflict and cooperation can exist concurrently; they are not mutually exclusive.

The literature on the causes of water-related conflict is manifold and provides good explanations for why these conflicts occur but cooperative settings are considered less in the above literature. In contrast, the transboundary river literature offers explanations for cooperation over international rivers, i.e., it strongly emphasizes the importance of river institutions for cooperation and state that changes which overstrain adaptation capacities of these institutions can induce conflicts. In an attempt to explore new grounds in this field, Bernauer et al. (2012b) and Funder et al. (2010) collected new data on conflict and cooperation over domestic water resources. While Funder et al. (2010) only focused on one specific district in Zambia and accordingly collected very detailed information, Bernauer et al. (2012b) rely on news media reports and therefore have a much larger but less detailed dataset. Both papers find, similar to the transboundary river settings that cooperative events occur much more frequently than conflictive ones. Böhmelt et al. (Typescript) examine the drivers of conflict and cooperation based on the WARICC (water-related conflict and cooperation) dataset (Bernauer et al., 2012b). They find that factors that drive the demand for water such as population and economic development have much stronger impacts on water conflict than

climatic factors. They also observe that stable institutions can positively influence cooperation over water resources.

As compared to international and large-scale violent conflict settings, the domestic or intra-state level is still only poorly investigated. Drivers for intra-state small-scale and low-intensity conflicts related to water are hardly known just as little as the structures and institutions that deal with such conflicts. The absence of such studies is, on the one hand, subject to a lack of data at this level. A systematic dataset that compiles low-level intra-state conflict for a large number of countries, suitable for statistical analysis was missing until now. On the other hand, it is very time-consuming to create such a dataset. Apart from the media, no-one is interested in reporting such events but media reporting has its challenges in terms of reliability and validity of covered events. Furthermore, there exists a language problem when including local media from several countries and the international press often does not report on small local events from other countries. Despite all these shortcomings, media sources remain the easiest and most feasible option for compiling such a dataset and this work is necessary for a statistical analysis of drivers for water-related conflict and cooperation. Accordingly, the first step of this dissertation is a new dataset. The second step is a statistical analysis of the new data. In a third step, three case studies of particularly interesting countries are conducted. The following section introduces these steps in more detail.

1.2. The four papers of this PhD

The first paper of this PhD describes the compilation of the new WARICC dataset which contains data from 35 countries in the Mediterranean, the Middle East and the Sahel Area. The dataset consists of conflictive and cooperative events that are related to water quantity or quality within parts of or the whole country. The paper emphasises the importance of such a detailed dataset for statistical analyses. The data includes exact time and location of events and provides information on the intensity and impact of these events as well as the involved actors. Therefore, it is suitable for different types of analyses such as quantitative analyses at the national level or disaggregated analyses at the local level, given that independent variables are available at this resolution. The dataset is also helpful as a starting point for country-specific case studies and can point to potential hotspots of conflict or cooperation within a country. The main variable in the dataset is the water event scale (WES). It is used in the second paper as the basis for the dependent variable. This first paper further informs about the data coding process and gives some descriptive statistics on the data. In this co-authored paper, I mainly contributed to the conceptual and the data coordination and collection part.

In the second paper, the main variable of the WARICC dataset is regressed on political, socio-economic and climate variables. The conceptual framework of this paper builds on three main sets of hypotheses, namely demand-, supply- and restraint-related determinants of water-related conflict and cooperation. Demand-side determinants in this paper are population density, agricultural productivity and economic development. These factors are commonly assumed to increase water consumption and therefore increase the risk of conflict due to less water availability per capita. Supply-side determinants comprise climate anomalies. We assume that short-term variations in precipitation and, to a lesser degree, temperature are responsible for varying water availability in countries and, accordingly, should have an impact on water conflict. Restraint determinants include the level of democracy and political stability. We hypothesise that higher levels of democracy prevent escalation to violent conflicts but increase low-level conflicts due to freedom of expression (protests, demonstrations, etc.). The empirical evidence gives more support to demand-side determinants; the results for the supply-side are statistically not significant. Restraint factors show, indeed, a cooperation-increasing effect. My main contribution to this paper consists of work on the theoretical as well as the analytical part.

The third paper looks at how decentralised water management structures can be useful in containing and dealing with water conflicts based on in-depth interviews with experts in the water sector. I examine the results of two case studies in Morocco and Portugal comparatively while addressing the questions where water conflicts occur, how they are addressed in the respective countries, and which structures are successful in dealing with these conflicts. The cases Morocco and Portugal were selected on the basis of the statistical analysis of the WARICC data. Morocco had on average more water-related cooperation than most other countries, while Portugal had on average more water-related conflict than most other countries in the dataset. This fact is even more interesting because the water management systems in Morocco and Portugal are very similar. They are both based on the river basin as management entity and have decentralised structures within these river basins but Morocco granted more autonomy in decision-making to those river basins than Portugal. I find that participation in these decentralised structures is an important point for water-related cooperation while institutional instability and a lack of regulatory process for water demand management facilitate water-related conflict.

In the fourth paper, I look at the case of Israel which sets a contrast to the decentralised water institutions in Morocco and Portugal. At a first glance, Israel features an extremely centralised water management system with one national institution with comprehensive decision-making rights and few participative options for outside stakeholders. When looking at the Israeli system in more detail, it becomes apparent that water management is fragmented among different ministries.

Furthermore, institutions responsible for drainage and river rehabilitation are decentralised and have a high degree of autonomy. Through in-depth interviews, it became obvious that some stakeholders gained considerable influence at the national level of decision-making while others have very little influence. In order to increase leverage at the national level, different groups developed different strategies. While well organised groups with more resources rather choose lobbying and specific campaigns for reaching their goals, marginalised groups seek confrontation. One way of the national level institutions to address such conflicts would be to opt for more participative opportunities and inclusion of all stakeholders in such processes.

1.3. Main arguments

This PhD seeks to explore the conditions of domestic water-related conflicts and cooperation in a broad range including the main drivers of such events in the first quantitative part of the PhD and structural and institutional forms of managing water resources in the second qualitative part. The second part further looks at individual stakeholders and their strategies to gain access to and influence on the decision-making process. The first two papers deal with the quantitative analysis and the third and fourth paper look at the case studies. The first paper, the construction of the new dataset, primarily builds on existing studies that investigate links between resource scarcity and more specifically water scarcity and large-scale violent inter- or intra-national conflict (Buhaug, 2010a; Esty et al., 1998; Gizelis and Wooden, 2010; Hauge and Ellingsen, 1998; Hendrix and Glaser, 2007; Koubi et al., 2012; Raleigh and Urdal, 2007; Theisen, 2008). In a first step, we assume that the same mechanisms that apply to large-scale violent conflicts are also valid for small-scale and low intensity conflicts. This assumption also defines some of the arguments in the second paper. Accordingly, the first two papers focus on a set of different arguments ranging from Neo-Malthusian to institutional and socio-economic explanations why conflict or cooperation in relation to water should occur. The Neo-Malthusian arguments draw the link between resource scarcity and violent conflict (Homer-Dixon, 1999; Percival and Homer-Dixon, 1998). They consider factors that increase resource scarcity such as natural supply, and socio-economic conditions such as wealth standards or population density. Institutional explanations emphasise the mediating capacity of factors such as democracy or a stable political environment (Mitchell and Hensel, 2007; Wolf et al., 2003b).

In the third paper, I move away from classical Neo-Malthusian explanations and institutional theory that build the conceptual framework for general drivers of water-related conflict and cooperation. Instead, I concentrate on water management and how it can be organised in order to specifically address water-related conflicts. The theoretical basis of this paper is the literature on water governance (Cohen and Davidson, 2011) with a focus on decentralisation in water management systems and implications from integrated water resource management (IWRM) (Biswas, 2004;

Blomquist and Schlager, 2005; Cohen and Davidson, 2011); literature on the organisation of common pool resources' (CPRs) management that gives insights into systems that foster cooperation (Agrawal and Ostrom, 2001; Ostrom, 1992); as well as literature on public goods provision and its insights into the problem of free-riding (Hardin, 1968; Marwell and Ames, 1981; Olson, 1968) and the implications for an efficient control and sanctioning system (Fehr and Gächter, 2000; Sefton et al., 2007).

In the last paper, I include individual stakeholders in the discussion and look at how different groups' influence in water allocation and their capacity to get organised facilitate cooperative or conflictive strategies in their aspiration to gain leverage at the level of national decision-making. The conceptual framework of this paper is based again on water governance whereas the focus is on the comparison of centralised and decentralised management systems (Larson and Soto, 2008) and their advantages and disadvantages in terms of stakeholder participation in management questions (Beierle, 2002; Fischer, 2000). On the stakeholder side, I explore groups' capacities and strategies to organise, such as lobbying behaviour and mobilising (Baumgartner et al., 2009; Dür and Mateo, 2013).

1.4. Main findings

Descriptive statistics of the new dataset WARICC confirm the picture of other datasets that cooperative events are more frequent than conflictive ones. Out of over 10'000 events, only 17.9% of events in the WARICC data are of a conflictive nature, 35.4% are cooperative and the rest are neutral events. Neutral events are water-related but cannot be classified as cooperative or conflictive. When looking at violent events, the picture becomes even clearer: only 0.68% of all events are violent events and these all happen in non-democratic countries. It is salient that according to the data, democracies show more conflicts per capita than non-democracies and that non-democracies show on average 41% more cooperative events per capita than democracies. This point is discussed in the next section.

The results of the panel data in the regression analysis show no significant evidence for conflict-increasing effects of supply-side factors, thus precipitation and temperature anomalies. Demand-side factors generally perform better than supply-side factors although the results are not robust with the exception of GDP per capita. Agricultural productivity and population density are less reliable. As expected, democracy has a significant conflict-increasing effect when it concerns low-level conflicts while political stability has a conflict-decreasing effect. The analysis further confirms that a model considering all three types of factors, supply, demand and restraint, better accounts for domestic water-related conflict and cooperation than models that focus only on one type of factors.

The third paper shows that institutions have an important role as mediators of water-related conflicts. Decentralised and participative structures that involve all stakeholders can build a suitable

system to deal with water-related conflicts. Other necessary points, however, include effective demand regulation with functioning controls and sanctions. The paper further indicates that some cooperation might be short-lived and that conflicts can be postponed by supporting inefficient structures through subsidies.

The fourth paper addresses challenges in a centralised water management system. When participatory mechanisms are missing in such a system, it bears the risk that water allocation is inequitable and that some stakeholders lack influence in decision-making. Without official ways to participate, stakeholders define their own strategies to increase leverage. The stakeholders in the Israeli system are not equally successful with their strategies. Their reactions to varying leverage on water management also impact water-related conflicts and cooperation. Conflicts mainly occur with marginalised groups such as Bedouins and sometimes with environmental NGOs.

1.5. Limitations

Although I aimed at analysing the subject of domestic water-related conflicts and cooperation comprehensively, there are several limitations to this PhD research and open questions remain. First of all, the spatial and temporal coverage of the WARICC data is limited. The dataset covers 35 countries from 1997-2009. The main reason for the spatial limitation is a lack of resources. The coding process is very time-consuming and the money to hire research assistants was restricted for this project. Self-evidently, these restrictions are project-related and if future projects wish to engage in extending the dataset, there are no barriers to this endeavour. The temporal limitations, however, are more difficult to solve due to the availability of online sources. The database BBC Monitoring[8] only starts in 1997 which is similar for other databases. Although Factiva[9] states that their database reaches back 35 years, it will be difficult to find many local media companies that had their information in a digital format before the 1990s. Without digital sources, this information has to be found in archives or through interviews which of course protracts the process of data collection enormously (Ravnborg et al., 2012).

Apart from the physical availability of data and resource restrictions, there are also limitations to the quality of the data. The media is not unbiased in terms of the events they report on. First, it was not possible to find out how exactly BBC Monitoring elects the media sources they cover. Upon request, they claimed that they cover all available media sources but this seems very unlikely since certain media sources pop up in irregular intervals over the years and seem to alternate with other sources. Second, there are some assumptions on what events the media will report on but it is difficult to verify these assumptions. There clearly exist barriers for the media in non-democratic countries. We

[8] http://www.monitor.bbc.co.uk/
[9] http://www.dowjones.com/factiva/

assume that non-democratic regimes are likely to censor the reporting on conflicts because they want to avoid a negative image in the press. Furthermore, in democratic countries where press freedom is guaranteed, we expect to see more reporting on conflictive events because they attract more attention. Cooperation might seem less interesting to the media. Consequently, non-democratic countries are likely to underreport on conflictive events while democratic countries are likely to underreport on cooperative events. However, we do not know whether these biases really exist and what dimensions they might have.

Limitations for the quantitative analysis exist in the spatial extent of the dataset, in the resolution of other independent variables, as well as explanations that relate to cooperative outcomes. Although the study area includes some countries that are generally exposed to a high risk of conflict such as the Middle East or North Africa, it also includes countries in the EU which are presumably more resistant to conflict due to their integration in the European institutional network. Those countries that are at a higher risk of conflict are also affected by water scarcity but precisely this scarcity could also trigger better institutional arrangements for water, at least in states that have fairly functioning institutions. However, due to the lack of a global dataset, we cannot make assumptions about other countries with many water conflicts. For example, in some Latin American countries water conflicts primarily stem from water pollution through mining companies[10].

I address now the second point in the quantitative analysis which is the resolution of data. Although the WARICC dataset is suitable for a disaggregated analysis[11], there is often a lack of data for the independent variables in the same resolution or there is no variation in these variables because they only concern the national level. For example, the variables for democracy or political stability are only gathered for a country as a whole and it would not make sense to look at them in a disaggregated way because they do not vary within countries except for maybe federal states. Another question is whether the disaggregated unit of analysis is better captured by political entities or a grid-size. When institutional factors are considered, political entities clearly make more sense. If the focus is on climate data or demand-side factors such as population density or agricultural productivity, a grid with the appropriate resolution would be suitable, too. Theoretical and empirical evidence for cooperative events is also deficient. The case study results were only available after submission of the paper with the econometric analysis and could therefore not help to adjust the

[10] A survey conducted in Latin American countries showed that the majority of conflicts related to mining had their origin in water pollution. Source: Roberto Sarudiansky and Hugo Nielson, "Mining conflicts in Latin America and the "E" axis". Contribution to the Interregional IAEA-CYTED-UNECE Workshop on Recent Developments in Evaluation of Uranium and Thorium Resources.

[11] Disaggregated means that the level of analysis is not the country level but a unit with a higher spatial resolution. This could be the municipality or village level or simply a grid-cell with a defined resolution.

theoretical framework of this analysis. There are clearly open questions left as to which solutions are optimal to address water scarcity and to avoid water-related conflicts.

Some of the already mentioned limitations such as time and financial constraints also apply to the case study work. Furthermore, the question always remains how representative individual case studies are for the other cases. With no limits on resources, the case studies would benefit from involving more stakeholders in each country through interviews or surveys. Additionally, the data could be complemented with research in available archives. The frameworks that I proposed need refinement which can only be done with more data on political processes and on stakeholder-state interfaces. These frameworks were constructed on the basis of three individual cases but they were not tested on other cases which should give insights into deficient arguments and wrong assumptions in the frameworks. Once the case study frameworks are refined and sufficiently consolidated, it would be interesting to feed their findings into a quantitative framework and test them on a broader scale.

1.6. Prospects

This PhD contributes to the field of domestic water-related conflicts and cooperation which is still in the early stages of development. On the one hand it gives some information on the drivers of conflict and cooperation, on the other hand it offers suggestions on how such conflicts can be bounded and kept at low intensity. These first insights into the drivers of such conflicts and some structural advantages or disadvantages are informative but remain incomplete and further research is necessary. In the following paragraphs, I will explain how further research can address the limitations of this PhD project.

The goal of further research should be first, to gain more information on institutions that deal with water-related conflict and the features that make such institutions resilient and effective. Resilient and effective means that institutions are able to deal with existing conflicts in a way that leads to durable solutions which are acceptable to all involved stakeholders but that also pave the way to minimise future conflicts in intensity as well as in numbers. Such information helps to improve knowledge on policy and management processes and to build theory on water-related cooperation. Second, this detailed knowledge should be tested on the general drivers of water-related cooperation.

Considering the difficulties involved in acquiring data from before 1997, I suggest that it is easier to increase the number of countries in the dataset, especially in other areas of the world such as Latin America or Asia. It should be also tested whether it is possible to merge existing data from other parts of the world (e.g., Funder et al., 2010; Ravnborg et al., 2012) with the WARICC dataset. In order

to extend the variables of the dataset and also include more institutional elements that can contribute to explaining water-related cooperation, I suggest to do more case study work in the first place. Ideally, this additional case study work should take place in another region that features similar institutional conditions in water governance. In terms of interviews, democratic countries are preferred because they make it easier to ask delicate questions. People in democratic states are less under observation. However, non-democratic countries are also interesting to look at. This would on the one hand test the existing framework and, on the other, provide the opportunity to involve more stakeholders in the data collection and to engage deeper with interactions between those stakeholders and between stakeholders and the state. Apart from interviews, surveys and focus groups are important methods that should be included in a next case study. Surveys would help to collect information from larger stakeholder groups such as agriculture or industry about their preferences and general problems they encounter with the official water management. In sufficient numbers, this information can be used for statistical analysis. Focus groups are interesting because they allow for a confrontation of members of water institutions with different stakeholders groups and their preferences and problems, respectively. An analysis of their mutual interactions also reveals how water institutions address existing problems and claims of stakeholders.

2. Water-Related Intrastate Conflict and Cooperation (WARICC): A New Event Dataset[12]

Thomas Bernauer, Tobias Böhmelt, Halvard Buhaug, Nils Petter Gleditsch, Theresa Tribaldos, Eivind Berg Weibust and Gerdis Wischnath[13]

Abstract

Water scarcity is widely regarded as a key factor linking climate variability and change with conflict. However, existing research on the water-conflict nexus is hampered by poor data that inhibits drawing firm conclusions on the role of water in shaping societal stability and security. This article reports on the construction of a new dataset on sub-national and geo-referenced events over domestic water-related cooperation and conflict for 35 countries in the Mediterranean, the Middle East, and the Sahel for 1997–2009. The main value of this dataset is in its precision. Its key component, the Water Events Scale (WES), records the exact time, location, and intensity of water-related conflictive and cooperative events, as well as the actors involved. A few descriptive statistics and illustrations serve to demonstrate the usefulness of the new dataset for quantitative analyses of intrastate conflict and cooperation over water resources.

Climatic changes and their consequences for humans and nature are creating enormous policy challenges. Global mean temperature increased by about 0.8°C during the last century (Hansen et al., 2010), and – depending on the emission scenario – recent projections suggest that it is likely to increase by another 1–6°C in the course of the 21st century (Meehl et al., 2007). This temperature increase, which is and will be very unevenly distributed over the globe, is in large measure responsible for significant changes in local to regional precipitation patterns as well as an increased frequency of droughts, floods, and other extreme weather events.

One consequence of climatic changes that has received much attention in the academic literature as well as in the news media is human conflict – including violent disputes between and within countries (e.g., Buhaug et al., 2008; Salehyan, 2008; WBGU, 2008). Because changes in temperature affect the hydrological cycle and therefore precipitation and water availability, research on the climate change–conflict nexus is very much concerned with water scarcity. In this context, the main argument is that water scarcity can induce deterioration of social and economic conditions and, as a

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[13] The authors are listed in alphabetical order; equal authorship implied. Bernauer, Böhmelt, and Tribaldos: Center for Comparative and International Studies and Institute for Environmental Decisions, ETH Zurich. Buhaug, Gleditsch, Weibust, and Wischnath: Centre for the Study of Civil War, Peace Research Institute Oslo (PRIO). Buhaug and Gleditsch: Department of Sociology and Political Science, Norwegian University of Science and Technology (NTNU), Trondheim. Address correspondence to: thbe0520@ethz.ch. The authors thank Paul Diehl and two anonymous reviewers for helpful comments. They also acknowledge funding by the European Community 7th Framework Program under the collaborative project "Climate Change, Hydro-conflicts and Human Security" (CLICO), project number 244443. Lars Seland Gomsrud, Johan Dittrich Hallberg, Meaghan Jones, Lena Kiesewetter, Daniel Laupper, Bianca Oehl, Melanie Pfändler, and Gwen Tiernan provided valuable research assistance. Replication data, codebook, and supplementary materials are available at: http://dvn.iq.harvard.edu/dvn/dv/internationalinteractions, http://www.prio.no/cscw/datasets, and http://www.ib.ethz.ch.

consequence, distributional conflict over dwindling water resources where the affected people live or where they migrate as a result (Smith and Vivekananda, 2007).

Research on whether climate change (or otherwise) induced water scarcity affects the risk of conflict relies on two approaches. The first builds on existing theoretical and empirical models of inter- or intrastate violent conflict. It adds water-related variables, such as water scarcity or changes in precipitation, to these models and draws inferences based on the partial effects these variables have on conflict risk or intensity (Buhaug, 2010a; Ciccone, 2011; Furlong et al., 2006; Gartzke, 2012; Gizelis and Wooden, 2010; Gleditsch et al., 2006; Jensen and Gleditsch, 2009; Koubi et al., 2012; Miguel and Satyanath, 2010; Theisen, 2008; Theisen et al., 2011). However, work relying on this approach faces two types of limitations. If we do observe a partial effect of water scarcity on conflict in a regression model, we can only infer that, on average, water scarcity is associated with an elevated conflict risk. By implication, at least some of the conflicts that did occur presumably had something to do with water. But such analysis cannot offer explicit and definite information on whether instances of conflict were associated with water problems. In other words, research using the first approach can only provide circumstantial evidence concerning the hypothesis that water scarcity may cause conflict. Another limitation is that, so far, most of these studies largely focus on conflict and pay little if any attention to cooperation[14]. This limitation is important not only empirically, but also theoretically. While Neo-Malthusians have proposed water scarcity as a mechanism for translating environmental change into conflict, Cornucopians argue that the adaptive capacity of societies is the key. Such adaptive capacity involves technological innovation, the use of the market mechanism, cooperation, and social institutions. When limiting the analysis to violent conflict as the dependent variable, the first approach is unable to assess the contradictory Neo-Malthusian claim, although data collection efforts are beginning to fill the gap with respect to less or non-violent forms of conflict (Hendrix and Salehyan, 2012)[15]. Yet, they still do not provide explicit information on cooperation.

The second approach addresses both limitations of the first. It involves issue coding and seeks to identify whether an event concerns a water issue. Moreover, it measures both conflictive and cooperative events. Such data can provide valuable insights into the frequency and intensity of conflictive events relative to cooperative events. Hence, it responds to the debate between Neo-Malthusian and Cornucopians by providing evidence whether, for instance, water scarcity leads to more conflict than cooperation (Gleditsch, 2003).

14 Among the exceptions are Brochmann and Gleditsch (2006) and (Dinar, 2008).
15 The Social Conflict in Africa Database (SCAD) also codes conflict events by issue (Hendrix and Salehyan, 2012). The issues listed include “environmental” and “food, water, subsistence,” but there is no specific category for water issues only.

The two approaches discussed are clearly complementary. The first benefits from more readily available data and builds on pre-existing theoretical and empirical models of conflict, but is limited by considering one side of the interaction spectrum only (i.e., conflict) and by ignoring the direct relevance of the phenomenon of interest (e.g., water). The second approach, while providing some remedy for these limitations, is likely to be more sensitive to possible bias in the source material and coder interpretation (Ruggeri et al., 2011). Most notably, issue coding requires characterization of events as being water-related. This means that, when the data coder decides on whether or not an event is water-related, s/he imposes a causal analysis on the data. In most cases, the causal judgment will be made by a journalist because event datasets typically rely on news reports for data collection. Because media reporting is frequently quite "thin," this can lead to false positives or false negatives, i.e., coding a non-water event as a water-related event or vice-versa. Yet another challenge is that events that are characterized as water-related may, simultaneously, also concern issues that are unrelated to water (e.g., property rights). We return to the issue of data quality when presenting some simple trends below.

Aaron Wolf and his associates have compiled a useful event dataset on water-related cooperation and conflict among riparian countries of international river basins (Wolf et al., 2011; Yoffe et al., 2004). That dataset has since been used and extended by other scholars (Kalbhenn and Bernauer, 2011). However, the obvious lacuna here concerns the domestic level. Since the negative consequences of climate change and water scarcity are expected to manifest themselves primarily at the local to regional level, we urgently need systematic data on water-related conflict and cooperation at the sub-national level in order to advance research on the climate–water conflict nexus. Our new dataset contributes to addressing this shortcoming.

In this article, we present Water-Related Intrastate Conflict and Cooperation (WARICC), a new geo-referenced dataset on events over domestic water-related cooperation and conflict for 35 Mediterranean, Middle East, and Sahel countries in 1997–2009[16]. In the following sections, we report on how this dataset has been constructed, the coding procedures, and the data structure, and present some simple patterns and trends in the study region.

2.1. Data Coding

As indicated, WARICC is based on news reporting. At the outset, we evaluated various electronic repositories/providers of news media information and conducted a pilot study using two major data

[16] The reasons for the geographic limitation are both substantive and budgetary. The countries covered in our data are widely regarded as vulnerable to problems of water scarcity. They also vary strongly in terms of level of development, political institutions, and other factors that are regarded as important in the climate change and conflict literature. Moreover, given the fact that event data coding is very costly, we decided to give priority to the study region of the associated EU project, i.e., the Mediterranean rim and parts of the Sahel. Extension of our dataset to other countries should be straightforward.

bases, Factiva and BBC Monitoring. With more than 28,000 sources, Factiva offers the most comprehensive coverage, though this turned out to be a mixed blessing. Applying the search string created for this project (see below) and excluding irrelevant news sources such as stock reports, sport news, and weather reports Factiva still returned an unmanageable amount of news reports, with a ratio of 1 relevant article to 100 irrelevant hits. We considered random sampling as a means to obtain a reasonable share of data points but rejected the possibility because of the extreme share of irrelevant media items and because asymmetric media coverage would lead to an overrepresentation of major events. Additional problems were that Factiva only translates a certain share of foreign-language articles into English and it also includes company press releases that can hardly be considered neutral. Finally, Factiva dropped parts of its BBC Monitoring sources from 2001 onwards. These considerations led us to decide in favor of BBC Monitoring. BBC Monitoring is a major worldwide source of daily domestic news that monitors information from local and international press, regional radio and TV broadcasting stations, translates them into English, and ultimately makes them publicly accessible. Although BBC Monitoring returned fewer hits than Factiva, the share of relevant articles was considerably higher and we have little reason to suspect that there is a systematic bias in our data that we could have avoided if the project had relied on other sources[17].

Using a search string that strikes a balance between efficiency (avoiding retrieval of excessive amounts of irrelevant information) and precision (capturing all relevant events), we compiled around 78,000 news items for the 1997–2009 period. We identified and coded water-related events, building on approaches used in previous event data coding projects (e.g., Goldstein, 1992; Howell, 1983; Reuveny and Kang, 1996; Vincent, 1983) as well as event data coding projects for conflict and cooperation in international river basins (Kalbhenn and Bernauer, 2011; Wolf et al., 2011). The key variable in our dataset characterizes the intensity of water-related conflict and cooperation on a Water Events Scale (WES).

2.2. Information Retrieval and Country Sample

Our recording units are single news items, such as newspapers articles and transcripts of on radio/television broadcasts (or summary reports on them)[18]. The information retrieval was undertaken based on a specific and uniform (across all retrievals) string of keywords:

[17] See Appendix A for further details.

[18] In our view, using a broad range of news items is superior to using news-wire reports (e.g., from Reuters or AFP) alone. An associated problem, however, is that forms of reporting are much more heterogeneous. This heterogeneity makes automated, machine-based coding very unreliable and, thus, we opted for human coding. Besides its labor intensity, the main disadvantage of human coding is potential subjectivity. To mitigate this potential problem we established very explicit, standardized coding rules and extensively trained our coders. In addition, we periodically and randomly checked whether data collection and processing were consistent with the coding (King and Lowe, 2003).

water OR lake OR river OR canal OR dam OR stream OR tributary OR dike OR dyke OR purification OR sewage OR effluence OR drought OR irrigation OR rain OR fish OR flood OR precipitation

This search string builds on the list of keywords and Boolean operators used for the IRCC dataset (Kalbhenn and Bernauer, 2011) and the Transboundary Freshwater Dispute Database (Wolf, 1998; Wolf et al., 2003b). All keywords automatically include "wildcards" for a string of letters or numbers to capture all closely related, relevant terms[19]. We deliberately did not include the terms conflict or cooperation in the search string. The reason for employing this strategy is simple: although our more general approach will probably decrease the efficiency of the coding by returning a substantial number of irrelevant media items, it is also likely to decrease the risk of omitting relevant events.

Table 1 provides an overview of the countries in the dataset as well as the number of news items retrieved per country. The number of hits varies by more than two orders of magnitudes between the countries, partly reflecting the variation in population size and general media attention in the sample. For example, the Principality of Monaco returned the fewest news items (27), whereas the maximum number of reports was obtained for Israel (around 7,400). As expected, a large majority of the hits turned out to be irrelevant, i.e., they do not report on a water-related event of cooperation or conflict. For example, our search string captured a large number of French news reports that refer to the Canal+ broadcasting corporation. The share of relevant hits also varies enormously between the countries. For example, while we found no relevant report for Monaco and only 0.4% of news items for France concerned conflict or cooperation over water, Eritrea returned 36% relevant hits. On average, about 13% of all news items contained information on domestic water-related events.

[19] For instance, our search string contains the term "water*." This picks up "waters" as well as "water."

Table 1. *Retrieved News Items and Water-Related Events, 1997-2009*

Country Name	*Country Label*	*Downloaded News Items*	*Coded Water-Related Events*	*Share: Events/News Items*
Albania	ALB	1,650	497	0.30
Algeria	ALG	1,202	237	0.20
Bosnia-Herzegovina	BOS	2,759	495	0.18
Burkina Faso	BFO	131	40	0.31
Chad	CHA	386	94	0.24
Croatia	CRO	3,971	472	0.12
Cyprus	CYP	472	135	0.29
Egypt	EGY	3,466	593	0.17
Eritrea	ERI	1,579	563	0.36

2.3. Dataset Structure and Coding

The dataset includes one observation per distinct event, which we then classified according to the following typology: An event can involve unilateral actions by individuals, firms, NGOs, or state authorities, or interactions between them. Examples are initial talks about the construction of a new water-supply network to improve the water quality of a region; an agreement on that new project that is signed a few months after the initial talks; and the construction of the water-network. Although the events are obviously related, each event is considered separately and assigned a value for the intensity of the conflict or cooperation. Events that are not the result of human action but imposed by nature are not included. For example, if a news item reports on a flood without reporting on related cooperative or conflictive human activities we do not record this event in our dataset. We

also characterize events along temporal and geographical dimensions. Table 2 provides an overview of the variables in the dataset.

Table 2. *Variables in the Dataset*

Basic Variables	*case*	Unique numerical case identifier
	ccode	Correlates of War country code
	cname	Correlates of War country name
	date	Date of event in the form "yyyymmdd"
	day	Day on which the event occurred
	month	Month in which the event occurred
	year	Year in which the event occurred
	location	Location name where the event occurred
	lat_coordin	Geo-referencing of the event location: latitude coordinate in the form of decimal degrees
	long_coordin	Geo-referencing of the event location: longitude coordinate in the form of decimal degrees
	cyprus	Dichotomous indicator identifying the Greek and Turkish parts of the island
	cluster	Indicator for the non-independence of single events in *case* format
Event Variables	*event*	Description of the event
	wes	Water Events Scale (*WES*)
	descr	Standardized description of the event according to *WES* value
	coop	Dichotomous indicator of cooperation, where 1 indicates whether an event is cooperative (0 otherwise)
	conflict	Dichotomous indicator, where 1 indicates whether an event is conflictive (0 otherwise)
	scale	Actor category that caused the event
	impact	Actor category that is affected by the event
	violence	Casualty count in case of physical violence associated with the event
	actor1-actor10	Variables listing the actors involved in the event
	direction	Variable indicating whether the event is directional or mutual
	international	Dichotomous indicator for the presence of international influence
	int_code	Correlates of War country code for the international actor involved in the event (country or international organization)
Media Control Variables	*source_name*	Name of news media source
	source_loc	Location of the news media source, Correlates of War country code
	neu_source	Dichotomous indicator for independence/neutrality of the news media source
	med_cover	Total number of news media items retrieved per country-year

Note: categories for the *cyprus* variable: 0=Turkish part; 1=Greek part (Republic of Cyprus); categories for the *scale* and *impact* variables: 1=grass roots and individuals; 2=firms, companies, NGOs; 3=sub-national authority; 4=government; categories for the *direction* variable: 1=event is caused by one actor only; 2=both/more sides are equally involved; categories for the *neu_source* variable: 1=source is neutral; 0=source is not neutral/ government-dependent; see the replication file for additional information.

Table 3. *Water Event Scale (WES)*

WES Value	*Description*	*Number of Events Recorded*	*Percentage of Total Events Recorded*
5	Events that are likely to or do result in substantial improvement with respect to water quality/quantity in the country as a whole.	31	0.3%
4	Events that are likely to or do result in substantial improvement with respect to water quality/quantity at the regional level within the respective country.	111	1.1%
3	Events of moderate intensity that may result in an improvement with respect to water quality/quantity at the regional or national level within the respective country.	1,138	11%
2	Agreements signed or other measures formally adopted that signal commitment to improvement with respect to water quality/quantity at the regional or national level.	985	9.5%
1	Events that are likely to or do result in a very small improvement with respect to water quality/quantity at the local level.	1,400	13.5%
0	Routine and purposive actions on water issues that have no identifiable positive or negative impact on water quality/quantity.	4,837	46.7%
–1	Events that are likely to or do result in a very small negative impact on water quality/quantity at the local level.	639	6.2%
–2	Tensions within government (intrastate) or between countries (inter-state) that may affect water quality/quantity at a domestic level.	425	4.1%
–3	Large-scale and general opposition of the public towards policies and actions that have negative implications for water quality/quantity at the regional to national level.	328	3.2%
–4	Events that are likely to or do result in a deterioration with respect to water quality/quantity at the regional level within the respective country.	293	2.8%
–5	Events that are likely to or do result in a deterioration with respect to water quality/quantity at the national level; physical violence associated with water problems.	165	1.6%
Total		10,352	100%

The scale for the key variable of our dataset, the Water Events Scale (WES), depicts the intensity and impact of domestic water-related events on an ordinal scale (Table 3 and Figure 1). This scale comprises 11 steps, ranging from -5 (most conflictive event) to +5 (most cooperative event). For instance, events assigned to the +5 category involve a very extensive role for any kind of actor (government, international organizations, firms, etc.) in trying to initiate or implement policies,

programs, or actions that substantially improve the quality or quantity of water in the whole country. Events in the -5 category, on the other hand, involve a strongly negative impact on the water quality/quantity of a country, for instance overt violence precipitated by governments, groups, institutions, or individuals in connection with water resources. Table 4 provides an example for each category of the WES[20].

Table 4. *Water Event Scale (WES) with Examples from Data*

WES Value	*Description*	*Country*	*Year*
5	National emergency water plan is implemented - comprises mini stations for desalination, drillings, transfers from other dams, etc.	Algeria	2002
4	Ministerial meeting agrees to reduce price of water per cu.m. for Sheikh-Zayed canal and pumping station.	Egypt	1999
3	Lebanon inaugurates water project.	Lebanon	2002

[redacted]

[20] See Appendix A for further details and more examples of various types of water events.

2.4. The Frequency of Cooperative and Conflictive Events

Against the background of Table 3, Figure 1 visualizes the distribution of cooperative and conflictive water-related domestic events in our data. The distribution of events across the scale is quite symmetrical around the middle category (0), although with a slight dominance of positive, i.e., cooperative events[21].

***Figure 1**. Distribution of Events on the Water Events Scale (WES), 1997–2009*

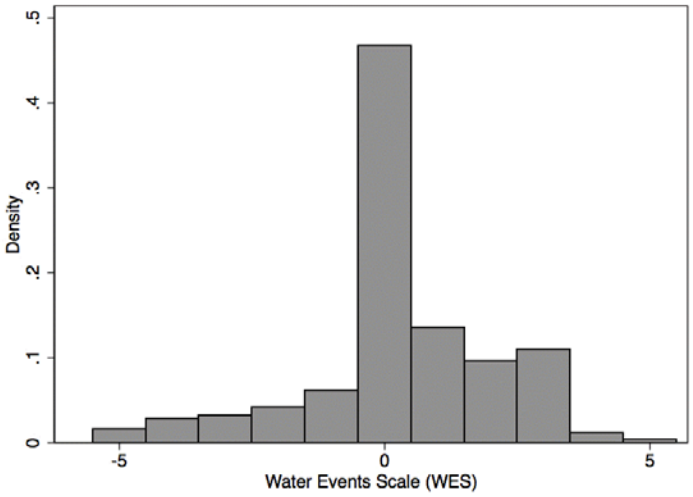
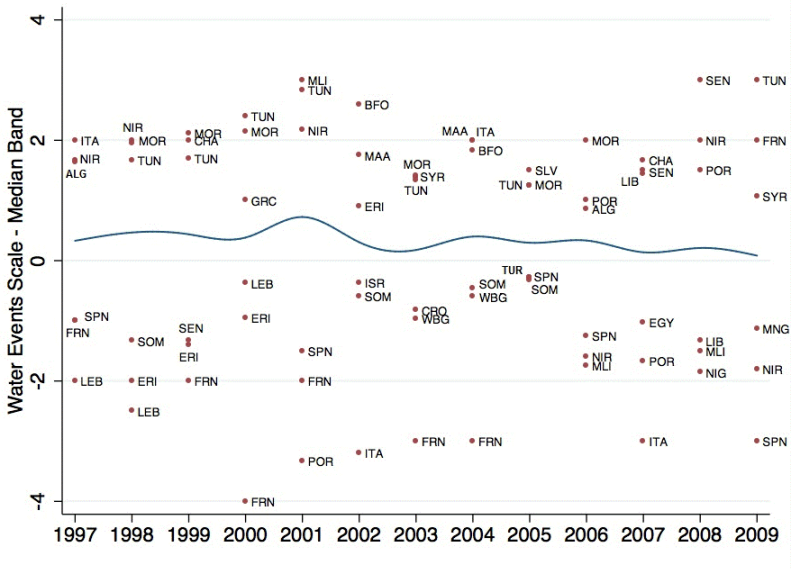


Figure 2 demonstrates that the yearly average level of water-related conflict and cooperation for the 35 countries as a whole is fairly stable and slightly positive over time. It shows the median band of the WES, using country-year mean values over all the years in our data. Figure 2 also identifies the three most conflictive/cooperative countries in each year based on the yearly mean WES score.

***Figure 2**. Median Band with Three Most Cooperative and Conflictive Countries, 1997–2009*



[21] A similar distribution emerges when the data are aggregated to the country year level.

2.5. Using the Data to Study Water-Related Domestic Cooperation and Conflict

A visual inspection of the most extreme countries in Figure 2 may suggest that water-related conflicts are quite frequent within several consolidated democracies (Italy, Portugal, or Spain), whereas the countries with the highest rate of cooperative events are mainly non-democracies. Table 5 corroborates this impression.

Table 5. *Event Distribution across Regime Type and Population, 1997-2009*

	Conflictive		*Neutral*		*Cooperative*	
	Democracies	*Non-Democracies*	*Democracies*	*Non-Democracies*	*Democracies*	*Non-Democracies*
# Events	646	1,204	1,369	3,468	670	2,995
Country-Years	115	176	142	235	119	226
# Events per Country-Year	5.62	6.84	9.64	14.76	5.63	13.25
Population	172	393	201	470	143	452
# Events per Million People	3.76	3.06	6.81	7.38	4.69	6.63

Note: population expressed as mean value for 1997–2009 in millions.

Table 5 divides the events count into three categories, i.e., conflictive, neutral, and cooperative by regime type[22]. Evidently, democracies and non-democracies differ little with respect to the incidence of conflict events. However, the frequency of neutral events is about 50% higher in non-democracies and cooperative events are almost three times as common in non-democracies as in democratic regimes. The same pattern is evident (if less prominent) if we consider events per capita; cooperative events are considerably more widespread in non-democratic regimes than among democracies.

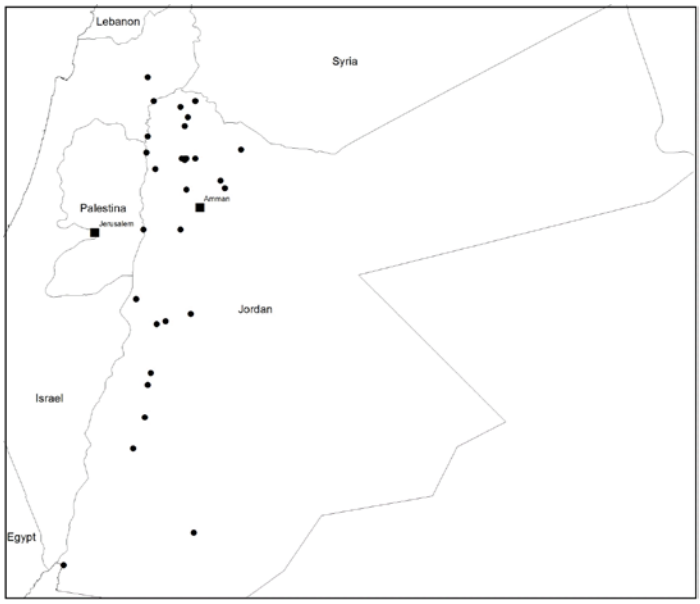
Understanding why we observe this somewhat counterintuitive pattern requires a more thorough analysis and is beyond the scope of this article. Even if our new dataset is based on a well-regarded international news provider, we cannot rule out the possibility that seemingly systematic differences in water-related behavior between democratic and non-democratic countries are at least partially a result of less critical, government-controlled media in the latter regimes. If news agencies in autocratic regimes report only what they are allowed to report, the true frequency of conflict events in such countries may be higher than what is indicated in Table 5. Moreover, events in which the government is an actor may be portrayed more positively in non-democracies than they would in democratic regimes, in order to avoid sanctions against the media. Democratic systems allow public expression of discontent, such as demonstrations, strikes, and other forms of non-violent protest that are rarely seen in authoritarian countries. As a result, there is little reason for conflict events in

[22] The regime type data were primarily taken from Polity IV (Marshall and Jaggers, 2002), where we considered country-years with higher values than 6 on the polity2 item as democracies and, consequently, country-years with polity2 values below 7 as non-democracies. For country-years that are not covered by polity2, we considered those as democracies that are characterized as "free" by the Freedom House Index (Freedom House, 2011).

democratic regimes to be under-represented in our data. Independent media in democratic countries, however, may find cooperative events less newsworthy than conflict events, leading to deficiencies in reporting of cooperative events. As such, the WES may be more useful in tracing variations in water-related interactions and events over time by country (e.g., in response to shifting climatic conditions) than in comparing different countries at the same points in time.

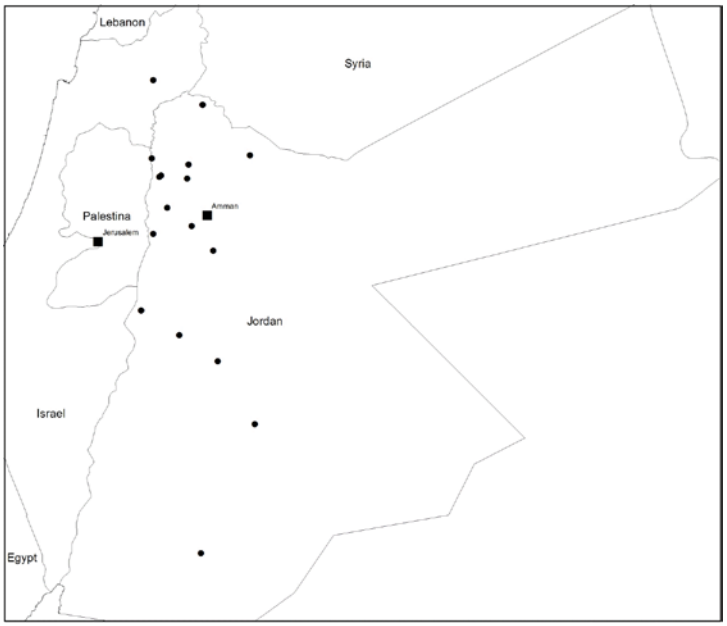
Systematic statistical analysis will be required to identify the factors that account for variation in cooperation/conflict levels across countries, locations within countries, and time. Such research is likely to offer new insights with respect to the water management–state capacity hypothesis (e.g., Gizelis and Wooden, 2010) as well as other arguments concerning the climate change–water conflict nexus at a sub-national level (Wischnath, 2011). Because we also record the geographic information of water-related events (see Table 2), our data can be used to study these sub-national distributions of cooperative and conflictive events. Geographic information allows comparison of spatial variation in water-related conflict/cooperation to sub-national settlement patterns, local weather patterns, waterways, irrigation, topography, land class, and other spatial features that may affect the location of such events[23]. Figures 3 and 4 illustrate how conflict and cooperation over water are unevenly distributed across a country. They depict the geography of water events in Jordan, a state without adequate supplies of water and only 3% arable land in its territory. We observe a cluster of (inter-) actions in the northwestern areas of Jordan and Amman, much fewer events in the sparsely populated southern areas of the country, and none in the eastern desert regions. Conflict events are mostly clustered in the north of the country.

***Figure 3**. Spatial Distribution of Cooperative Water Events in Jordan, 1997–2009*



[23] See Buhaug and Lujala (2005), Cederman and Gleditsch (2009), and Tollefsen et al. (2012) for examples of spatially disaggregated studies of armed conflict.

***Figure 4**. Spatial Distribution of Conflictive Water Events in Jordan, 1997–2009*



2.6. Conclusion

In recent years, academic research on the climate change–conflict nexus has made considerable progress primarily by adding water and climate variables to state-of-the-art models of international and internal war. Another analytical approach, which relies on issue-coding of water-related events, has been lagging behind, but holds great promise. In particular, it can help in addressing two disadvantages of the former approach. Notably, it can offer more direct insights into the climate-water–conflict relationship. It also brings cooperative events into the analysis and thus allows for more comprehensive future empirical quantitative assessments of the competing Neo-Malthusian vs. Cornucopian hypotheses. WARICC represents one effort to further research on these issues.

3. Demand, Supply, and Restraint: Determinants of Domestic Water Conflict and Cooperation[24]

Tobias Böhmelt, Thomas Bernauer, Halvard Buhaug, Nils Petter Gleditsch, Theresa Tribaldos and Gerdis Wischnath

Abstract

This article focuses on one of the most likely empirical manifestations of the environmental conflict claim. The authors examine how demand for and supply of water may lead to domestic water conflict. Conversely, they also study factors that may reduce the risk of conflict and, hence, induce cooperation. The article advances several theory-based arguments about the determinants of water conflict and cooperation, and then analyzes new time-series cross-section data for 35 Mediterranean, Middle Eastern, and Sahel countries for 1997-2009. The empirical work shows that demand-side drivers, such as population pressure, agricultural productivity, and economic development are likely to have a stronger impact on water conflict risk than supply-side factors, represented by climate variability. The authors also find evidence that violent water conflicts are extremely rare, and that factors conducive to restraint, such as stable political conditions may even induce cooperation. Overall, these results suggest that the joint analysis of demand, supply, and restraint factors significantly improves our ability to account for domestic water-related conflict and cooperation.

3.1. Introduction

A number of recent books have argued that there is a long-term trend toward a reduction of violence in human affairs, both at the international and domestic level (Goldstein, 2011; Muchembled, 2011; Pinker, 2011). However, while there seems to be widespread agreement on this trend, there is far from a consensus about its causes (Blattman and Miguel, 2010) or on the prospects that it will actually continue. A pessimistic view is found in the environmental-security literature, which claims that the unsustainable use of natural resources and the ensuing environmental degradation may generate violent conflict over scarce natural resources (Bächler, 1999; Homer-Dixon, 1999; Kahl, 2006).

Inspired by the debate around the notion of 'limits to growth' (Meadows et al., 1972), social scientists have picked up on a long-standing argument initiated by Thomas Malthus (1798/1993), who focused on how increasing scarcities may lead to violent conflict (Buttel et al., 1990). As outlined in his 'Essay on the Principle of Population,' Malthus primarily considered the impending gap between food production and population pressure. More recently, concerns have been voiced over social consequences of a broader range of scarcities and (human-induced) environmental

[24] This paper was submitted to Gobal Environmental Change on 1 February 2013 and is now under review.

degradation (Gleditsch, 2003; Hauge and Ellingsen, 1998). Increasing water scarcity has been a key element in this literature, provoking scholars and policymakers alike to foresee future 'water wars' (Katz, 2011; Theisen et al., 2011; Ward, 2002). Projections of severe, human-induced climate change with its effects on the water supply in many parts of the world have boosted such neo-Malthusian fears.

A contrasting view is offered by so-called Cornucopians, who argue that scarcities can be overcome by human ingenuity, technological progress, the wise use of market mechanisms, or social and political institutions that promote cooperation (Kenny, 2011; Lomborg, 2001; Simon, 1989, 1996; Wolf, 1998). In fact, Wolf (1998) contends that resource competition is more likely to be accompanied by cooperation rather than conflict. Similar disagreements run through the recent literature on the security implications of climate change. Pessimists predict an increased frequency and severity of armed conflicts as global warming progresses (Burke et al., 2009), while others view the conflict potential of climate change as small or overshadowed by more traditional determinants of violent conflict (Buhaug, 2010a; Gleditsch, 2012; Koubi et al., 2012).

In this article, we re-examine this controversy within a broader theoretical framework and an analysis based on new data, which include low-level conflict and cooperation over water resources. We focus on the demand for and supply of water resources, while also considering factors that may be conducive to restraint between the actors involved. To empirically test our arguments, we rely on time-series cross-section data on domestic water conflict and cooperation in 35 Mediterranean, Middle Eastern, and Sahel countries for 1997-2009 (Bernauer et al., 2012b). The empirical work shows that demand-side drivers, such as population pressure, agricultural productivity, and economic development are likely to have a stronger impact on water conflict risk than supply-side factors, represented by climate variability. We also find evidence that violent water conflicts are extremely rare, and that factors conducive to restraint, such as stable political conditions may even induce cooperation. Overall, these results suggest that the joint analysis of demand, supply, and restraint factors significantly improves our ability to account for domestic water-related conflict and cooperation.

The article proceeds as follows. The next section briefly reviews the existing literature on environmental degradation and conflict/cooperation by focusing mainly on previous empirical work. We then present our theoretical framework, where we classify our explanatory factors as demand, supply, and restraint factors. Afterwards, we outline our research design and describe the empirical tests of our hypotheses. After discussing the findings, we end with an assessment of remaining gaps and ideas for further research.

3.2. Previous research on environmental factors and domestic conflict/cooperation – A short overview

There is a long tradition of empirical work on the security implications of environmental change in general and water scarcity in particular. The evidence offered by this literature is mixed, however. Whereas some single or comparative case studies contend that environmental stress is likely to lead to violent conflict (Homer-Dixon, 1999; Kahl, 2006; Libiszewski, 1996; Suliman, 1996), others argue that resource scarcity plays at most a minor role in generating conflict (Benjaminsen, 2008; Kevane and Gray, 2008; Witsenburg and Adano, 2009). The discrepancy in conclusions between these works may be understood in part as a result of what cases are being analyzed. A serious limitation with the case study tradition is its near-exclusive selection of cases involving conflict, a research design that fails to shed light on the absence of violence in other countries with similar scarcities or other environmental problems (Gleditsch, 1998). In turn, this makes it difficult to draw firm conclusions across a wider range of countries and to generalize obtained results[25].

The recent emergence of climate change as a major issue on the policy agenda has led to a revival of the neo-Malthusian argument and a wave of quantitative comparative studies examining possible links between climate variability (including extreme weather events) and domestic violence. The bulk of these studies provide little evidence for a powerful, direct link between climate and armed conflict (Gleditsch, 2012), and research that finds significant effects does not agree on the direction of the relationship (for contrasting examples, see Buhaug, 2010a; Burke et al., 2009; Ciccone, 2011; Gizelis and Wooden, 2010; Hendrix and Salehyan, 2012; Koubi et al., 2012; Raleigh and Kniveton, 2012; Theisen, 2008).

There is less statistical research addressing the effects of environmental change on a broader spectrum of interaction types. Most relevant research concerns international river basins and interstate relations (e.g., Bernauer and Kalbhenn, 2010; Brochmann and Hensel, 2009; Kalbhenn, 2011; Mitchell and Hensel, 2007; Wolf et al., 2003a). The predominant finding from this literature is that cooperative interactions are more prevalent than conflictive interactions, and that water-related international interactions involving violence are very rare. It remains unclear whether this pattern is detectable also at a strictly domestic level of interaction. In contrast to mainstream comparative climate-conflict studies, which rely on binary indicators of conflict/no conflict or event counts, our work (Bernauer et al., 2012b) considers cooperation and conflict as relative phenomena along a common continuum and utilizes issue coding to identify the issue at stake in each case (e.g., quantity of river flow in transboundary river systems).

[25] For more detailed reviews of this literature, see Bernauer et al. (2012a) and Deligiannis (2012).

3.3. A theory of domestic water conflict and cooperation: Demand, supply, and restraint

Water is an essential resource for human beings, perhaps even the most important one. For this reason, it always appears high on the list of scarce resources that may be worth fighting for, particularly in dry areas such as the Mediterranean region, the Sahel, or the Middle East (Bernauer and Kalbhenn, 2010; Libiszewski, 1996).

Most writings in the neo-Malthusian tradition assume that both demand for and supply of scarce resources are at work in generating social conflict (e.g., Percival and Homer-Dixon, 2001: 14). Unfortunately, the literature remains vague on which of the two is more relevant in generating conflict, and few studies have assessed this dynamic empirically (see Beck and Bernauer, 2011 for a rare exception). The third causal component that we will consider here, restraint, is mostly absent from this work or it is implicitly assumed to be working through the other two mechanisms.

3.3.1. Demand

A major driver of freshwater demand is population pressure, which was at the core of the original Malthusian model and remains central to today's calculations of future water stress. The logic is simple: higher population density, all else held constant, increases the demand for water and may also amplify inequality in access to water (see e.g., Gizelis and Wooden, 2010; Matthew and Gaulin, 2001). According to a recent UNDP (2008) report, one-third of the African population lives in drought-prone areas today, and almost all Sub-Saharan countries are projected to be in a state of water stress by 2025.

Moreover, we consider agricultural productivity. A change in or the actual level of agricultural productivity reflects the interaction between domestic institutions and environmental pressures, and how these processes are linked to domestic water-related conflict (Gizelis and Wooden, 2010; Matthew and Gaulin, 2001). For instance, the agricultural sector potentially competes with urban and municipal users, which spreads the underlying conditions for domestic water-related conflict. Furthermore, higher agricultural productivity might increase the consumption pressure on water resources (Gizelis and Wooden, 2010: 448). In turn, this leads to further asymmetry in the distribution between individual consumers (and industrial sectors).

Even in the absence of significant population pressure, demand for freshwater in low- and middle-income countries is likely to increase with economic development and related processes such as industrialization, energy production, health and sanitation developments, or changing food habits and agricultural production, including expansions of irrigation systems in arid regions (Gleick, 2011). Only in wealthy and technologically advanced societies may the net effect of additional development

lower the mean water consumption per capita (i.e., increasing efficiency and substitution strategies outweigh increasing demand from changing consumption habits)[26].

This reasoning seems at odds with empirical findings that economic interdependence and low GDP per capita are robust correlates of civil war (Bussmann et al., 2005; Hegre and Sambanis, 2006). However, whereas wealthier societies on average may be less exposed to armed domestic conflict for reasons partly related to individual opportunity costs and state capacity (Collier and Hoeffler, 2004; Fearon and Laitin, 2003), that literature only considers the extreme outcome of civil war and offers little insight into the dynamics within the massively heterogeneous sample of non-civil war cases that our study is concerned with. These rationales lead us to the first set of testable hypotheses:

***H**1a Higher population density increases the risk of domestic water conflict (decreases the probability of domestic water cooperation).*

***H**1b Higher agricultural productivity increases the risk of domestic water conflict (decreases the probability of domestic water cooperation).*

***H**1c Higher economic development increases the risk of domestic water conflict (decreases the probability of domestic water cooperation).*

3.3.2. Supply

The supply of water is usually determined by natural factors, the most prominent being seasonal variations and long-term changes in climate patterns[27]. Climate anomalies influence the level of precipitation from one year to the other. They also affect snow cover, which in some regions acts as a natural reservoir of freshwater that in turn becomes available downstream during the summer months (Parry et al., 2007). While anthropogenic climate change will impact average levels of water availability in the longer term, main human determinants of supply in a shorter perspective are found in the form of dams and reservoirs, which regulate water flow and make water supply more manageable and predictable (but also create ecological problems and societal challenges downstream), as well as groundwater extraction and desalination of sea water. In most societies, including the study region of this analysis, temporal and spatial variations in precipitation (and to a lesser extent, temperature) patterns give a representative image of variations in local water supply. Accordingly, we examine the following supply-side hypothesis:

[26] Economic development may also be seen as a supply and a restraint factor, which we discuss below.
[27] The Intergovernmental Panel on Climate Change (IPCC, 2007) defines climate as 'average weather,' usually over a 30-year period. Due to the short time period in our dataset, we will refer to this supply-side factor as 'climate anomalies' rather than 'climate change.'

***H**2 Stronger climate anomalies increase the risk of domestic water conflict (decreases the probability of domestic water cooperation).*

3.3.3. Restraint

We add to these (neo)-Malthusian-inspired hypotheses the notion of restraint. Although resource scarcity of one kind or another is a widespread condition, scarcity by itself does not lead to open competitive confrontation and the eruption of armed conflict in most cases. Hence, 'something holds us back from violence.' This 'something' does not necessarily mean that conflict is absent (and that cooperation is successful) if we also consider non-violent conflicts. Although there may in principle be a host of factors that determine a society's restraint against escalating water conflicts, we focus here on what is arguably the most important contextual dimension, namely institutional characteristics.

The 'democratic peace' refers to the observation that democracies rarely, if ever, fight one another (Dixon, 1994). Democracies are also often seen as superior providers of public goods and more likely to have environmentally-friendly policies and cooperate in finding joint solutions to environmental problems (e.g., Bättig and Bernauer, 2009; Lake and Baum, 2001; Neumayer, 2002; Payne, 1995). Thus, if water-related social problems are amenable to solutions, democracies may see less domestic conflict over them. Indeed, Gizelis and Wooden (2010) find that democratic institutions mitigate the impact of water scarcity on intrastate-armed conflict.

On the other hand, it has been suggested that authoritarian regimes are better able to solve water allocation problems because they can impose solutions and suppress opposition to them. (Bernauer and Siegfried, 2008, 2012), for example, show that there was less water-related conflict in the Aral Sea basin under Soviet rule than in the more democratic post-Soviet environment. Furthermore, increasing levels of democracy are likely to open up more 'political space' for people to express their grievances and engage in conflictive interactions with other water users or authorities that regulate water supply. Consequently, the democratic restraint against environmental conflict may in fact only kick in at relatively high (i.e., violent) levels of severity, implying that we may expect overall more instances of water conflict in democratic regimes than among non-democratic ones but these events are very unlikely to escalate to the use of armed force.

A related argument concerns political stability. Numerous studies have shown that both highly authoritarian and highly democratic countries are more durable and less exposed to violent internal power struggles and domestic conflict than the so-called anocracies (Gleditsch et al., 2009; Vreeland, 2008). This dynamic is likely to play out also in relation to how water scarcity and distribution challenges are handled (see e.g., Bernauer and Siegfried, 2008).

Based on this, we formulate two final hypotheses relating to how political characteristics may act as a restraint against water conflict:

H3a Higher levels of democracy increase the risk of domestic water conflict (decrease the probability of domestic water cooperation).

H3b Higher political stability increases the probability of domestic water cooperation (decreases the risk of domestic water conflict).

3.4. Research design

3.4.1. Data and dependent variables

In order to evaluate our hypotheses, we employ new event data on water-related conflict and cooperation in 35 Mediterranean, Middle Eastern, and Sahel countries for 1997-2009 (Bernauer et al., 2012b). In its original format, the dataset is structured such that there is one observation per water-related event. An event can involve unilateral actions by individuals, firms, non-governmental organizations, or state authorities, and interactions between them. Events that do not result from human action, but are, for instance, imposed by nature, are not coded.

A conflict-cooperation intensity scale characterizes event types. Hence, the key variable in this dataset, the Water Events Scale (WES), measures the intensity and impact of a domestic water-related event in an ordinal fashion. This scale consists of 11 points, ranging from -5 (most conflictive event) to +5 (most cooperative event). Events assigned to the +5-category involve a very extensive role for any kind of actor in trying to initiate or implement policies, programs, or actions that substantially improve the quality or quantity of water in the whole country. Out of 10,352 water-related events coded for those countries and years, only 70 events (0.68% of all events) were violent events (i.e., the -5-category). About 18% were conflictive non-violent events (1,780 events, excluding the 70 violent cases), while 35.4% were cooperative events. Finally, about 47% were neither cooperative nor conflictive events (i.e., neutral or the 0-category). Evidently, violent water-related events are extremely rare and studying only water-related violence would therefore exclude the large majority of water-related social interactions.

We aggregate these data to the country-year, which serves as our unit of analysis (N=446 country-years). For the first set of empirical tests, we use the yearly mean value of the WES for each country as the dependent variable[28]. The second set of empirical assessments, which builds on within- and

[28] Median or weighted means also seem appropriate for aggregating the WES values for the single events into a country-year format. We carried out robustness checks using such measures (mean, median, weighted means/medians by cooperative and

out-of-sample predictions, employs two dichotomous variables: the first one (cooperation) receives a value of 1 if the mean WES score in a given country year is positive (0 otherwise); the second (conflict) receives a value of 1 if the mean country-year WES score is negative (0 otherwise).

3.4.2. Explanatory variables – Demand side

According to our theory, the following three facets are likely to affect water resources and, therefore, also cooperation and conflict: population density, agricultural productivity, and economic development. Population density is measured as the midyear population divided by land area in square kilometres. The data for this variable were taken from the World Bank Development Indicators. Additionally, we incorporate a measure of agricultural productivity. This variable captures the ratio of the crop production index to the percentage of agriculture land (Gizelis and Wooden, 2010: 448). We retrieved these two indicators from the World Bank Development Indicators as well. Gizelis and Wooden (2010: 448) note that a country's degree of agricultural productivity 'captures demand-side water use and indicates how productive a country's agriculture is relative to the amount of land being used' for this purpose. Finally, to operationalize a country's overall level of economic development, we use GDP per capita, also taken from the World Bank Development Indicators. For the first and third of these variables, we use the natural log in order to take account of the skewed distributions.

3.4.3. Explanatory variables – Supply side

We measure climate anomalies with data for temperature and precipitation. To this end, we include the deviation of the current level of precipitation and temperature, respectively, from past long-run levels, i.e., the 30-year moving average (see Koubi et al., 2012). Hence, we treat climate anomalies as a large-scale phenomenon that is beyond human control at the local level and within the short to medium term. The precipitation data are derived from the Global Precipitation Climatology Centre (GPCC) (Beck et al., 2004) whereas the temperature data are from the University of Delaware's Global Surface Air Temperature Database (Matsuura and Willmott, 2009)[29].

3.4.4. Explanatory variables – Restraint factors

For democracy, we rely on the combined polity2 score from the Polity IV dataset (Marshall and Jaggers, 2002). This variable ranges from -10 (full autocracy) to +10 (full democracy). Data for Bosnia and West Bank/Gaza are missing in this dataset and we imputed values of zero to mitigate potential consequences of missing data. Second, political (in-) stability is measured by an indicator that counts the years since a country entered the Polity IV dataset or had a three-or-more points change on the

conflictive events, weighted means/medians by the standard deviation) to ensure that our results are not artefacts resulting from a specific aggregation strategy. The results presented below are, in fact, robust to using alternative ways of aggregating.

[29] Missing climatological data for Malta and Monaco were replaced by valid data for nearby areas in Italy and France, respectively.

polity2 index in either direction of the scale. As soon as such a change occurs, this count item is reset to 0 and the count starts again.

3.4.5. Descriptive statistics and methodology

All right-hand-side variables are lagged by one year to minimize endogeneity. Table 6 summarizes the descriptive statistics and variation inflation factors (VIFs) of all variables in the analysis. The VIFs demonstrate that the explanatory factors largely do not suffer from multicollinearity. All items display a VIF that is well below the threshold level of 5. However, in order to control for any remaining multicollinearity and to ensure the robustness of our findings, we also run models where we introduce the variables on demand, supply, and restraint separately into our estimations.

Table 6. *Basic information on variables.*

	N	Mean	SD	Min	Max	VIF
WES – Country-Year Mean	446	0.25	0.92	-4	3	
WES – Cooperation Dummy	446	0.56	0.50	0	1	
WES – Conflict Dummy	446	0.25	0.43	0	1	
Population Density	446	4.22	1.65	0.83	9.78	1.41
Agricultural Productivity	442	3.93	5.32	0	36.25	1.12
GDP per capita	430	7.89	1.74	4.73	12.13	2.81
Temperature - 30 Year MA	446	0.25	0.44	-1.12	1.34	1.08
Precipitation - 30 Year MA	446	0.10	102.72	-383.74	325.56	1.05
Democracy	446	2.50	6.43	-9	10	2.12
Political Stability	420	18.10	17.45	0	61	1.67

Our main empirical estimation strategy is based on a widely used method for analyzing panel data, i.e., Prais-Winsten regression models with panel-corrected standard errors and an AR1 autocorrelation structure (Beck and Katz, 1995, 1996). This approach controls for panel heteroskedasticity and contemporaneous as well as serial correlation. Tests indicate that country fixed effects are unnecessary in our case. We also leave out a lagged dependent variable as recommended by the Beck and Katz approach. Other tests emphasize that the cure might be worse than the disease here, introducing bias and inconsistency into our models. For an alternative model specification, however, we also included yearly fixed effects that control for exogenous system-wide shocks that may be common to all countries in our dataset. These results are virtually the same as the ones that are reported below[30].

Ward et al. (2010) have forcefully remind us that drawing inferences from statistically significant results might be misleading in that they tell us little about the predictive power of a covariate or an entire model. In order to address this point, we assess the ability of our full model (Model 4 below)

[30] This alternative specification is not reported in the text, but can be checked with our replication materials.

to actually predict countries' level of water-related cooperation or conflict. To that end, we use in-sample and out-of-sample prediction techniques that rely on the binary dependent variables of conflict and cooperation.

3.5. Empirical results

Table 7 shows the results of our first estimation strategy. Model 1 focuses solely on the demand-side variables. Model 2 and Model 3 employ the same approach but for the supply-side and restraint factors, respectively. Model 4 is the full model, which includes all the explanatory variables. The model-fit statistics alone indicate that some of our hypotheses are unlikely to hold. In particular, Model 2 that exclusively looks at the supply-side variables has next to no explanatory power and we cannot reject the null hypothesis that all coefficients in that model are indistinguishable from 0.

This is mirrored by the coefficients on climate anomalies as expressed by temperature and precipitation deviations from the 30-year moving average. While these coefficients are negative, suggesting a conflict-increasing effect of climate anomalies, they are not statistically significant in any model. Ultimately, we conclude that the impact of our supply-side items is low at best. This is in line with previous research on climate variability (see also Bernauer et al., 2012a; Gleditsch, 2012; Koubi et al., 2012).

Table 7. *The determinants of domestic water-related conflict and cooperation.*

	Model 1 (Demand)	Model 2 (Supply)	Model 3 (Restraint)	Model 4 (Full)
Population Density	-0.036			-0.039
	(0.023)			(0.046)
Agricultural Productivity	-0.008			-0.017
	(0.007)			(0.006)***
GDP per capita	-0.138			-0.133
	(0.033)***			(0.054)**
Temperature - 30 Year MA		-0.060		-0.081
		(0.084)		(0.091)
Precipitation - 30 Year MA		-0.001		-0.001
		(0.001)		(0.001)
Democracy			-0.046	-0.029
			(0.010)***	(0.012)**
Political Stability			0.002	0.008
			(0.003)	(0.003)**
Constant	1.541	0.256	0.307	1.477
	(0.313)***	(0.046)***	(0.067)***	(0.480)***
N	426	446	420	400
Wald χ^2	21.44***	0.83	20.36***	50.91***
R^2	0.05	0.00	0.05	0.09

Note*:* Panel-corrected standard errors in parentheses; * significant at 10%; ** significant at 5%; ***significant at 1% (two-tailed); a negative sign on a coefficient indicate a conflict-promoting effect.

With regard to the demand-side indicators, all three variables have a negative sign, which corresponds to our theoretical expectations. Most of their significance levels depend on model specifications, though, and, thus, we cannot place much faith in the revealed substantive impact of either Population Density or Agricultural Productivity. Nevertheless, the demand-side variables do seem to perform better on average than the supply-side items. The fit of Model 1 is higher than in Model 2 and at least one of the demand-side influences reaches conventional significance levels in each model in Table 7. This is primarily driven by economic development as operationalized via GDP per capita. Although GDP per capita has been identified as one of the most robust negative influences on civil war, our models indicate that more economically developed countries are more likely to see water-related conflict. A one-unit increase on this variable is associated with an increase of about 14% on the WES variable. In other words, this supports our notion that high economic development is associated with increased consumption of natural resources in general and freshwater resources in particular (Rock, 1998). Economic development is also closely associated with high emissions of greenhouse gases and, thus, with global warming (Bernauer et al., 2012a; Stern, 2006). In turn, while high economic development may decrease the risk of high-intensity civil conflicts, it may well increase the probability that a country does experience more low-intensity disputes over water resources.

Coming to the restraint factors, these variables largely perform as expected and reveal robust effects on domestic water-related conflict and cooperation. Adding or suppressing variables from the models does not alter these findings. In both Model 3 and Model 4, the democracy impact is negative and significant. A one-unit increase on the democracy index is associated with a 3.75% decrease on the WES variable on average. Therefore, it seems indeed that authoritarian regimes can solve water allocation problems more effectively than democracies, since the former have the ability to impose solutions and suppress opposition to them. This interpretation is also in line with the claim that there is more 'political space' for people to express their grievances and engage in conflictive interactions the government in democracies. Having said that, we also found arguments in the literature claiming that the conflict-increasing effect of democracy is likely to fade or reverse at high levels of democracy. In particular, it has been contended that democracy is likely to confine water conflict to non-violent forms. Hegre et al. (2001) conclude in this context that the relationship between democracy and civil conflict follows an inverted U-shaped relationship, with the highest risk of conflict in the semi-democratic zone, i.e., in anocracies. While such a curvilinear relationship is not detectable in our data, we found that the apparent conflict-inducing effect of democracy is reserved for non-violent water conflicts. Violent conflict over water resources is overwhelmingly a non-

democratic phenomenon; only three of the reported 31 violent events took place in democratic regimes[31].

On the other hand, Political Stability has a conflict-reducing effect; the coefficient on this variable is positive and significant in one out of two models, meaning that higher levels of stability are associated with more cooperative outcomes. The substantial impact of this item is rather low, however. On average, we only see an increase of about 1% in domestic water-related cooperative behavior. And since this item only approaches statistical significance in one model, its impact does depend on specifications as well.

3.6. Robustness checks: In-sample and out-of-sample predictions

We conducted a wide range of sensitivity analyses and robustness checks to assess whether our main findings are sensitive to changes in model specifications and estimation procedures[32]. To that end, we focus on the in-sample and out-of-sample predictions, i.e., the forecasting of domestic water-related conflict and cooperation. First, we replicated Model 4 from above in a probit regression setup with different sets of cubic splines for temporal correction (Beck et al., 1998). For these two models, we used the dichotomous indicator on cooperation and conflict, respectively. As demonstrated in Table 8, the results of these estimations do not reveal substantial changes over Model 4 in total, although some coefficients have a stronger / weaker effect due to the different emphasis of each dependent variable in that table. Thus, we proceed with Figure 5 that builds upon the models in Table 8.

This figure summarizes one possible avenue of in-sample predictions, i.e., the ordered grouping of the predicted probabilities of either WES – Cooperation Dummy or WES – Conflict Dummy by quintiles and comparing these with the actual instances of water cooperation and conflict in our data. We refer to the fifth quintile as the "most likely" group, the fourth quintile as the "moderately likely" group, and the bottom three quintiles as the "least likely" group[33]. Arguably, the predictive power of our full model seems to be relatively high, regardless of whether we focus on water conflict (right panel) or cooperation (left panel). The fifth and the fourth quintiles combined, i.e., the most and moderately likely groups comprise 135/241 cooperative events and 67/98 conflictive events. Put differently, those predicted probabilities that form these particular forecasting categories already predict 56% of water-cooperation years and 68% water-conflict years correctly. Consequently, only 106 country-years (31 country-years) that actually saw more cooperation (conflict) than water-

[31] In more detail, these democratic regimes with violent events were Italy, Croatia, and Israel.
[32] In addition to the in-sample and out-of-sample predictions discussed here, we summarize other robustness checks in Appendix B.
[33] Using quintiles instead of terciles seems more suitable with our events, since this reflects the long tail in the distribution of the predicted probabilities more accurately.

related conflict (cooperation) are characterized as least likely cases, i.e., our model would not predict that we observe a mostly cooperative (conflictive) behavior over domestic water issues – although in reality we did. In sum, however, this initial check of the in-sample predictive power of our core model seems promising.

Table 8. *The determinants of water conflict and cooperation – Probit analysis.*

	Model 5 (Cooperation)	Model 6 (Conflict)
Population Density	0.007	0.120
	(0.084)	(0.099)
Agricultural Productivity	-0.005	0.030
	(0.013)	(0.009)***
GDP per capita	-0.151	0.105
	(0.075)**	(0.091)
Temperature - 30 Year MA	-0.107	0.208
	(0.139)	(0.184)
Precipitation - 30 Year MA	-0.001	-0.001
	(0.001)	(0.001)
Democracy	-0.046	0.040
	(0.018)**	(0.020)**
Political Stability	0.004	-0.013
	(0.006)	(0.007)*
Constant	1.762	-1.636
	(0.445)***	(0.618)***
N	400	400
Wald χ^2	107.37***	61.00***
Pseudo-R^2	0.19	0.18

Note: The table entries are probit coefficients; standard errors clustered on country in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1% (two-tailed); cooperation (conflict) years variable and cubic splines included in either model, but not reported due to space constraints.

Figure 6 sheds more light on the actual in-sample predictive power of the probit models that are based on Model 4. Here, we show Receiver Operator Characteristic (ROC) plots. Generally, models with more predictive power generate 'true positives at the expense of fewer false positives' (Ward et al., 2010: 366). As a result, a perfectly predictive model would correctly classify all actual cases of water-related conflict or cooperation and never generate false positives, i.e., cases of conflict/cooperation our model would predict although they did not happen. While we can reject the notion that our model perfectly predicts water-related conflict or cooperation, it does have a higher predicted probability for a randomly chosen positive event than for a randomly chosen non-event. This is mirrored by the area under ROC curve statistic (AUC), which theoretically varies between 0.5 (no predictive power) and 1.0 (perfect predictive power). As demonstrated by Figures 5-6, our models that distinguish between water cooperation and conflict perform well above average in this regard, i.e., above an AUC value of 0.5. We, therefore, conclude that the in-sample predictive tests

highlight that leaving out most of our variables on demand, supply, and restraint from model estimations of domestic water-related conflict and cooperation would not only be misleading from the perspective of statistical significance, but also from the viewpoint of predictive power.

Figure 5. *Frequency of water cooperation and conflict by prediction quintiles.*

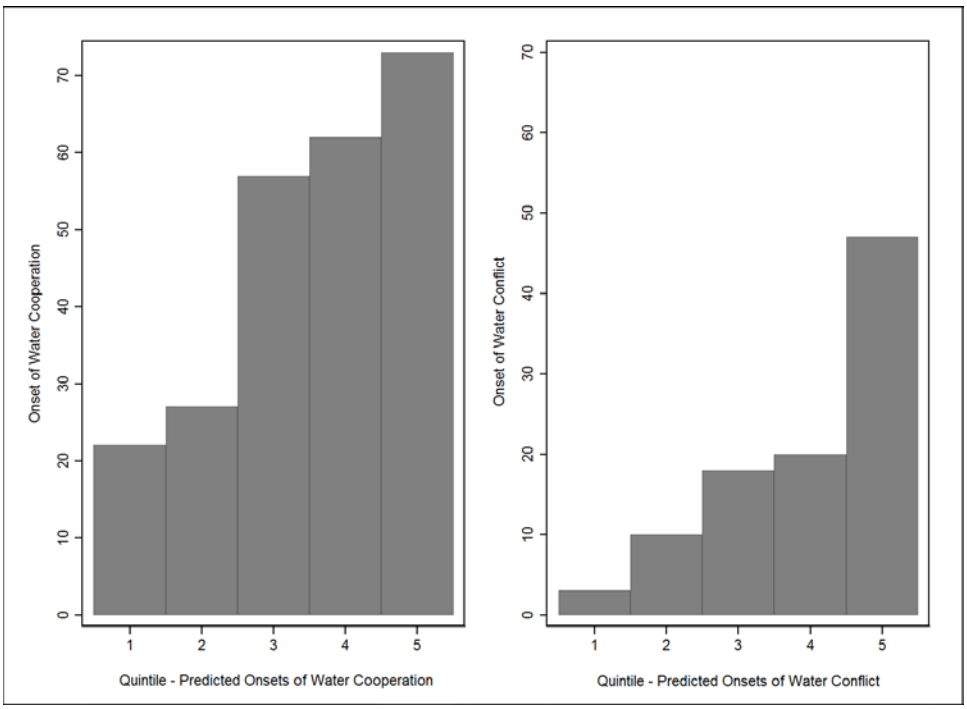
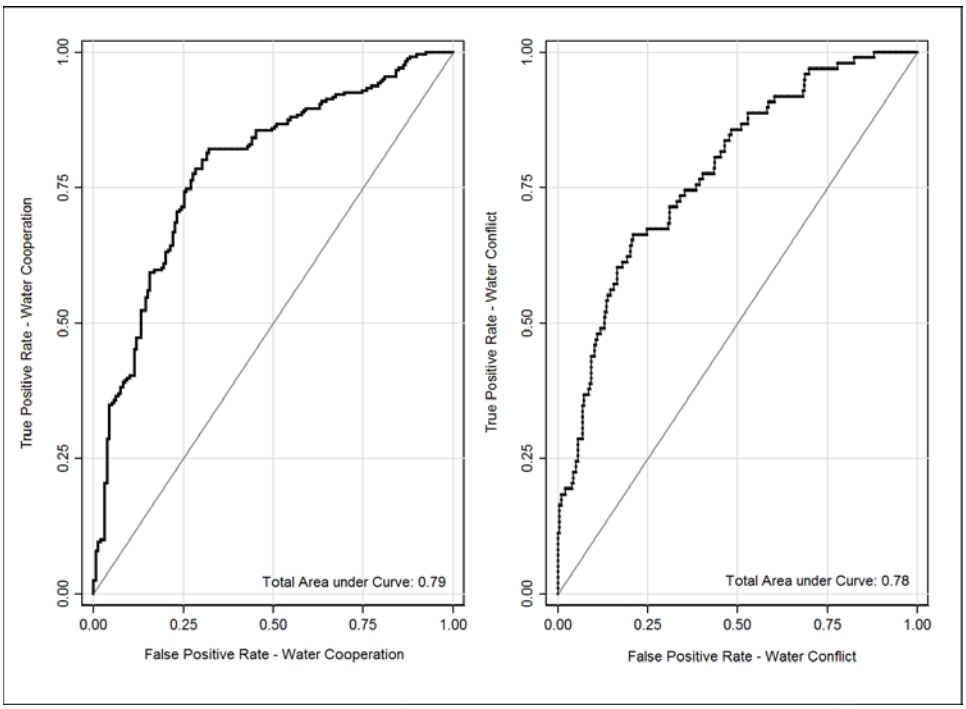


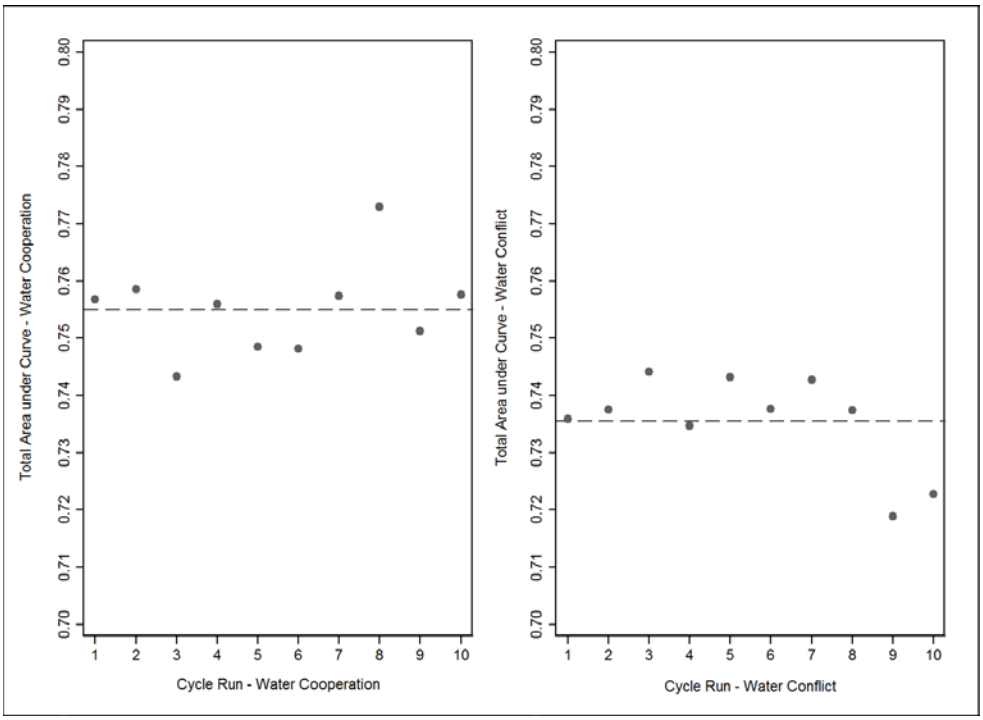
Figure 6. *In-sample prediction: Area under ROC curve for cooperation and conflict.*



Finally, the question remains if this conclusion holds when employing the harder test of an out-of-sample prediction. We use a 4-fold cross validation quasi-experimental setup that was repeated 10

times (Ward et al., 2010: 370)[34] – either for the full model that employs WES – Cooperation Dummy as the dependent variable or a model that examines WES – Conflict Dummy. Figure 7 depicts our findings. As one would expect, the predictive power of either model decreases as compared to the in-sample values from above. Nevertheless, the power of the models remains reasonably and considerably high (AUC=0.755 for left panel on average; AUC=0.735 for right panel on average). Hence, the predictive power of our variables on demand, supply, and restraint remains unchanged even when conducting the tougher out-of-sample prediction.

Figure 7. *Out-of-sample prediction: 4-way cross-validation exercise.*



Note: Left panel pertains to estimates of AUC for WES – Cooperation Dummy; right panel pertains to estimates of AUC for WES – Conflict Dummy; four-way cross validation estimates are shown by dots; dashed horizontal line signifies mean estimate AUC over all four-way cross-validations that were repeated for 10 different random partitions of the data.

A number of additional sensitivity tests were carried out, some of which are described in the accompanying Appendix B. These tests included additional corrections for heteroskedasticity, serial correlation, possible endogeneity between political institutions and domestic water cooperation and conflict, alternative climate variability indicators, and two-stage regression estimating the effect of climate on conflict/cooperation via economic performance. Moreover, as many of the WES events are highly localized, and climate patterns also tend to vary across space within countries, we integrated geo-coded conflict events (WES <-2) into a spatio-temporal data structure (see Tollefsen et al., 2012) and estimated the local impact of climate on conflict behavior. Neither of these additional tests produced findings that deviate substantively from those reported here.

[34] The exact procedure for this cross-validation is described in Ward et al. (2010) and can be replicated with our data files.

3.7. Conclusion

In this study we asked which factors drive domestic water-related conflict and cooperation. Is it factors determining the demand or supply of water resources or institutional restraints against overt social conflict? While the empirical analysis offered evidence that both demand factors (primarily, economic development; to a smaller degree agricultural productivity and population density) and institutional restraint (primarily, democracy; to a smaller degree political stability) influence domestic water-related interaction, we did not find any indication that short-term variations in water supply, as indicated by precipitation and temperature patterns, matter for conflict/cooperation dynamics. This finding speaks to the broader debate on climate security and appears to substantiate other research that fails to connect climate variability to more severe forms of armed conflict. Social interaction is shaped by opportunities and restraints determined in large part by the qualities of the societies themselves, not by nature.

The analysis also revealed that whereas economic development and democracy seem to tilt the balance of water-related interaction toward more conflictive behavior, this is the case only for non-violent events; violent conflict over water is almost exclusively a non-democratic phenomenon. Accordingly, democratic systems may provide opportunities for protest (and a free press also is more likely to pick up and report negative events), and development-related processes may put increasing strains on scarce water resources, thus increasing the conflict potential. But the political institutional mechanisms of these systems ensure that such conflictive interaction is kept at a manageable, non-violent level.

Drawing on new data on water-related events across a broad spectrum of interaction types, from overt violent conflict to high-impact cooperative initiatives, this analysis provides a significant extension to the extant literature's habitual dichotomous treatment of such events. However, this study has only scratched the surface of understanding drivers of such interactions, and future research should invest more in modeling, theoretically as well as empirically, when, how, and what kind of cooperation may provide the optimum solution to imminent water scarcities. In addition, more research is needed to better understand local dynamics. This analysis is based on aggregated country-level data but it is not unlikely that a more nuanced high-resolution assessment (see Buhaug, 2010b; Cederman and Gleditsch, 2009) may uncover new dynamics of supply, demand, and restraint-side drivers of water- and environment-related interaction.

4. Does conflict resolution benefit from decentralised water management structures? The cases of Morocco and Portugal

Theresa Tribaldos[35]

Abstract

Water resources are increasingly under stress from population growth, changing consumption behaviour due to higher living standards, pollution through industry and agriculture, as well as progressing climate change. This paper examines how countries address these problems and how water management institutions can be structured in order to serve as effective tools for efficient and peaceful water allocation.

The case study countries, Morocco and Portugal, exemplify under which conditions decentralised water management structures can be successful in preventing or dealing efficiently with existing conflicts over water resources. They further reveal major challenges in addressing such conflicts. Both countries have decentralised water sectors with responsibilities delegated to the regional and municipal levels. Accordingly, interviews were conducted with various stakeholders from all management scales of water sectors in both countries. In this paper, I find that decentralisation along watersheds and participation of all relevant actors are the main factors that drive cooperation while instability of institutions, lack of a regulatory process for the demand of water, as well as failure to address national income inequalities carry inherent conflict potential. However, the paper concludes that in the case of Morocco, seeming cooperation can also be interpreted as a delay of conflicts because the central state subsidises and keeps up inefficient structures. On the other hand, small disputes between water users may help to engage in solutions and thus, prevent escalations of conflict.

4.1. Introduction

Water resources get increasingly under stress due to several factors. Primarily, the demand for water is changing with higher consumption due to higher living standards (Gleick, 2012). This process is often accompanied by increasing pollution from industry and intensive agricultural techniques (UNDP, 2008). However, the most influential factor is a growing population in many areas that are already affected by water scarcity today (UNDP, 2008). At the same time, the natural supply of water is affected by climate change; trend estimates predict less precipitation for many regions in the world, among them the Mediterranean, the Sahel area, and the Middle East (Meehl et al., 2007). In addition, the occurrence of extreme events such as droughts and floods is likely to increase, thereby posing challenges for water management and planning for the respective governments.

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Predictions that “water wars” (Ward, 2002; Welzer, 2008) might result from increased water scarcity in dry areas have not been justified so far, as little as convincing evidence linking water scarcity to large-scale conflicts has been found in the literature (Buhaug, 2010a; Esty et al., 1998; Koubi et al., 2012; Theisen, 2008). Despite the dearth of evidence linking scarcity to large-scale conflict, increasing stress on water resources does present management challenges (Vorosmarty et al., 2010). Growing stress on water resources directly impacts states’ institutions by challenging their capacities to deal with changes in water quality and quantity. Good water quality and sufficient water quantity are essential for a functioning economy and society. In the long run, the lack of satisfying water resources may jeopardise social peace in societies because it sustains or creates imbalances in the society and hinders economic and social development. In order to find structures that are resilient towards changes in water quality or quantity, institutions have to be analysed at a national and subnational scale. Such an analysis can help to enhance the design and setup of water institutions and to paint a clearer picture of advantages and disadvantages of individual management systems.

The concept of integrated water resource management (IWRM) has been propagated intensively for the last 20 years (Biswas, 2004). In theory, it seems to be a useful tool for water management because it should consider all water resources and involve all different stakeholders in the decision-making process (GWP, 2000). In reality, the definition is squishy and the concept is unrealistic to implement (Biswas, 2004; Blomquist and Schlager, 2005). If implemented, it creates major problems with regards to boundary definitions of watersheds, discrepancies between political and hydrological boundaries (Cohen and Davidson, 2011), and the dilemma of how to implement participation (Blomquist and Schlager, 2005). A clear recommendation of how IWRM should be structured does not exist and it is, therefore, unclear how to implement it. Although attempts to implement IWRM have been made in several states in different forms (Fischhendler, 2008), it remains a rather theoretical concept. Nonetheless, IWRM comprises interesting features such as participation and river basin specific institutions which are important aspects of a conflict-avoiding water management.

In this paper, I focus on the characteristics of decentralised water management systems and how they can be structured to deal efficiently (i.e. in an acceptable time for involved stakeholders) and effectively (i.e. conflicts are actually solved) with conflicts between different water users. More specifically, I investigate how water can be managed in order to achieve cooperation instead of conflicts. I argue that decentralised water management that is structured along watersheds can be beneficial for conflict handling and prevention, under the condition that all involved stakeholders can participate in the decision-making process. Unstable institutions, however, as well as a lack of effective regulation of water demand decreases trust in and credibility of the system and can trigger

conflicts. This argument is based on some features of IWRM and the literature on public goods provision. It is analysed based on the examples of the water management systems in Morocco and Portugal where interviews were conducted with officials from relevant institutions and stakeholders in the systems. Furthermore, I use different data on water resources collected by official institutions.

The next section in this paper outlines the conceptual framework and argument. This part is followed by explaining the methodology of the in-depth interviews and a section presenting the empirical evidence from the case study countries. In the discussion section, I analyse the empirical evidence according to the conceptual framework and present interpretations that can be drawn from it. Finally, I conclude the paper and present important lessons from the case studies.

4.2. Conceptual framework

In this paper I focus on features that make water management resilient towards conflicts and suitable to their resolution, i.e. features that facilitate cooperation. The main argument lies on decentralisation and the benefits it can have on water management. However, decentralisation can only be successful if certain additional conditions are met. These conditions are explained in this section and summarised in Figure 8. Conflict and cooperation are defined according to (Bernauer et al., 2012b) as actions between different water stakeholders that result in a negative respectively a positive impact on water quality or quantity.

I argue that decentralised water management has some advantages over centralised systems if certain requirements are met. Several authors argue that decentralisation not only brings the allocating institutions closer to the end user but the whole allocation process is also better tailored to local conditions (Blaikie, 1987; Fiorino, 1990; Ostrom, 1992). Consequently, decentralisation can help to avoid bloated and redundant institutions steered by the central state (Hillesheim, 2012; Hutchcroft, 2001). Redundancy is undesirable because it creates extra cost that could be avoided. If decentralisation is implemented with comprehensive decision-making rights and responsibilities, administrative units decide autonomously which steps are necessary (Johnson, 2001) to manage available water resources. The question remains what the decentralised unit should be for water management. This question will be answered differently under varying conditions. Hydrological administration could be defined along political boundaries. Such an arrangement can make use of existing administrations and rely on their legitimacy. Fraser et al. (2006) emphasise the importance to be flexible when choosing the scale for environmental management because ecology usually has other boundaries than politics. However, I argue that in terms of conflict prevention and resolution the watershed is beneficial because it offers the possibility to bring all involved stakeholders to the same table. Municipal administrations with a large variety of responsibilities such as the economy

and social aspects have a different agenda than institutions that deal only with the management and allocation of water. If responsibilities are not clearly defined within the municipal administration, funding might be rather allocated to other projects than to water.

Second, IWRM as a theoretical concept has been promoted by the Global Water Partnership and was inspired by several UN meetings and principles (GWP, 2000). Its main idea is to move away from fragmented water management where different institutions deal with different aspects. Instead, all aspects of an increasingly complex network interlinking different components of water resource management should be integrated (GWP, 2000). IWRM includes planning and management in both the economic and the political sense and should also preserve the environment. As Biswas (2004) deplores, this attempt to integrate all possible aspects created a theoretical concept that is hardly possible to implement in practice because it tries to incorporate contrasting ideas and stakeholders. Molle (2008) adds that its definition is so vague and all-inclusive that basically everyone can implement it according to her own taste. Considering the critiques and ambiguities related to IWRM as well as the fact that none of the case study countries uses the term for their management systems, I refrain from using the term in this paper. Nevertheless, key aspects of IWRM are part of the present framework. They include river basin or watershed management and participation of individual stakeholders (GWP, 2000).

The third point in this framework deals with the literature on public goods provision and its contribution towards the problem of free-riding. As Hardin (1968) and Olson (1968) describe in their work, overexploitation of public goods or open resources can be a serious problem without appropriate regulation in place. Users tend to free-ride if they can and if they are not convinced that other users behave in an altruistic way as well. However, free-riding is not a necessary outcome. Marwell and Ames (1981) find evidence for mild but not for strong free-riding behaviour. Users can be informed about the disadvantages of free-riding and tend to agree to a sanctions regime if they understand the consequences of free-riding (Yamagishi, 1986). Fehr and Gächter (2000) state that sanctions considerably improve cooperation behaviour and Sefton et al. (2007) even suggest that sanctions are necessary to initiate and sufficient to sustain cooperation. These findings are important inputs to the following sections on strict demand regulation.

The fourth point is river basin management. Although there is some debate on the approach of river basin management (Blomquist and Schlager, 2005; Cohen and Davidson, 2011), the European Union with the Water Framework Directive (WFD) as well as several other countries adopted this approach and recognise some improvement in their management (Kaika and Page, 2003). Castro et al. (2003) further note that the introduction of the river basin approach in England in 1974 substantially improved drought management due to enhanced decision-making processes and planning. For a

well-functioning river basin management, participation of stakeholders is usually seen as a necessary component because it increases legitimacy and interest in decision-making (Green and Fernández-Bilbao, 2006; GWP, 2000; Kaika and Page, 2003). Participation engages people in water management and puts different opinions and requests on the table for the decision-making process (Newig et al., 2005). Furthermore, I argue that participation of all involved stakeholders increases acceptance and thus, the durability of the obtained decisions. The first reason is that stakeholders are able to introduce their requests, expectations, and concerns through participatory approaches in decision-making. Second, once stakeholders agree on a compromise, they are more likely to stick to the decision because they do not want to seem unreliable.

However, decentralisation and participation on its own are not sufficient conditions for cooperative management of water resources because the risk that stakeholders try to use water to their own advantage and to free-ride is high (Hardin, 1968). When I speak of free-riding in this paper, I include illegal water abstractions, thus water not designated for individual consumption or water utilization without the mandatory payment; or illegal pollution, thus discharge of wastewater and other polluting substances. Such behaviour is likely to invoke conflict among different water users and between water users and the state due to an unfair distribution of costs and benefits. Utilisation of infrastructure and resources while burdening the cost on others is never appreciated by the whole community. Illegal abstractions can also lead to overexploitation and water shortage in the future while illegal discharge of polluting substances diminishes water quality. Even so, free-riding is not an inevitable outcome. Ostrom (1992) outlined 8 design principles crucial for cooperation in sustainable management of common-pool resources (CPRs). Local institutions, participation of appropriators, monitoring, and sanctioning play an important role in these principles. Baland and Platteau (2003) emphasise property rights, strict usage guidelines, monitoring, and effective sanctioning as important aspects of functioning management of CPRs. Hill et al. (2008) point out that a balanced measure of decentralisation as well as monitoring and enforcement are necessary conditions for effective water management solutions. Based on the work of public goods provision and sustainable management of CPRs, I emphasise the importance of regulating water demand in order to avoid free-riding. Demand regulation means that water administrations have to clearly define rules about who is allowed to use what water under which conditions. If demand is not strictly controlled in a water-scarce environment, the risk of overexploitation and deteriorating water quality increases due to free-riding behaviour. Swyngedouw (2004), for example emphasises the importance of demand control and strict prices for the preservation of water resources. He stresses the risk of overconsumption for urban water supply by users with more financial capacities. According to Bernauer and Kalbhenn (2010), degradation of water resources increases the risk of conflict. To the contrary, there is evidence that sanctions have a strong positive influence on cooperative behaviour (e.g., Fehr and

Gächter, 2000; Marwell and Ames, 1981). It is also important that rules are clear to everyone from the beginning and that disputes over water can be taken to official institutions. Such a procedure creates bounded conflicts and can prevent escalation.

Furthermore, numerous authors stress the importance of stable institutions for conflict prevention in transboundary river settings (e.g., Hensel et al., 2006; Mitchell and Hensel, 2007; Wolf et al., 2003b; Yoffe et al., 2003). Although there is less evidence on a domestic or intra-national scale, this finding seems to be true also for this scale (Böhmelt et al., 2013). Therefore, I claim that stable and accountable institutions are an important factor for conflict prevention and an efficient handling of existing conflicts. On the contrary, I argue that instable institutions increase insecurity in decision-making and undermine trust of stakeholders towards these institutions. This is likely to lead to disregard of official rules and to facilitate informal solutions which are likely to deprive institutions of their income through tax and charges evasion.

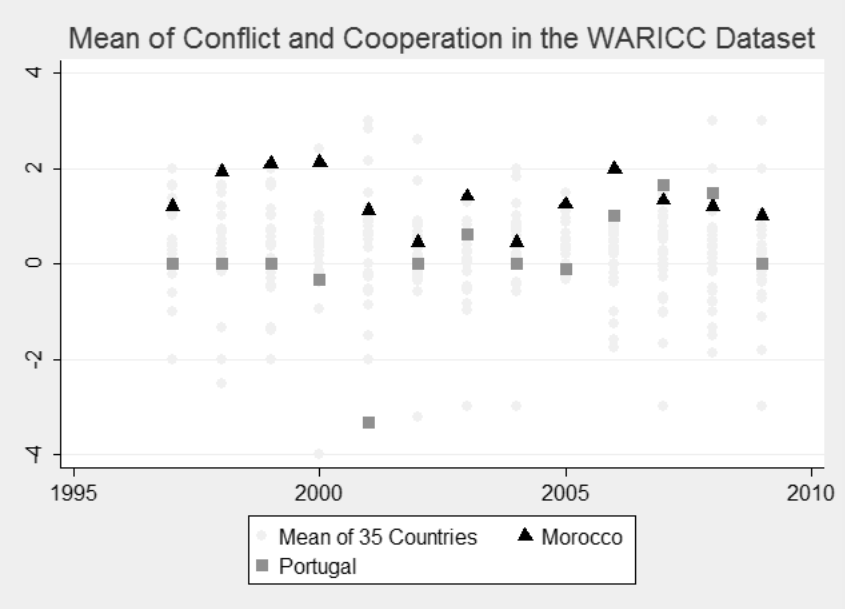
Figure 8. *Framework for cooperation in water management.*

4.3. Methodology

Morocco and Portugal were chosen as case study countries because of their similar structures in water management but a diverging general picture of conflict and cooperation over water resources. According to the new WARICC (Water-Related Intrastate Conflict and Cooperation) dataset (Bernauer et al., 2012b), Morocco scores on average very high in cooperation while Portugal has on average more conflict over water resources than most other countries (Figure 8). During in-depth interviews in both countries with stakeholders in the water sector, I first analyse whether the information retrieved from media products (Bernauer et al., 2012b) is congruent with information revealed through interviews; second, I explore the factors that drive conflict and cooperation over water resources in both countries.

Water management in both countries is decentralised with river basin administrations that have varying degrees of autonomy from the central state in water-related decision-making. While Morocco has three levels of decision-making with national, river basin, and local competencies, Portugal has only two levels; the national and the river basin level are subsumed under one authority since 2012, the local level is fractional compared to Morocco. Morocco comprises 9 river basin administrations and Portugal 5. In-depth interviews were conducted with stakeholders from all levels in both countries. In Morocco, 17 interviews were conducted in total with officials at the national and the river basin level, as well as with employees from development agencies and representatives at the local level. In Portugal, 15 interviews were conducted in total with water specialists from universities, officials from the national and river basin level, as well as with representatives of local water projects. Furthermore, water data from local RBAs was collected. The interviewees in the following sections are referenced with Mor/Por (= Morocco/Portugal), Off (= officials from national or river basin level), Oth (= representatives from development agencies, the local level, universities), # (number of interview), date of interview.

Figure 9. *Average annual value of conflict and cooperation for Morocco and Portugal from WARICC data (Bernauer et al., 2012b), computed from individual water related events per country and year, measured on a scale of -5 (most conflictive) to +5 (most cooperative).*



4.4. Empirical results

4.4.1. Case Description Morocco

Morocco's climate is characterised by three different climate zones, namely the Mediterranean in the north-western part, the Semiarid in the middle and the Atlas Mountains, and the Arid in the south. Inter-annual as well as inter-regional precipitation and temperature variability are distinct.

Table 9 lists individual basin characteristics (Becker et al., 2013; Matsuura and Willmott, 2009; Schneider et al., 2013). Overall, Morocco experiences conditions of water scarcity which are likely to deteriorate due to population growth and expansion of irrigated agriculture. According to IPCC estimations, climate change will most likely worsen the situation with increased temperature predictions for Morocco of 2-4°C and decreased precipitation predictions of about 20-30% by the end of this century (Meehl et al., 2007).

Table 9. *Climate characteristics for individual river basins in Morocco.*

Water basins and agencies	Area (km^2)	Mean elevation (m)	Mean precipitation (55 years)(mm)	Mean temperature (55 years)(°C)	Date of Agency Formation
Guir-Ziz-Rheris agency	60'047	1'168	142	18.3	2009
Moulouya agency	74'149	1'111	280	15.3	2000
L'Oum Er-Rbia agency	46'942	876	410	16.4	1996
Tensift agency	27'036	791	273	16.1	2000
Bouregreg agency	19'512	507	444	16.8	2000
Loukkos agency	14'006	466	743	18.0	2000
Sakia El Hamra et Oued Eddahabab agency	290'508	278	83	19.4	2009
Sebou agency	39'328	679	597	15.3	2000
Souss-Massa-Draa agency	128'908	851	153	16.5	2000

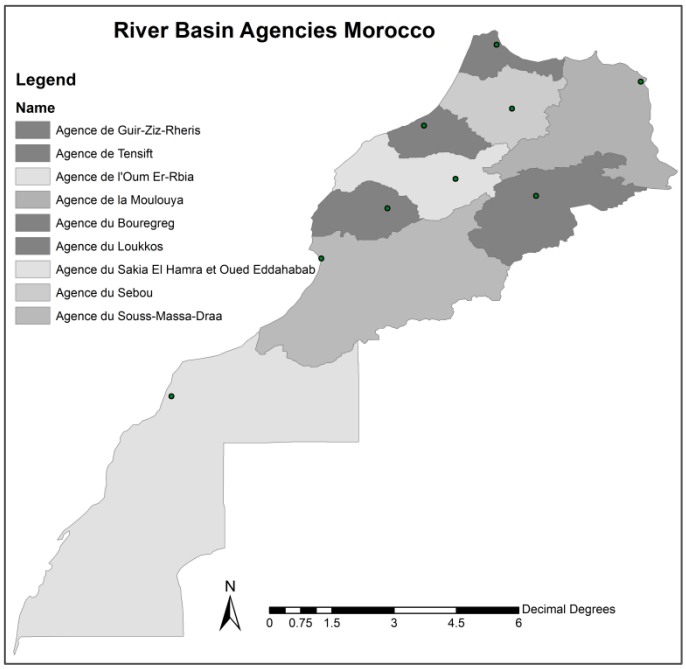
Water management in Morocco can be categorised into three phases: the period before the French protectorate (until 1912) shaped by predominantly individual customary practices based partly on Islamic law; the period under the French protectorate (1912-1956) when water rights became part of public law; and the period after independence (after 1956) which was characterised by large investments in water infrastructure (Doukkali, 2005, p. 76). The adoption of water rights into the legal system intended to protect water resources but this approach failed due to a general inability to control water utilization in the country. Dam construction on a large scale and extensive irrigation infrastructure ("la politique des grands barrages") were supported and pushed heavily by King Hassan II (Jouve, 2002) and have continued to shape the spirit of water management until today. Before the 1980s, investments in water infrastructure were carried out mainly through the state. Severe droughts during the 1980s facilitated new policies to boost private investments in groundwater exploitation and irrigation technology (Doukkali, 2005). At the end of the 1980s, it became obvious that the mere expansion of water supply was not sufficient to meet the challenges of growing water consumption and shortages during extended drought periods. This led to the introduction of a new and innovative water law in 1995 (Morocco, 1995).

Under the new law, management and allocation structures are divided along 9 river basins (Figure 9). For every river basin, an agency is responsible for management of existing water resources, the planning process until 2030, and the implementation of individual steps. The water law explicitly

determines water as a public good (Morocco, 1995). It covers all surface and groundwater except for a few areas in the Tensift basin where historical water rights are still tied to the land (Bouderbala, 1999).

As specified in the water law, water management in Morocco is organised at three levels: the national, the regional (RBA), and the local level. The national level consists of the water department in Rabat which coordinates all planning activities at the national level, including large infrastructure projects. A supervisory council for water and climate controls not only the work of the water department but also the work of the RBAs at the regional level. It is composed of representatives of the state, the RBAs, water and electricity providers, regional agricultural offices, representatives elected by their communities, and representatives of regional assemblies. This council guarantees consultation of the public to a certain degree. The RBAs are responsible for all water planning and management activities within their basins. At the local level, users are organised in water user associations with the purpose to vindicate their claims and manage small-scale water supply for households and agriculture. The law also regulates the establishment of river basin agencies as statutory entities with financial autonomy. In theory, they should operate cost-efficiently but this does not work in reality. Revenues should come from water utilisation fees, taxes, and other services provided by the agencies. However, the agencies are currently not able to generate enough revenues to sustain their structures (MorOff4, 24.05.2012/ MorOff17, 18.05.2012). Up to now, the central state subsidizes the river basin agencies to a large degree. For example, Tenneson and Rojat (2003) estimate that Loukkos agency only generates around 40% of its expenses. They further claim that, based on data from the ministry of agriculture, only 20% of water costs in the whole country are paid for by water users; the remaining 80% are subsidized by the state. This picture was also confirmed by interviewees in RBAs who admit that their budget is mainly financed through the central state (MorOff4, 24.05.2012/ MorOff7, 30.05.2012/ MorOff17, 18.05.2012).

Figure 10. *River basins in Morocco (based on GIS data from www.water.gov.ma).*



The detailed water law requires the RBAs to create a master plan (PDAIRE – plan directeur d'aménagement intégré du bassin hydraulique) for a minimum of 20 years that regulates supply, demand, and necessary constructions. These master plans require detailed research on existing water resources as well as monitoring of quantitative and qualitative developments. Master plans are adjusted every five years if necessary. This master plan must be approved by the supervisory council. Once master plans from all basin agencies are finalized, the water department in Rabat builds a national strategy based on them. This national strategy also must be approved by the supervisory council. The master plans must clearly define which steps are to be taken to guarantee water supply for the next 20 years, which priorities and time limits should be given to infrastructure projects, and which stakeholders must be involved in individual projects.

The high level of participation in decision-making processes even at the local level facilitates discussions on water-related problems and forces stakeholders to engage in cooperative solutions. Serious conflicts over water are therefore seldom. Unresolved tensions or conflicts between water users are usually taken to the RBA for advice. As a last resort, water users can bring their cases to court but this happens rarely according to interviewees of RBAs (MorOff6, 21.05.2012/ MorOff7, 30.05.2012/ MorOff12, 30.05.2012). The cooperative image in Morocco implied by the WARICC data is also confirmed by interview partners all over the country. However, despite the existing structures and the modern water law, Morocco lacks monitoring capacities and is unable to control and sanction illegal water abstractions (MorOff11, 23.05.2012). These illegal abstractions not only have

the potential to seriously damage groundwater bodies due to overexploitation but also represent an obstacle to full cost recovery in RBAs.

While water conflicts in the WARICC dataset include issues of bad water quality and pollution as well as a general governmental failure to improve access to water and water quality, the problems mentioned by interviewees deal with competition between agriculture and tourism, cases of flooding, overexploitation of groundwater, and illegal water abstractions. A possible explanation for diverging results in different sources could be that the media tends to report more on sensational issues such as severe pollution events. If such events date back a view years, it is not unlikely that an interviewee does not remember them or not know them if she was not in charge at the time of the event. The average of water conflict in WARICC for Morocco, measured as percentage of conflictive events compared to all events, is with only 4% low. Cooperation in Morocco prevails and, according to the WARICC dataset, primarily deals with financing of water infrastructure and international cooperation regarding water supply. It does not reveal the decentralised and participative structures in Moroccan water management that are more likely to produce these high levels of cooperation. This difference in results on water cooperation can often be explained through different responsibilities. While the financing of large infrastructure usually is the responsibility of the finance ministry, contracts that involve other countries are handled by the foreign ministry and not by river basin institutions.

4.4.2. Case description Portugal

Portugal belongs to the zone of Mediterranean climate. It is strongly influenced by the Atlantic Ocean which results in a more temperate climate than in other Mediterranean countries. Table 10 lists individual basin characteristics for Portugal (Becker et al., 2013; Matsuura and Willmott, 2009; Schneider et al., 2013). Predictions for climate change estimate a temperature increase of 2-3° C and a precipitation decrease of 15-30% for Portugal until 2100 (Meehl et al., 2007). However, estimates for Portuguese population development predict a population peak now and a decrease for the upcoming years[36].

Table 10. *Climate characteristics for individual river basins in Portugal.*

Water basin administrations	Area (in km^2)	Mean elevation (m)	Elevation range (m)	Mean precip. (55 years) (mm)	Mean temp. (54 years) (°C)	Pop. density persons per km^2
Tejo agency	3987	268	1 – 1966	792	15.5	131
Alentejo agency	22'312	181	1 – 941	607	16.0	26
Algarve agency	24‘854	157	1 – 885	712	16.1	98
Centro agency	13'241	289	1 – 1918	1006	14.5	141
Norte agency	26'221	553	1 – 1483	1073	13.1	148

[36] http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/

Water management in Portugal was entirely under the control of municipalities until 1993 without a clear mandate or a budgetary separation between water and other issues which allowed for serious mismanagement (PorOth15, 07.08.2012). The term water management in Portugal included first of all water supply; only during the last thirty years, attention has moved to wastewater management which has become increasingly important due to growing pollution levels of water resources in the 1970s and 80s (Thiel, 2010). In 1993, only 15% of the Portuguese population was connected to the sewage system and consequently, many water resources were of poor water quality (Nunes Correia, 2012). In 1993, a new law (Decree law n.° 372/1993) made it possible for municipalities to grant concessions to companies to offer water services (Cunha Marques, 2010). All 308 municipalities in Portugal can choose to organise water and wastewater management themselves or to outsource these services to private or state-owned companies. Municipalities can further split up their water and wastewater management along the borders of parishes. In 2010, there existed 405 water supply and 315 wastewater management companies (Cunha Marques, 2010). A logical consequence of this structure was that, according to the financial and organisational capacity of municipalities, the quality of water services also varied strongly between the individual political entities. This opportunity was taken by many municipalities, especially at the first step of the water supply chain called bulk water, the connection from the water source to the municipal gates. Along with the new law, the state-owned company AdP (Aguas de Portugal) was founded which is now the main bulk water supplier in Portugal. The system for agricultural and industrial water supply functions in the same way although the quality for drinking water is subject to stricter standards. Wastewater and sewage are returned from the municipal networks to the bulk suppliers where they are cleaned and treated for release into the natural water cycle[37].

The EU introduced the water framework directive (WFD) in 2000 (EP and EC, 2000) which was incorporated in Portuguese law with a new water law in 2005. The WFD has the purpose of improving water quality and protecting water bodies and species (Article 1). It determines river basins as the administrative unit for water management (Article 3). Member states commit themselves to providing the necessary means and to establish the appropriate administration. The WFD contains detailed provisions about the implementation and monitoring of the directive, measurement and supervision of environmental standards as well as strategies for the future (Articles 4 to 19). The WFD was only implemented under pressure of the EU and the initiation of legal actions against Portugal (EC, 2007).

[37] http://www.adp.pt/

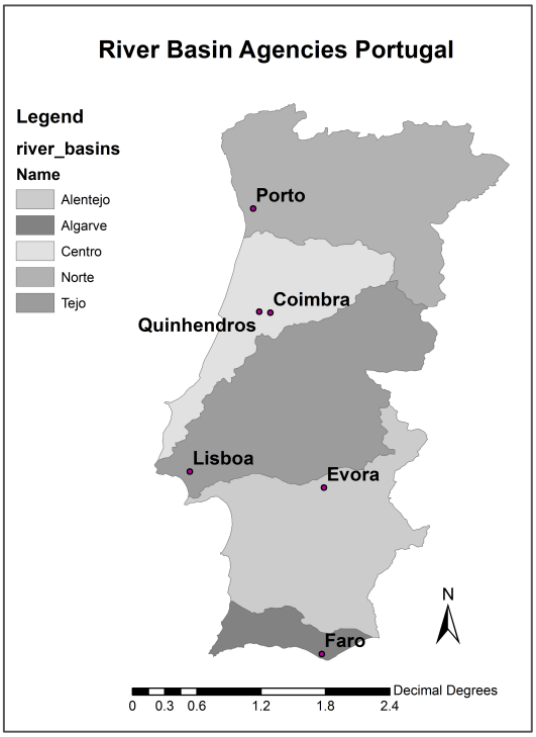
The main pillars of the new law are outlined here according to Nunes Correia and Ramos (2011p. 3 ff). Until 2012, the water management in Portugal was structured along 5 hydrological areas with their own autonomous RBAs (Figure 10) and the national water institute in Lisbon (INAG) coordinating national water planning. INAG was created in 1993 but the RBAs only started operating in 2007. RBAs used to be completely autonomous in financial as well as procedural matters until the end of 2011. The main purpose of the water law is to protect water bodies and their ecosystems and to deal with and decrease pollution in those water bodies. The provision of enough water resources for the population is less prominent than in Morocco because Portugal usually has enough water for its users. Each of the RBAs is required to prepare a management plan for its territory with revisions every three years. This management plan should guarantee the knowledge and supervision of problems and conditions in water bodies. INAG formulates a national water plan which sets rules and guidelines for the whole country resulting from the regional management plans, and serves as a basis for long-term water strategies.

Since the beginning of 2012, the structure of water management has been reorganised. The RBAs as well as INAG are now placed under the direction of the Portuguese Environment Agency (Agencia Portuguesa do Ambiente, APA). This reorganisation intends to save costs and make working processes more efficient. The RBAs are no longer autonomous and APA is making efforts to harmonise and standardise the form and procedure of management plans in order to make them clearer and easier to compare but so far, the new reorganisation of water management after only 5 years of operation causes confusion regarding the responsibilities of the regional offices which still exist (PorOff8, 27.07.2012/ PorOff9, 24.07.2012/ PorOff11, 30.07.2012).

Although some water user associations exist in Portugal, they are less important in number and function compared to Morocco. Consequently, individual water user responsibility is limited to a few cases. RBAs do not figure as mediation boards in general. Although water users also address the RBAs for advice on water conflicts sometimes, the way to court is much more common in Portugal. Interview partners in RBAs confirmed that many disputes between individuals over water issues are pending and these procedures usually take a long time (PorOff1, 24.07.2012/ PorOff3, 31.07.2012/ PorOff8, 27.07.2012). This picture is also mirrored in the WARICC dataset (Bernauer et al., 2012b) where Portugal has on average 30% conflictive events, more than most other countries. These events include mostly pollution and some cases of protests over a lack of water for agriculture during a severe drought in 2005 and insufficient drought aid. However, interviewees consider conflicts related to the licensing system and water tariffs as the main national problems (PorOff3, 31.07.2012/ PorOff8, 27.07.2012/ PorOth14, 23.07.2012/ PorOth15, 07.08.2012) while individual regions suffer from pollution and sometimes droughts. Cooperative water-related events in the WARICC dataset

include international agreements, drought procedures, and improvement of water quality as well as the construction of hydro-electric dams. Positive developments mentioned by interviewees are the strengthening and greater stability of water management institutions (PorOff6, 25.07.2012/ PorOff9, 24.07.201), the slow improvement of the financial situation of water suppliers (PorOff1, 24.07.2012/ PorOth12, 25.07.2012/ PorOth15, 07.08.2012), and the considerable enhancement of water quality throughout the whole country (PorOff4, 01.08.2012/ PorOff8, 27.07.2012/ PorOth12, 25.07.2012/ PorOth14, 23.07.2012). Portugal seems to be more conflictive in the WARICC than in the information revealed by the case study. Although numerous small-scale conflicts occur, these are not necessarily bad because they show that the legal system works and citizens trust these institutions.

Figure 11. *River basins in Portugal (based on GIS data from http://intersig-web.inag.pt/intersig/).*



4.5. Discussion

I claim in my argument that decentralised and participative structures help to prevent domestic conflict or to deal efficiently with it. I further stress the importance of regulation that limits free-riding behaviour and controls water demand. Finally, stable and accountable institutions play a crucial role in this argument because they enable these structures to work. In the following paragraphs, I discuss evidence from the interviews supporting my argument with special reference to decentralisation, participation, free-riding, monitoring and stable institutions. In Morocco, 3 of the 5 in the framework postulated conditions are present while in Portugal, there are only two.

From a legal and institutional point of view, Morocco and Portugal have similar structures and both set up the river basin as management entity based on their water laws from 1995 and 2005. Both laws regulate how these entities have to be managed, which research is mandatory, and how actors and water users have to be involved in the process. The main difference between the two laws lies in the original objective of their initiation. While the main purpose of the EU WFD is to improve water quality, Morocco's incentive for a new water law was increasing water scarcity and the imperative to guarantee water supply for the population now and in the future; environmental aspects were less important. The EU WFD is also relatively new compared to Morocco's water law and was implemented with pressure from the EU. It is therefore, too early to assess the impact of the EU WFD on domestic water conflict and cooperation.

Decentralisation to river basins

One of the main arguments for decentralisation is better knowledge of local conditions by local stakeholders. In terms of water management, one would expect a better knowledge on how to allocate water resources among local users. Two examples from Morocco and Portugal illustrate this argument nicely. The first example describes a conflict about the allocation of water resources between agriculture and tourism in the water-scarce city of Marrakech that was solved through the RBA. Over recent years, the number of golf courses in and around Marrakech rose to 28. Their lawns were irrigated with fresh water from ground- and surface sources which led to complaints from local farmers. They claimed that this water was reserved for agriculture and not for golf courses. The RBA which figured as mediation board between the two sides solved this conflict by constructing a new sewage treatment plant with special distribution pipes to supply all the golf courses with treated water. This solution was found after discussions with the involved stakeholders (MorOff11, 23.05.2012).

The second example describes a farmer's association 30 km east of Coimbra in Quinhendros, Portugal. Farmers cultivate paddy rice on 6800 ha of land and use a sophisticated irrigation system of different rice plots that are connected to an irrigation canal system. Since not all plots can be flooded simultaneously, conflicts between members occur over when and how long users are entitled to open their valves. Such conflicts are solved through allocation of user rights. The user rights are allocated through dialogue among the members in regular meetings. Problems between members have to be discussed accordingly until a solution is found. According to the director of the irrigation scheme, this system works well and farmers usually stick to their assigned days and times (PorOth10, 31.07.2012). The association works independently and is not supervised by state or sub-state institutions.

Participation

Participation of stakeholders is regarded as a very important part in the WFD of the EU but opportunities for participation is also manifold in Marocco. First of all, there is the supervisory council for water and climate in Morocco which must not only approve the regional master plans but also the national water strategy. The supervisory council includes apart from state officials also the above mentioned stakeholders. The Portuguese equivalents to the Moroccan council are the national and regional water councils. Both of these councils have advisory functions with the government and the regional RBAs respectively and consist of officials and other stakeholders (Gooch et al., 2010). Participation is also taking place at a local level. Two examples highlight this participation well. The first example is from Morocco and concerns a local pilot project in Taroudant which aims at supplying drinking water to every household in an entirely rural environment. The project is financed by the KfW (Kreditanstalt für Wiederaufbau) and is run in collaboration with the national drinking water provider in Morocco, ONEP (Organisation Nationale de l'Eau Potable). It is exemplary for the challenges that are encountered in rural Morocco. Rural areas in the South are characterized by a very low education level. In some areas, illiteracy among women reaches 90% (UNDP, 2007); for men, this number is slightly lower. The interpreter for Berber of the project stressed the difficult situation of women in this area (MorOth9, 22.05.2012) who are the main workers in the family: they cultivate most of the land and they are responsible for households and raising the children. Their organisation capacities are low due to weak connections to other women. A main condition of the project was that women-only reunions were institutionalized and held on a regular basis to discuss water management and hygiene issues. This was a crucial point for the project managers because women are the main water users in households and agriculture due to their responsibilities. Initially, this requirement was only met reluctantly by men in the community but at the end they agreed. After more than ten years in the project, women reunions have increased women's participation in such fundamental issues as water utilisation and allocation and they have also increased women's empowerment in other aspects of life. This on-going project already increased cooperation among women on community-based water management and allocation (MorOth13, 22.05.2012) but long-term empowerment has to be assessed in the future.

The second example comes from a river renaturation project in the city of Porto. Since the city of Porto is densely populated, most of its rivers are channelled underground and flooding areas are insufficient. As a consequence, some neighbourhoods were flooded regularly. After several lengthy court cases of residents claiming for compensation, Aguas do Porto, the water supplier of the city, decided to reopen some space for this specific river. In cooperation with the owner, a little park was developed with recreational access to the public. Interestingly, some users of the park now take care

of maintenance. It also involves solving tensions that arise over, for example, pollution or communal gardening (PorOth5, 01.08.2012). Both of these examples show that well-established forms of participation are, on the long run, accepted and supported by the involved actors. They increase responsibility and encourage people to engage in issues that affect them.

Free-riding, monitoring and sanctioning

In the conceptual framework, I argue that free-riding can be a serious obstacle to cooperation over water while it can further lead to overexploitation of water resources. The following examples emphasise problems that can occur when water abstractions or pollution sources are not controlled and sanctioned. The first two examples concern Morocco and the overexploitation of groundwater sources in the Southern region of Agadir and the Souss-Massa-Draa (Figure 9). Although Morocco has invested much in the construction of dams to collect water and increase storage capacity, the harnessing of additional water resources was not sufficient to meet growing demand. The situation became especially grave for agriculture where a small number of bigger and increasingly export-oriented farmers started to plant more water-intense cultivations. Their increasing water demand was met by higher groundwater abstractions and started to seriously affect groundwater levels (MorOth10, 31.05.2012/ MorOth15, 15.05.2012). Abstractions without a licence are forbidden by law but not really controlled by the RBAs (MorOff6, 21.05.2012/ MorOff11, 23.05.2012). When groundwater levels drop, farmers have to invest more in pumping which is more difficult for small farmers. The second problem related to groundwater abstractions concerns water fees. Although in theory, everyone should have a license for water abstractions and pay a fee for it, in practise this is often not the case. The main argument against the enforcement is a lack of resources (MorOff11, 23.05.2012/ MorOth16, 23.05.2012). Most river basin agencies complain that they do not have enough employees to control illegal pumping activities. The second argument brought forward is that these farmers are too poor to pay the price for water and that the enforcement of such a regime would drive them into unwanted legal confrontations with the RBAs (MorOff4, 24.05.2012/ MorOff11, 23.05.2012). As a consequence of this behaviour, depletion of aquifers is continuing unhindered and the RBAs lack income. This considerable deficit in the budget has to be subsidized by the central state (MorOff17, 18.05.2012).

The third example pertains to Portugal. Thanks to the EU WFD, water quality in Portugal has improved considerably over the last 20 years. While Portugal suffered from high pollution levels and bad water quality in the 1970s and 80s (Thiel, 2010), RBA officials are proud nowadays of the good water quality of Portuguese beaches and inland water bodies (PorOff4, 01.08.2012/ PorOff6, 25.07.2012/ PorOff8, 27.07.2012). Pollution through oil spills in the 1990s and at the beginning of the new millennium was met with extended EU-wide regulation on maritime safety (EP and EC, 2004).

Since then, Portugal steadily improved its drinking water quality (ERSAR, 2010) and wastewater management (Palma et al., 2006). Performance of water suppliers is publicly available which increases their efforts to further improve water and service quality due to public pressure. Problems remain in wastewater treatment, point source, and agricultural pollution. These pollution sources are difficult to monitor and, if detected, sometimes difficult to sanction when different municipalities are involved. The city of Porto, for example, has to deal with a heavily polluted river flowing in from another municipality where the sewage treatment plant has been broken for 3 years. Despite repeated complaints by the service company Aguas do Porto (PorOth5, 01.08.2012), the situation has not improved and is neglected by the RBA which should enforce the functioning of treatment plants. According to the same interviewee from Aguas do Porto, the lack of instruments to enforce action between different municipalities leads to numerous conflicts all over Portugal which sometimes persist for years.

The following example emphasises the importance of enforcing regulation in order to avoid free-riding. As of 2007, Portugal has a new policy (Decree law n.° 226-A/2007) which makes it mandatory to have a licence for water abstractions from wells. The deadline to apply for licenses expired in 2010, and depending on the region, there can be heavy fines for using wells without licenses. Due to the vulnerability of its groundwater bodies, the RBA Algarve is particularly strict with licenses and forbids almost all extraction from these sources. Violations of this policy get punished with a 20'000€ fine (PorOff8, 27.07.2012). Consequently, the RBA Algarve states that illegal wells are very rare in their region. Other RBAs in Portugal do not sanction illegal wells which does not encourage their declaration. Exact numbers are not known but the responsible authorities estimate that illegal wells are frequent (PorOff3, 31.07.2012).

Stable institutions

The following section deals with the importance of stable institutions and insecurities that arise from the lack thereof, based on the example of Portugal. The recent history of Portuguese water management is full of policy and structural changes. Water supply moved from a complete control by the municipalities to the option of water concessions that may be granted to private companies in 1993. In 2000, the EU introduced the WFD which was implemented by Portugal in 2005. RBAs started working in 2007 but were deprived of their independence and financial autonomy in 2012 after only 5 years of existence. These frequent reforms left the feeling with many RBA employees of insecurity and confusion about their mandates. A thorough assessment of the benefits or disadvantages of these reforms was also not possible in such a short time period because their effects could not yet operate. A commonly expressed attitude with employees is therefore to wait with decisions until reforms settle and to see, whether they are will be stable or not. Many interviewees seem frustrated

about their work. Especially postponing decisions is problematic because it creates legal uncertainty among stakeholders. Furthermore, it was mentioned that numerous conflicts exist between different municipalities (PorOth5, 01.08.2012) over pollution issues because mandates are not clear and RBAs do not always exercise their responsibilities.

4.6. Conclusion

The point of departure for these case studies was the WARICC dataset which painted a very cooperative picture for Morocco and a very conflictive one for Portugal. These pictures were unexpected. It is not clear intuitively why Morocco, a non-democratic water-scarce country, should be so cooperative in water issues while Portugal, a democratic country which is a member state of the EU and not located in a particularly dry area, is at the other end of the conflict-cooperation-spectrum. Therefore, those countries were ideal candidates for case studies, even more because they have similar water management systems with decentralised and participative structures, organised along river basins. The results from the Morocco case study seem to corroborate the WARICC data *prima facie*. The case study also draws a cooperative picture but with 2 of the 5 postulated conditions lacking, Morocco has some conflict potential in the future. This potential will be discussed later on. Portugal fulfils only 2 of the 5 conditions which is partly an explanation for the conflictive picture in the country. The other part may be explained through media preferences and other institutional factors. These will also be examined in this section.

The first serious limitation of the WARICC dataset is the covered time interval. With 13 years of data, it is impossible to make out a trend and thus, to relate events directly to certain policy changes. This finding is especially true for Portugal where several policy changes and reforms took place since 1997 when the WARICC data starts. For an assessment of these reforms' impact on water-related conflicts in the country, the analysed time interval is simply too short. Although some specialists evaluate the reforms as positive, a statement about the trend of on-average conflict cannot be made. On the other hand, the institutional situation in Morocco has not changed since 1995. Nevertheless, it is impossible to say whether these high levels of water-related cooperation started as a result of the new water law or whether this was already the case before the reform. The second important limitation of the WARICC dataset is the source of data which stems from news media items. Not all events make it to the media equally and not all countries have a free press. Whereas Portugal was ranked 28 in this year's press freedom index, Morocco was only ranked 136 and subsisting deficits in press freedom are deplored (Maghraoui, 2001). It is difficult to say whether the Moroccan government tries to censor water press releases but one can assume that an autocratic regime is not too keen on making internal conflicts public if it can be avoided. In Portugal, the press is free but it might be more interesting to report on conflictive events rather than on cooperative ones.

Alternative explanations for conflict might be differences in income levels, technical capacity, membership in the EU, or the rule of law. The Global Competitiveness Report 2012-2013 lists access to financing, inefficient government bureaucracy, and policy instability among the five most problematic factors for business in Portugal (Schwab, 2012). In Morocco, these factors include inefficient government bureaucracy and access to financing. The GDP per capita in Portugal is three times as high as in Morocco. The same report also ranks Portugal higher than Morocco in aspects like property rights and judicial independence, although the differences are only a few ranks. With regards to efficiency of the legal framework, burden of government regulation, or transparency of government policymaking, Morocco is ranked better than Portugal, sometimes by many ranks. These factors rather support my argument that the high level of cooperation in Morocco is likely to be related to the water management system and the stable institutional framework rather than to economic factors. Although the system in Portugal is similar, institutional instability and constant reforms seem to be a serious problem.

A tentative prospect into the future reveals some caveats. In the Moroccan case, the lack of adequate demand regulation has two main problems, namely overexploitation of groundwater resources and the inability of RBAs to generate the funds they need for their services. The first point creates critical groundwater levels and the second a budgetary deficit of RBAs. Dropping of groundwater levels can have serious consequences for water quality and the economy and should not be neglected (Llamas and Martínez-Santos, 2005). The budgetary deficits are not a problem as long as the central state is willing to substitute them. However, should the government decide to cut down on subsidies and force water users to pay, the risk of unrest will increase because financial strength varies strongly between large-scale export-oriented and small-scale local-oriented farmers. Accordingly, the current situation in Morocco can also be interpreted as a postponement of conflicts built on the shoulders of groundwater and high government subsidies. In Portugal, the biggest challenge at the moment seems to be the containment of tariff increases to socially acceptable levels. The economic situation has reached a point where many people struggle to pay their financial duties and the government should pay serious attention to this development.

5. Stakeholder leverage in a centralised system: Israeli water management

Theresa Tribaldos[38]

Abstract

One of the main arguments for centralised water management in Israel is the protection of water resources. Although control over water can be more straightforward in a centralised system, it does not necessarily lead to more sustainable or equitable management in general and can be more conflict-prone. As opposed to decentralised systems, a strongly centralised system can lack participatory mechanisms for stakeholder involvement. If such mechanisms are absent, stakeholders have to strategize how to gain influence at the national level of decision-making. These strategies include party representation, lobbying, public support or confrontation, and have an impact on conflictive or cooperative behaviour related to water management.

In order to explore different stakeholders' strategies, I ask two questions about stakeholder leverage in the Israeli water management system. First, which groups are influential in national decision-making and can steer water allocation? Second, how have less influential groups strategized to gain leverage in the system?

I find that different groups have varying abilities to influence decision-making in the centralised system in Israel: civil society actors and minorities have minimal leverage, while agricultural interests have relatively strong leverage. How groups exercise leverage also varies: civil society actors try to increase leverage through official procedures while marginalised groups often choose a strategy of confrontation that leads to numerous conflicts with the state. These findings suggest that more participatory approaches could help to achieve a better involvement of underrepresented groups, a fairer allocation of water resources and fewer conflicts.

5.1. Introduction

When deciding on the most suitable structures for water management, the discussion on decentralised or centralised systems comes up repeatedly. Several arguments support a decentralised management of natural resources such as the proximity and knowledge of local conditions by local actors (Blaikie, 1987; Fiorino, 1990; Larson, 2002; Ostrom, 1992), an increased legitimacy of decisions (Agrawal and Ostrom, 2001; Ribot, 2003), and a more efficient management because inflated administrations can be avoided (Hillesheim, 2012). The argument for a centralised management follows similar lines. Control might be better in centralised systems and local cronyism is not uncontrolled if representatives from the central government keep an eye on local institutions (Hutchcroft, 2001).

The state of Israel has an extremely centralised water management system. At the time of foundation, one major argument for a centralised water management system was that a scarce and

[38] Acknowledgement: This research has been supported by the Swiss National Science Foundation (SNF; project number: PBEZP1-142895).

precious resource like water needed special protection which could not be guaranteed with decentralised structures (Alatout, 2008). The argument was driven by the ideological imperative to settle the land and connect to it through agricultural activity which needed sufficient amounts of water for irrigation (Fischhendler, 2008). Today, Israel's water management is well-known for its efficient use of water resources and its creative solutions in applications of recycled water for irrigation in agriculture (Arlosoroff, 2007). Rigorous controls and metering of water consumption implicate almost no unauthorized abstractions of water (Feitelson et al., 2007) which can create substantial management challenges in other countries (Tribaldos, Typescript). Such strict controls are more feasible in a highly centralised system where responsibilities are clearly delegated to one or few authorities with the appropriate means to fulfil this task. However, all these precautions did not prevent Israel from unsustainable management and the accumulation of large water deficits (Feitelson, 2005).

Unsustainable water management and accumulation of water deficits over a prolonged period of time might be related to a stronger influence of certain groups on water management. I hypothesise that the influence of different stakeholder groups on management of water resources is partly responsible for decisions on water allocation and consumption. This influence varies over time and is related to questions of resources to organise and strategize within the group, political institutions, or the importance of the discussed issue (e.g., Dür, 2008). Thus, influence and success of different stakeholder groups is not only dependent on election outcomes but also driven by more or less effective strategies to increase leverage (Dür and Mateo, 2013). The most influential water stakeholder group in Israel is agriculture although it is probably not a homogenous group with regards to several aspects such as influence, water consumption, or political strategies. Nevertheless, it managed to maintain its historically important role for the state (Feitelson, 2005). Industry was never a controversial group in terms of water management and its share of water consumption is relatively small (Rejwan, 2011). Environmental and minority groups, on the other hand, have more difficulties to gain attention for their claims. Whereas environmental aspects of water such as residual water in rivers and attached ecosystems only recently gained attention in the political arena in Israel (Tal, 2002), minority groups, mainly Bedouins, struggle to get organised and to successfully vindicate their claims (Keinan, 2005). Inequitable management and allocation of water resources creates different kinds of conflicts among different stakeholders or between stakeholders and the state. Conflicts in this paper include court cases over water allocation, pollution, prices of tariffs and extraction levies, as well as intense targeting of politicians through lobbying or mobilising actions outside the official institutions. I explicitly concentrate on domestic water-related conflicts and groups that act within the 1967 Israeli borders. International conflicts between Israel and the Palestinians as well as its other neighbours are not subject of this paper. They are only mentioned in

as much as they are considered in Israeli water allocation, i.e., water allocation to Jordan and the Palestinian territories.

An analysis of domestic water-related conflict in Israel with a focus on stakeholders is new. It is even more interesting because existing data on the topic is not very instructive. Thus, the WARICC dataset (Bernauer et al., 2012b) primarily covers events relating to international conflicts with the Palestinians, Syria and Lebanon. Those conflicts that happen within Israel are connected to the drought years in the 1990s and 2000s, water pollution, and strikes in the water sector.

Accordingly, this paper is structured as follows. In the conceptual framework, I outline my argument with a discussion of the existing literature on centralisation and decentralisation, public goods provision, and civil society actors' influence. In the case study description, I introduce the methodological approach for this paper and the context of the Israeli case. Findings and resulting challenges are presented in the section stakeholder participation in Israel and completing remarks and some policy recommendations are outlined in the conclusion section.

5.2. Conceptual framework

Water management means that the state has to allocate a scarce resource to different water users, provide enough water for those users or regulate their demand, treat wastewater, and preserve water quality and quantity for future generations. Two main opposites in water governance are centralisation and decentralisation as well as fragmentation and integration. While centralisation and decentralisation describe a top-down process where power is delegated from higher level to lower level institutions (Larson and Soto, 2008), integration and fragmentation describe processes that take place between institutions at the same hierarchical level (Edelenbos and Teisman, 2011). These processes distribute responsibilities among one or several institutions. Both concept pairs are continua; they are discussed in the following sections.

Decentralisation in resource management has received much attention and support during the last decades (e.g., World Bank, 1997; Conyers, 1983; Larson and Ribot, 2004). The ideal implementation of this concept is democratic decentralisation, thus political and administrative delegation of powers from the central state to local authorities with local participation (Ribot, 2004) as opposed to centralisation where all power lies with the central state. It is generally assumed that decentralised management structures are better than centralised ones for several reasons such as higher efficiency, legitimacy or sustainability (e.g., Larson and Soto, 2008) but there is little direct comparison of those systems. Attempts at decentralisation failed when accountability was missing (Djogo and Syaf, 2004) or democratic decentralization was not achieved (Larson, 2005). Therefore, the focus of decentralisation shifted to participatory components of decentralisation and their

importance for successful decentralisation (Beierle, 2002; Fischer, 2000). A general problem is also a reluctance of central authorities to transfer control and autonomy to local governance institutions because they fear to lose control (Ribot, 2006). The authority to control the access to and the use of natural resources presents itself as a strong argument against decentralisation (Gupta, 2009).

The second discussion revolves around integration and fragmentation. Integration is used in the context of integrated water resources management (IWRM) which describes a coordination of all water-related issues while satisfying everybody's needs and preserving ecological aspects (GWP, 2000). Fragmentation concerns the division of power among different institutions without sufficient communication between them and is usually seen as problematic in water management and obstructive to integration approaches (Bakker and Cook, 2011). Edelenbos and Teisman (2011) analyse the evolution of fragmented water governance and the recent call for integration of different aspects into one main institution. They discuss IWRM and ask when and how it can be implemented without neglecting specialisation which is according to them the main driver of fragmentation. Fragmentation and integration can take place at the same time. A good example for this interaction of fragmentation and integration is given by Fischhendler (2008). He relates the unsustainable water management of IWRM in Israel to the gap between the establishment of infrastructure integration and fragmented institutions. Gupta (2009) explores the difficulties of implementing existing concepts such as IWRM or decentralisation in water governance and concludes that traditional practices and the history of water governance in a specific country have to be considered when new management models are introduced. Wallis and Ison (2011) look at water management systems in Australia and find that attempts to integrate institutions sometimes make processes more complicated because existing structures are maintained concurrently. Furthermore, Nielsen et al. (2013) conclude that more successful approaches to IWRM are often linked to more centralised top-down strategies while local knowledge is ignored and participation is limited. These studies confirm the critique that IWRM is difficult to implement because participation and integration are difficult to combine (Blomquist and Schlager, 2005).

Participation which is propagated not only by the decentralisation literature but also by IWRM is not a straightforward process either. The most important question is probably which stakeholders should be included and how. Gupta (2009) refers to capacity differences in society and the related marginalisation of certain members of society who do not have the chance to participate in decision-making. While Rowe and Frewer (2000) emphasise that not all participation methods have the same quality and effectiveness, Warner (1997) stresses that any form of participation should be consensus-driven. Stakeholder analysis helps to identify important stakeholders affected by decision-making

(Reed et al., 2009). However, if local knowledge is of interest, then it is also important to consider the type of knowledge and the stakeholders who have this knowledge at their disposal.

Differing political, social, or economic power of stakeholders becomes especially important when participation is not institutionalised, i.e., when local stakeholders are not included in the decision-making process of central state politics. If there is no official way to engage in water management and allocation, stakeholders have to design their own strategies to gain influence. These strategies depend, on the one hand, on the political opportunity structures of a country such as the availability of resources or the institutional landscape (Kitschelt, 1986) or more specifically the degree of formal access which is defined through the degree of decentralisation, the concentration of state power, the fragmentation of public administration, and direct democratic procedures (Kriesi, 1991). On the other hand, such strategies are dependent on internal aspects of the group. Dür and Mateo (2013), for example, examine different groups' strategies to gain influence while considering the groups' thematic orientation, their financial capacities, and the topic in question. A common finding in interest group literature is that business groups rather apply strategies that try to directly influence decision-makers while citizens groups are more likely to mobilize and target public opinion (e.g., Baumgartner et al., 2009; Yamin, 2001). Dür and Mateo's framework, however, assumes that groups are able to organise and to strategize in terms of their goals and target groups. Often, this is not the case if marginalised groups are involved who lack knowledge and capacity to organise and build coherent strategies. Some studies therefore stress the importance to explicitly include marginalised groups in the decision-making process in order to gain more social justice (Dovi, 2009; McDermott, 2009).

Based on the existing literature, I build the framework for the Israel case study as follows. In centralised water management systems where participatory mechanisms for stakeholders are missing, different stakeholder groups choose their strategies in order to influence decision-making at the national level. I assume that different stakeholder groups have different ways of organising according to their numbers and financial capacities. These ways reach from well organised structures with own budget and agenda to individuals that could be grouped with regards to their preferences but usually are unorganised and fight for their own advantages. The strategies that are chosen by different groups depend on their abilities to organise. Some of the strategies are more likely to have a conflictive effect on interactions with the state than others and some strategies are directly confrontational. Strategies include political representation through elections, mobilisation of public support, direct lobbying with decision-makers, court procedures and confrontation through protests. The different stakeholders, their strategies and their type of organisation are summarised in Table 11. The tick indicates which group applies what strategies. While households only apply a strategy

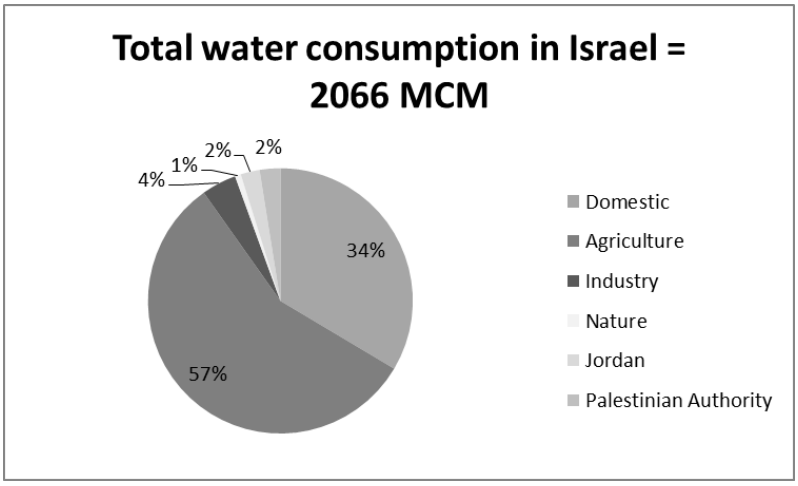
when they are unhappy, their leverage is high when they decide to act. In such a case, they may organise public campaigns and protests. Minorities work primarily with direct confrontation. Agriculture is very diverse and well organised; they apply all possible strategies depending on the situation. The same is valid for environmental NGOs with the exception of representation through elections.

Table 11. *Stakeholder groups and their strategies.*

Individuals	Institutional organisation	Representation Elections	Lobbying	Public Support	Confrontation
Households		-	-	(✓)	(✓)
Minorities		-	-	-	✓
	Agriculture	✓	✓	✓	(✓)
	Environmental NGOs	-	✓	✓	✓

Different stakeholder groups also have different preferences. These individual preferences vary, of course, according to the groups' needs and intentions. Agricultural users have different requirements in terms of water quality and quantity than households. Agriculture is still the biggest water user in Israel although over 50% of its water requirements come from recycled wastewater[39]. The second biggest consumer in Israel is domestic water consumption. The remaining amount of water is allocated to the Palestinians and Jordan, industry and nature (see Figure 11). All of these groups are small in comparison to agricultural and domestic water consumption.

Figure 12. *Total Israeli water consumption in Million cubic meters[40].*



Conflict in this paper is generally defined as actions that happen outside official governmental or parliamentary processes and oppose the strategy of official water management or try to change this

[39] These numbers are taken from the presentation "Israel water sector – overall review" from the Water Authority for 2011 (http://www.water.gov.il/Hebrew/Pages/Water-Authority-Info.aspx).
[40] Ibid.

strategy in some way. Due to several reasons, we might expect more conflicts over water between the state and stakeholders in a centralised system. First of all, some groups are poorly represented in national politics and might feel increasing levels of frustration because they are unable to vindicate their point of view or because they feel relatively disadvantaged by national decision-making. Second, these feelings are related to low leverage at the national level, because these groups lack importance in size or content of their claims. Third, insufficient participation opportunities decrease legitimacy of national decision-making and public support for such decisions because stakeholders are disconnected from the process. Furthermore, the lack of these opportunities might facilitate conflictive reactions because some stakeholders simply do not find another option to defend their positions.

This setup allows for three expectations. First, groups with sufficient political representation in parties through elections manage well to enforce their claims because they can put them directly onto the political agenda. Groups without such representation lack influence in national water decision-making. Second, groups without political representation which can rely on organisational structures choose strategies of lobbying and bottom-up projects not initiated by national politics. Third, groups that are unable to build structures and organise choose strategies of confrontation. These assumptions are discussed during the next sections based on 10 expert interviews, existing literature and official statistics.

5.3. Israel case study

10 expert interviews have been conducted in Israel with two university professors, a former deputy water commissioner, a former water commissioner, the former head of the water supply department of Mekorot[41], a lawyer, a private consultant, the director of the Yarkon River Authority, an employee of the NGO SPNI (Society for the Protection of Nature in Israel), and the Israeli director of FoEME (Friends of the Earth Middle East). In addition to the expert interviews, I consulted existing literature and official statistics.

Water resources in Israel are of high political and strategic interest because they enable farmers to cultivate arid and semi-arid environments and thus, to settle and claim the land. With the foundation of the state of Israel in 1948, the perception of scarce water resources became increasingly popular and acted as a convincing argument for strict state control of water management and a centralised management system (Alatout, 2008). In 1959, the state introduced a water law which declared all water[42] in the country as public and put it under state control, exercised by a water commissioner

[41] Mekorot is the national state-owned water company in Israel.

42 Article 2 of chapter 1 of the 1959 water law: For the purposes of this Law, "water resources" means springs, streams, rivers, lakes and other currents and accumulations of water, whether above ground or underground, whether natural,

with comprehensive decision-making power (Israel, 1959). The law was amended in order to include pollution control in 1972, to delegate urban water supply from municipal administrations to corporations in 2001, and in 2006 to establish the new water authority, superseding the water commissioner (Kislev, 2011; Laster and Livney, 2011). The law also enabled the physical integration of water infrastructure into the national water carrier (Figure 12), one system connecting all major water sources of the country[43] and distributing them (Fischhendler and Heikkila, 2010). Although control of water management is fully centralised in Israel, formerly in the hands of the water commission and now of the water authority, there exist two exceptions to this structure, namely drainage and river authorities which will be introduced later in more detail (see also Table 12). The centralised management could not avoid overexploitation of water resources and a severe water crisis at the end of the 1990s and the beginning of the new millennium (Feitelson et al., 2007). As a consequence of this development, the Water and Sewage Authority (from now on abbreviated as Water Authority) began working in 2007 under the Ministry of Energy and Water. It is responsible for regulation of water supply, water allocation, management in general, and setting of prices and tariffs. With its establishment, a considerable amount of authority, previously shared among six different ministries, was integrated into the new institution (Feinerman et al., 2013).

Whereas freshwater supply, sewage, and the consumption of reused water are managed centrally by the water authority, there are 11 decentralised drainage and two river authorities. The drainage authorities' purpose is to evaluate and implement flood protection projects; especially since a reorganisation in 1996, these authorities seem to work more efficiently (Maruani and Amit-Cohen, 2009). The creation of the river authorities in 1988 (Yarkon) and 1992 (Kishon) respectively was achieved first and foremost to protect and rehabilitate heavily polluted and exploited rivers in the country. Especially the Yarkon River Authority has not only been successful in strongly improving the river's quality but has also established effective stakeholder participation and public support for their projects (Pargament et al., 2010). The Yarkon River Authority includes 18 different bodies such as government departments, local authorities, other organisations and corporations, as well as landowners[44]. The Authority also emphasises its responsiveness to public requests[45].

regulated or made, and whether water rises, flows or stands therein at all times or intermittently, and includes drainage water and sewage water

43 These include the Sea of Galilee, the Mountain Aquifer, and the Coastal Aquifer.

44 Interview with David Pargament, 28.02.2013, director of the Yarkon River Authority.

45 According to David Pargament, everyone can call for inquiries and emails are answered within 2 to 3 days.

Figure 13. *National water infrastructure from 1995 (Source: Feitelson and Fischhendler, 2009).*

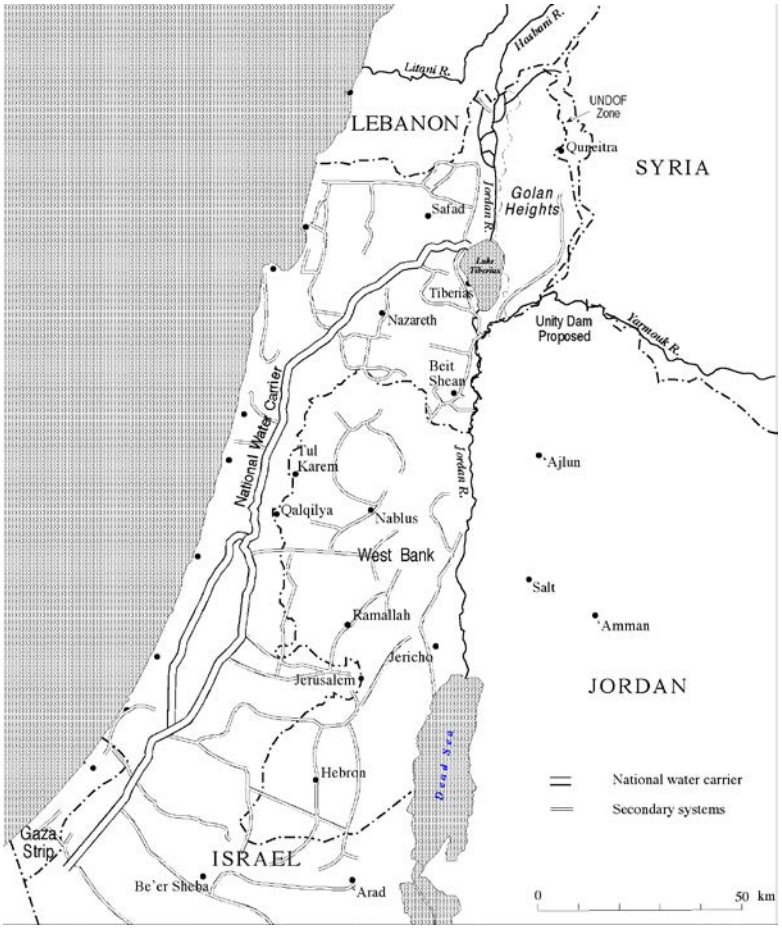


Table 12. *Water institutions in Israel.*

	Structure	**Responsibilities**
Water Authority	Centralised	Freshwater supply, sewage, treatment and redistribution of wastewater
River Authorities	Decentralised	Protection and rehabilitation of rivers
Drainage Authorities	Decentralised	Flood protection

Water infrastructure in Israel is highly centralised. The government tried to move from fragmentation to more integration with the last reform in 2006. Whereas formerly six different ministries were actively involved in certain aspects of the management process, these functions were subsumed under the Water Authority and its Council. The Council is primarily responsible for setting the prices of water tariffs and extraction levies; it also organises public hearings to topics that might raise concern (Kislev, 2011). It can further suggest amendments of the water law to the Knesset

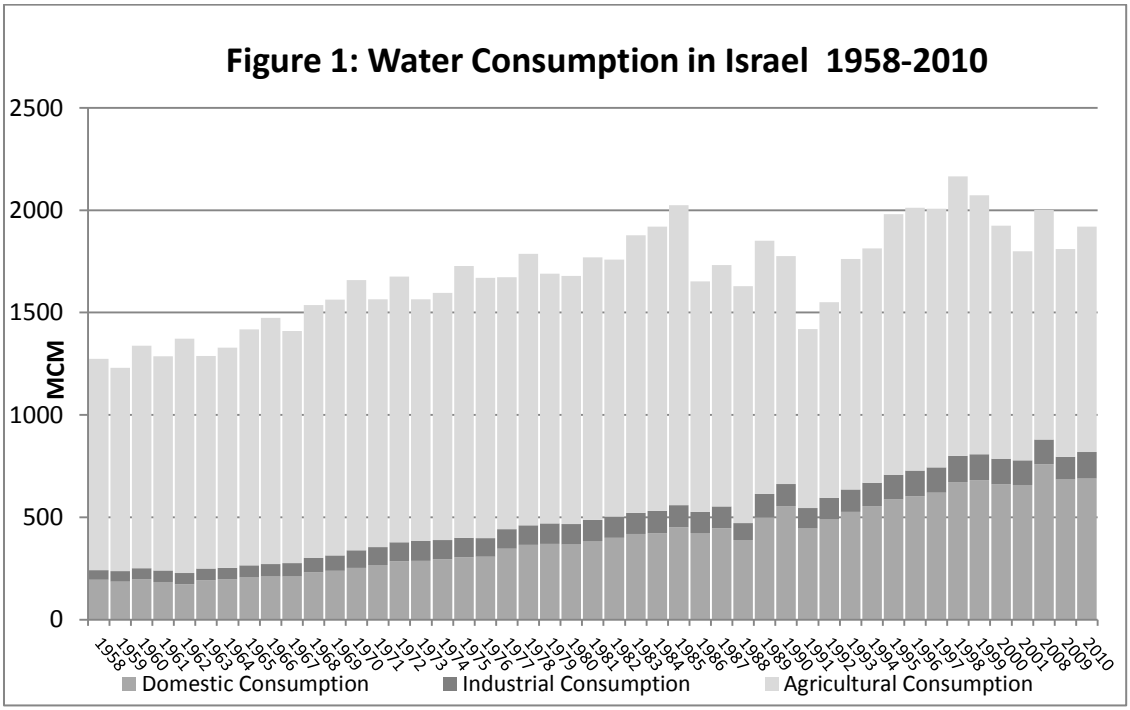
finance committee. The Council is comprised of the director of the Water Authority, members of five ministries[46], and two representatives of the public.

When looking at water consumption, agriculture is the biggest water user in Israel (Figure 13). Due to its strategic and ideological importance (Alatout, 2008), agriculture has always enjoyed special governmental attention in terms of water allocation and prices. The prices of agricultural consumption are subsidised through higher prices in domestic water consumption. As a consequence of increasing water scarcity during the last decades and related cuts in water quotas by the water commissioner, agriculture managed to substantially reduce its water needs through modern irrigation technology and to substitute freshwater through recycled and brackish water which can be used for irrigation of many crops after secondary and for an even wider use after tertiary treatment (OECD, 2011). Water for industrial consumption is also subsidised although it is more expensive than water for agriculture. Domestic freshwater consumption has increased considerably (Figure 13) since the foundation of the state mainly driven by an increase in population which has grown from 3.7 Mio in 1980 to 7.4 Mio in 2010 and is expected to rise to 12 Mio in 2050 (UN, 2010). Accordingly, the overall consumption of water in the domestic sector has risen as well although per capita consumption is relatively low compared to other countries in the region and some Mediterranean countries in Europe that sometimes experience water scarcity (Figure 14). Domestic consumption in Israel also dropped in years with conservation measures during drought times (Figure 13). Natural rivers and streams were for a long time only seen as a source for freshwater supply. Their ideational value as symbol for an intact nature and recreational space for citizens is more of a recent phenomenon which developed with the awareness of the importance of healthy river ecosystems (Tielboerger et al., 2010). When the river authorities were established at the beginning of the 1990s, natural rivers and streams were in terrible conditions and subject to progressive degradation (Katz and Tal, 2013; Pargament et al., 2010). Growing environmental interest and a strengthening of NGOs engaging in water issues brought the conditions of rivers back on the discussion table with the establishment of river authorities. The institutional change, the dissemination of sewage treatment plants, and the development of large-scale seawater desalination facilitated claims for more residual water to be left in the rivers (Katz and Tal, 2013). Israel further has some obligations towards Jordan and the Palestinian Territories, stipulated through the peace treaty with Jordan in 1994 and the Oslo II accords with the Palestinians in 1995 (Kislev, 2011). Accordingly, relevant stakeholder groups in Israel include agriculture and industry, domestic water users, environmentalists, and on an international scale Jordan and the Palestinians.

46 These include the Ministry of Agriculture, Environment, Interior, Infrastructure, and Finance.

In general, domestic water-related conflicts in Israel are non-violent and happen in the political arena or in courts. Disputes and conflicts over water arise in different areas between different groups. First of all, there is of course the conflict between Israel and the Palestinians which pertains to the international level. The Oslo II accords covered the establishment of the Joint Water Committee (JWC), drilling rights for Palestinians in the West Bank and the delivery of 28.6 Mio cubic meters annually from Israel to the Palestinians. Although the Oslo II accords were only an interim agreement, they are still in place due to the lack of a permanent agreement. Today, Israel delivers 54 Mio cubic meters annually and takes the view that this amount more than fulfils its obligations stipulated in the agreement (Kislev, 2011). Despite this increased amount of water delivery, Palestinian water supply is not sufficient for their needs and thus, water flow is interrupted regularly in Palestinian cities. These conditions lead to Palestinian claims for more water and control of the Mountain Aquifer.

Figure 14. *Water consumption in Israel 1958-2010. (Source: Central Bureau of Statistics, Israel).*



Another locus of conflict is in Bedouin settlements in the Negev in the South. Some of these settlements are not authorised by the state and the water authority takes the view that it is only obliged to provide water infrastructure to permanent and authorised settlements. Unauthorised settlements are only provided with water for basic human needs which can be limited to a few access points. Bedouin communities react to this explanation with numerous judicial claims because they fear to lose their nomadic land if they agree to move to permanent settlements. So far, these

cases have not had much chance of success[47] but the government is working on a solution to these problems[48]. According to Tubi and Feitelson (work in progress), some conflicts also happen between farmers and Bedouins. They usually occur during drought times and can cover the full range from verbal complaints to violent events with injuries (Tubi and Feitelson, work in progress). These events were found by the authors through local archives and did not come up during my interviews nor were they found in the WARICC dataset.

Conflicts concerning the agricultural sector often address farmers in the North. These farmers literally sit at the source of water because the North of Israel is the water-rich part of the country. Therefore, they have strong leverage vis-a-vis the Water Authority, especially when it comes to extraction levies. Extraction levies are taxes that are paid for water abstraction, and should reflect the scarcity of the resource. They vary according to time and place and are paid in block rates, i.e., they are higher the more water is extracted (Kislev, 2011). Figure 15 shows 3 different regions with block rates A, B and C for aquifers and surface water. The disconnected area includes the area south of the Sea of Galilee, down the Jordan Valley until the Dead Sea and the Sea of Galilee area includes the shores of the lake, the upper part of the Jordan and the Golan (Kislev, 2011, p. 52). The disconnected and the Sea of Galilee area have much lower extraction levies thanks to the Water Cooperative of the Jordan Valley. This cooperative, joined by several kibbutzim, went to court over water prices three times, last time in 2006. Although their cases were rejected three times, they managed to negotiate very low extraction levies in an agreement with the government in 2006[49]. Disputes over prices between cooperatives and the Water Authority also seem to constitute the majority of judicial cases; only a minority of these cases deals with conflicts between individual users[50]. Some judicial cases also deal with pollution. These are criminal cases where the Water Authority prosecutes polluters who dump polluting material into surface or groundwater. Unfortunately, statistical data on these cases were not available.

Some conflicts also occur between NGOs and the state. These conflicts sometimes end in court but sometimes the threat of legal action is enough to pressure the Water Authority into action[51]. Usually, they are related to two issues. First, the state is not adhering to its duty of disclosure of information and holds back documents that should be released by law. Second, the state does not act against water pollution cases that should be clearly prosecuted[52]. NGOs act when they feel that

47 Interview with Yoav Kislev, 25.02.2013, emeritus professor at Hebrew University of Jerusalem.
48 Israel Land Administration 2007: The Bedouin of the Negev.
http://www.mmi.gov.il/envelope/indexeng.asp?page=/static/eng/f_project.html
49 A cooperative is a group of farmers that cultivates state owned land but all other property is owned individually and not collectively like in kibbutzim.
50 According to unpublished data by Yoav Kislev, 25.02.2013.
51 Interview with Orit Skutelsky, 12.03.2013, campaigner for the rivers and streams project at SPNI.
52 Ibid. Interview with Gidon Bromberg, 13.03.2013, Israeli director of Friends of the Earth, Middle East.

the state is not moving fast enough or is obstructing their campaigns to improve water quality or quantity of residual waters.

Figure 15. *Total water withdrawal per capita for selected countries. (Source: FAO, 2013).*

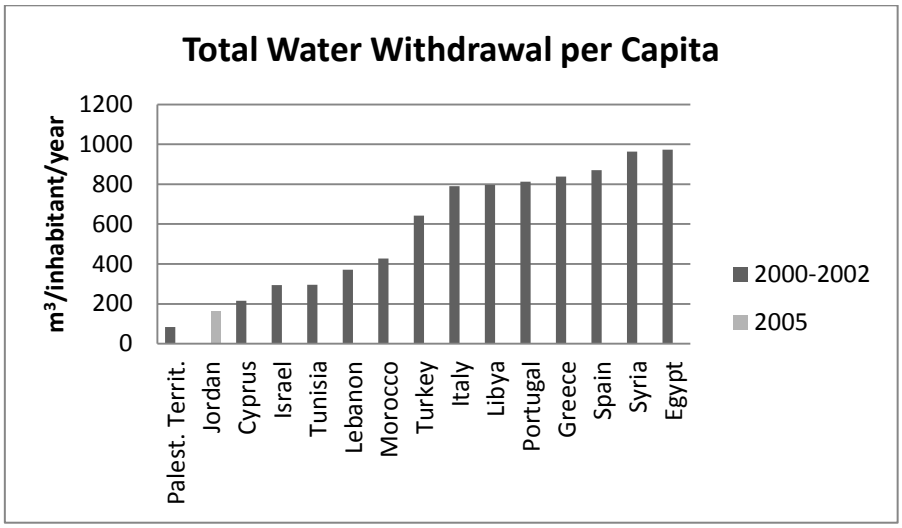
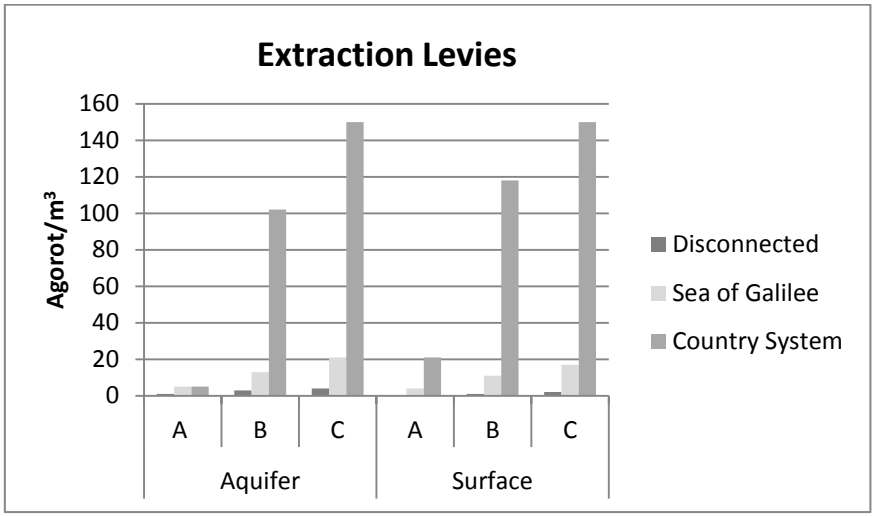


Figure 16. *Extraction levies in Israel. (Source: Kislev, 2011)*



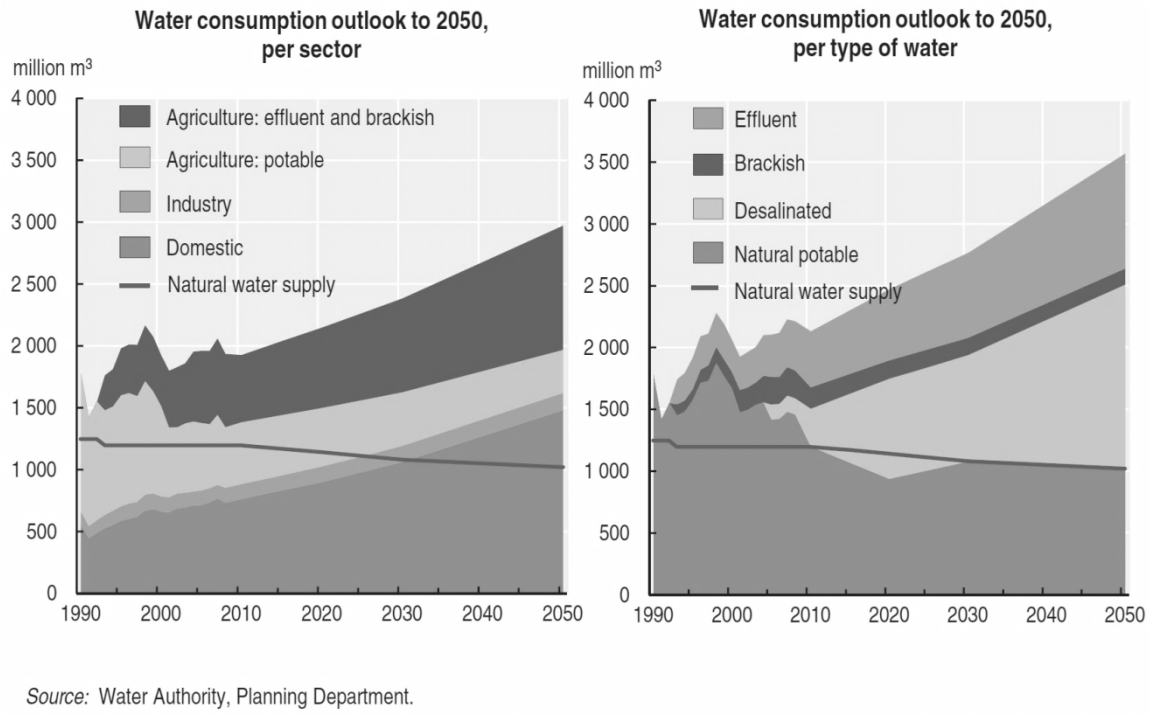
5.4. Stakeholder participation in Israel

Different stakeholder groups in Israel are now discussed with respect to their leverage, their strategies to gain influence in national decision-making, and how these factors can change. Agriculture has been the biggest water consumer in Israel since the foundation of the state and continues to be so although it might be outstripped soon by domestic consumption. This happened already in the case of freshwater consumption (Kislev, 2011) because agriculture increasingly uses treated wastewater. Agriculture not only occupies an economic but also, and in particular, an ideological function in Israel. This ideological function is founded on the idea that the Israeli people

and new immigrants should connect to their homeland. Furthermore, it has some practical implications such as defending the land against outside claims, guaranteeing food security, or the absorption of new immigrants (Feitelson, 1999). The ideological argument reaches back to Zionism and the first Jewish immigration to Palestine before the state of Israel was founded (Lipchin, 2007). In 2000, the Israeli government decided to sustain the same agricultural area in the future as it used to in the past although agriculture only contributes about 3% to national GDP[53]: "agriculture is not an economic issue, it is a national interest"[54]. If agriculture is seen as a national interest, the state has to provide it with the necessary amount of water for irrigation which brings me back to my first two points, water consumption and political representation. Agriculture's total consumption is declining due to more efficient irrigation technology. The amount of freshwater used in agriculture is also declining because treatment of sewage has reached such a high standard, that in can be used for most agricultural practices. Therefore, agriculture is not a direct competitor of households when it comes to freshwater consumption and freshwater is increasingly used for other purposes. Figure 16 shows water consumption by sector and type since 1990 with an outlook until 2050. Political representation of agriculture from moshavim and kibbutzim[55] is also declining. While these representatives used to have high numbers in the Knesset until the 1970s, the newly elected Knesset of January 2013 does not have a single representative from the agricultural sector[56]. However, the last Knesset before the elections was still influenced by agriculture in such important bodies as the Water Committee (Feitelson, 2005). The decline of agricultural representatives in Israeli politics is a sign for the shrinking economic importance of this sector but it is not necessarily a sign of shrinking leverage at the level of national water management. Agriculture's leverage with the Water Authority is strong because of good personal contacts[57] and the proximity to important water sources[58]. On these grounds, it can be said that agriculture overall enjoys a high leverage in national water management.

53 Central Bureau of Statistics, Israel, for the year 2011.
54 Interview with Shimon Tal, 14.03.2013, Israeli water commissioner from 2000-2006.
55 Moshavim and kibbutzim are groups of farmers that cultivate state-owned land. While kibbutzim are organised collectively, moshavim are organised individually.
56 Interview with Eran Feitelson, 13.02.2013, professor at the Hebrew University of Jerusalem.
57 According to Shimon Tal, these contacts already had tradition during the times of the Water Commission. Many water commissioners had agricultural backgrounds themselves (Feitelson et al., 2007).
58 The leverage of these farmers can also be seen in the agreement of 2006 with the favourable terms they managed to negotiate for extraction levies although the court rejected their claims three times.

Figure 17. *Water consumption outlook for Israel (OECD, 2011).*



Source: Water Authority, Planning Department.

The second stakeholder group that is discussed are domestic consumers. Of course, it is slightly incorrect to subsume domestic consumers into one group because they are not organised as such and they also overlap with other groups. Essentially, every agricultural stakeholder is also a domestic consumer. However, freshwater consumption is increasing due to population growth[59] as well as on-going immigration[60] and the state strives for a reliable water supply at all times. As opposed to many other countries in the area, freshwater in Israel is available 24 hours without interruptions. Consequently, freshwater supply does not seem to cause problems to water consumers. Water-efficient devices are standard in most Israeli households and the leeway for technological water savings is, therefore, limited[61]. Economic incentives via higher prices would be more promising for water savings but the state has to be careful when increasing the burden for average households. Social protests during the summer of 2011 showed that financial capacity is already stretched for many. Water prices were also a topic that was mentioned during the interviews. Yoav Kislev, for example, deplored that the public is not consulted over the prices of water tariffs. These are set by the Water Council without outside involvement[62]. Sarah Haklai called for more dialogue with all stakeholders for decision-making in water management including prices[63], and Shimon Tal said that

59 According to the Central Bureau of Statistics, every woman in Israel has, on average, 3 children.
60 The Central Bureau of Statistics in Israel gives numbers of between 0.5% and 1% population growth through immigration per year.
61 Interview with Shaul Arlosoroff, 13.03.2013, former deputy water commissioner in Israel.
62 Interview with Yoav Kislev, 25.02.2013, emeritus professor at Hebrew University of Jerusalem.
63 Interview with Sarah Haklai, 13.03.2013, former head of the water supply department of Mekorot.

price increases should not be too abrupt and that the public should be consulted[64]. Prices are also a topic with respect to desalinated water. Although they are declining with more advanced technology, desalinated water is still more expensive than other sources. The government agreed with desalination companies that it will cover the fixed costs of desalination plants in any case whether desalinated water is produced or not[65]. In dry years, this is not an issue. In years with above average precipitation however, this means that consumers have to pay the fixed costs, even if no desalinated water is produced. It would be interesting to know what the public reaction to this scenario will be and how much desalinated water would be produced if public consultation was taking place. While domestic consumers cannot be understood as an organised or homogenous group, institutions that provide water supply for households are, of course, very organised and pursue their strategies. Especially Mekorot has an influential position since it is responsible for the national water carrier and the pumping from water resources. Therefore, they are always in contact with the Water Authority about water levels and other potential problems. Mekorot is also confronted with complaints from farmers when they have to cut water supply during times of drought. This happened during the first years of the 2000s and some farmers even threatened to commit suicide because they feared for their livelihoods but the decisions on cut backs lies with the Water Authority and not with Mekorot[66]. Thus, consumer satisfaction is important in the political arena but consumer leverage with the Water Authority is limited. Water supply institutions are better connected with the Water Authority but also call for more openness and participation[67].

Environmental NGOs also suffer from a lack of participation opportunities but they are, as opposed to domestic consumers, organised groups which have their channels of influence. They have very specific campaigns which target the right contact points. In this paper, I discuss the NGOs SPNI and FoEME which both have projects for improving water quality in Israel. SPNI was founded in 1953 and is Israel's oldest and largest environmental NGO. Its foundation was directly related to the drainage of the Hula wetlands which were partly re-flooded during the 1990s. Today, SPNI works on several projects in biodiversity, energy, birds and mammals, as well as the conservation and restoration of Israel's streams and rivers. The campaign for stream and river restoration was only made possible through desalinated water. This extra amount of water allows opening up the discussion about leaving residual water for nature in springs, rivers, and streams[68]. This campaign is lengthy but also rewarding. The lengthy part involves a lot of educational work in the population, the Knesset, and the Water Authority. The rewarding part pertains to the support of the population. Most people get

64 Interview with Shimon Tal, 14.03.2013, Israeli water commissioner from 2000-2006.
65 Interview with Yoav Kislev, 25.02.2013, emeritus professor at Hebrew University of Jerusalem.
66 See footnote 63.
67 Interview with Sarah Haklai, 13.03.2013, former head of the water supply department of Mekorot.
68 Interview with Orit Skutelsky, 12.03.2013, campaigner for the rivers and streams project at SPNI.

enthusiastic about intact river systems and are willing to support such initiatives[69]. Drainage of rivers in Israel is not a new phenomenon but reaches back some 60 years. Most people do not remember how natural rivers and streams looked like and have to first learn about the problems of rivers today. SPNI's campaign, therefore, aims at targeting the population, on the one hand, to sensitise them for this issue through pictures and field schools. On the other hand, they lobby intensely in the political arena. This lobbying work involves visits to Knesset meetings, information of Knesset committees, and direct requests to ministers to participate in certain campaigns[70]. SPNI further stays in close contact with employees of the Water Authority in order to be informed about certain moves and projects. The Water Authority has a closed decision-making process and it is almost impossible to get informed about any news unless one is acquainted with employees and gets informed through them[71]. SPNI is trying to push their project high on the Water Authority's agenda. One of their main goals is also to influence policy-making at the national level in order to achieve more transparency, participation, and involvement in the work of the Water Authority[72]. SPNI is also not shy to force the Water Authority with legal charges in order to release protocols or other documents which should be released under the freedom of information law from 1998 (Israel, 1998) but are kept secret[73].

Whereas SPNI only works in the national arena, FoEME explicitly concentrates on the international sphere. They promote regional cross-border cooperation between Israeli, Palestinian, and Jordanian communities and, at the same time, try to influence national policy-making because this level is crucial for a successful regional cooperation. With regards to a master plan on how the Jordan River should be managed as a whole, FoEME first created a detailed regional vision with the collaboration of regional experts and second, they prepared national roadmaps that describe how the goals can be reached. For the national roadmaps, policy consultancies are brought in which make specific suggestions for policy changes[74]. FoEME works with top-down and bottom-up approaches. The Jordan River master plan was a top-down approach where they start at the policy level. The good neighbours program, on the other hand works bottom-up and starts at the community level. The goal of the good neighbours program is to clean up and protect transboundary water resources which degraded in many parts to not more than sewage canals. At the beginning of the program in 2001, community participation in the project started to roll slowly but now interest has risen so much that the limiting factor is funding[75]. The program has been very successful in terms of sewage removal from the Jordan River. Although communities were required by the law to treat their sewage

69 Interview with Orit Skutelsky, 12.03.2013, campaigner for the rivers and streams project at SPNI.
70 Ibid.
71 Ibid.
72 Ibid.
73 Ibid.
74 Interview with Gidon Bromberg, 13.03.2013, Israeli director of Friends of the Earth, Middle East.
75 Ibid.

correctly, it needed some extra pressure through legal threats to move things forward[76]. FoEME, too, expresses discontent with the Water Authority. They feel that the Water Authority is not really willing to release water into the Jordan River because it is seen as source for water supply and not as a natural asset[77]. On the contrary, communities participating in the good neighbours program realised that a clean and vital Jordan River also represents a source of income because it generates tourism.

In the case of the NGOs SPNI and FoEME, it can be said that they are very well organised and connected. They know whom to address for which requests and are able to generate funding for their activities. Although funding could always be higher to include more activities, these two NGOs are often successful when they initiate new projects. Conflicts during their work cannot be avoided completely but they adhere to official rules and lobbying in order to accomplish their projects and they are well informed about rights and legal options when official institutions do not show enough willingness to cooperate. However, a noticeable rise in leverage seems to have started with the production of desalinated water. This production enabled NGOs to make claims which can be considered seriously by the Water Authority.

The last group that is discussed here are the Bedouins. Bedouins have difficulties to fit into modern Israeli society. Their traditional way of nomad life is not compatible with the concept of a modern state (Shmueli and Khamaisi, 2011) where people are sedentary and live in permanent settlements. Some Bedouins refuse to live in settlements provided by the state and claim land outside these official settlements as their own. This perception of the property situation clashes with the state because almost all land in Israel is state-owned (Marx and Meir, 2005; Yahel, 2006). From the 1950s onwards, the Israeli state tried to urge Bedouins into Bedouin towns and settlements. Although these attempts to urbanise Bedouins improved living conditions in terms of decreasing mortality as well as better health and educational systems for many (Meir, 1990), it also caused conflicts between the state and those Bedouins who did not want to move into designated towns because they were afraid to lose their land (Marx and Meir, 2005; Shmueli and Khamaisi, 2011). One of the main complaints is that the state never involved any Bedouins in the planning process of these towns and urbanisation attempts (Marx and Meir, 2005). While legal cases on land issues between Bedouins and the state are a continuing process (Meir, 2009), these unresolved problems also have implications on water conflicts. The Water Authority refuses to provide proper water infrastructure to unrecognised settlements which results in temporary supply that only guarantees the basic human needs for

76 Interview with Gidon Bromberg, 13.03.2013, Israeli director of Friends of the Earth, Middle East.
77 Ibid.

surviving[78]. Although such legal cases do not have much chance of success, they seem to be the only way for the Bedouins to express their positions due to a missing comprehensive strategy.

5.5. Conclusion

Based on the conducted interviews, internal conflicts over water in Israel[79] such as court cases over several issues and general opposition against official water management occur primarily between different stakeholder groups and the state. International conflicts between Israel and the Palestinians are mentioned in this paper but not discussed in detail because the focus is on internal issues and internal stakeholders. Stakeholder groups that can be related to conflicts are mainly agriculture, environmental NGOs, and Bedouins. These conflicts stem from power plays and the testing of institutional authority in the case of agriculture and the Bedouins; a lack of participation and consultation on water management issues related to renaturation and rehabilitation of rivers and streams in the case of environmental NGOs; and insufficient organisation and consultation in the case of the Bedouins. Few problems are evident with domestic water consumption and water supply. The reason for this fact is founded in the well-functioning water supply system which leaves little ground for complaints except rising prices for water tariffs. Complaints over water tariffs are presumably linked to the high costs of living in Israel and a rising financial burden for average households. It is therefore impossible to clearly separate protests over water tariffs from protests over the general costs of living.

In retrospect, my initial assumption that stakeholder leverage in a centralised system is limited only holds partly. Although institutionalised mechanisms to involve stakeholders in the decision-making process are lacking, stakeholders employ several methods to increase their leverage and to get their demands accepted. While agricultural stakeholders use their political connections and contacts, urban consumers rely on public pressure through elections or protests. Strategies of environmental NGOs are combined of intense lobbying tactics with Knesset members directly, bottom-up strategies that involve local actors and increase pressure on national politics, or legal threats through the courts and regulatory provisions if other attempts are not successful. In the case of the Bedouins, water-related conflicts often end in court. The chosen methods of different groups depend on their political power and the resources they have at their disposal. The success of these different methods also varies according to these factors. Accordingly, the leverage of agricultural stakeholders is higher than that of urban consumers and environmental NGOs. The Bedouins are certainly the least influential among the discussed groups.

[78] Interview with Yoav Kislev, 25.02.2013, emeritus professor at Hebrew University of Jerusalem.

[79] By comparison, many internal conflicts in Portugal happen between individual users over water abstractions from personal wells (Tribaldos, Typescript).

Suggestions for addressing conflicts over water in Israel would be more transparency and the introduction of participatory approaches for decision-making in water management[80]. More transparency in the work of the Water Authority would open the floor for criticism. While such criticism might seem inconvenient in the first place, it would force the Water Authority and the Council to deal with this criticism and look for consensus with difficult issues such as prices of water tariffs, the amount of produced desalinated water that is desirable by a majority of the population, or the renaturation and rehabilitation of rivers and streams and the price the population is willing to pay for it. It could even improve the situation of the Bedouins, at least on a level of understanding and the planning stage.

For a real consensus, however, transparency is not enough and participatory approaches are necessary in order to have a constructive involvement of stakeholders. The establishment of consultation processes in water management could be an instrument to analyse stakeholders' preferences. Apart from the detection of stakeholders' preferences, they also help to reveal weak points in decisions and to foresee future conflict potential. Such processes are already common practice in infrastructure planning processes but not in the Water Authority's decision-making[81]. Another instrument for more participation would be an independent council with its own budget that consists of different stakeholders and has supervisory functions towards the Water Authority. Such a council is desired by water experts[82] and planned by the government[83]. The exact starting date and the features of this council, however, are still discussed in the Knesset.

A good example of more consultation and participation is the Yarkon River Authority which stands out of the otherwise centralised system in Israel. They managed to include all stakeholders in their planning which seems to be widely appreciated[84]. They were also very successful in working towards their initial goal, i.e., to increase water quality in the Yarkon river. The best evidence for this improvement are species that were extinct for many years and now have returned to the river[85].

In order to consider the preferences of different stakeholders in a centralised water management system, I propose to opt for transparent processes and participatory mechanisms. Such instruments also help to counteract the feeling of relative inequalities between different stakeholder groups. They further enable critical discussions on water-related issues before the actual decisions are made and thus guarantee the consideration of various opinions by different groups.

[80] The suggestion for re-establishing a Water Board was made several times by Eran Feitelson and others in the Bein Committee and among other occasions.
81 Interview with Shimon Tal, 14.03.2013, Israeli water commissioner from 2000-2006.
82 Kislev 25.02.2013, Skutelsky 12.03.2013, Haklai 13.03.2013, Eran Feitelson 13.02.2013.
[83] Interview with Shimon Tal, 14.03.2013, Israeli water commissioner from 2000-2006.
[84] Yoav Kislev, David Pargament, Orit Skutelsky.
[85] http://www.yarqon.miotix.com/en

6. Appendix A

Water-Related Intrastate Conflict and Cooperation (WARICC): A New Event Dataset Codebook

Thomas Bernauer, Tobias Böhmelt, Halvard Buhaug, Nils Petter Gleditsch, Theresa Tribaldos, Eivind Berg Weibust, and Gerdis Wischnath

Version: 1.0

Background

Coding of data on cooperative and conflictive water-related events for all riparian countries of the Mediterranean Sea as well as all countries in the Sahel for the time-period 1997–2009

Research on the conditions that facilitate or prevent sustainable management of local, national, and international freshwater resources has intensified over the recent years, largely because of the severe impact of climate change on multiple countries – particularly those in the Mediterranean and Sahel area. Most of the existing studies on this issue, however, rely on qualitative analyses or comparisons of results from a few cases. There is no systematically compiled, high-quality dataset for a large number of countries that would allow scholars to study the determinants of frequency and intensity of domestic-level water-related conflict and cooperation with multivariate statistical techniques. This project seeks to fill this gap by constructing such a dataset, which in turn enables scholars to examine how water-related conflict and cooperation vary across time and space, and to what extent such variation is driven by political, economic, or climatic factors.

Finding the Best Source: Factiva vs. BBC Monitoring

In order to find and employ the best, i.e., most efficient and effective news source for our project, we considered different monitoring tools, but eventually focused on *BBC Monitoring*[86] and *Factiva*.[87] Factiva is a research tool that collects news reports by examining 28,000 sources (newspapers, journals, radio, TV, and other news services) from more than 200 countries in 23 languages, including nearly 600 continuously updated newswires with more than 2,300 sources being available on or before the date of publication. This news source offers different possibilities to narrow down information searches not only by applying a precise search string, but also via the possible exclusion of certain sources such as stock reports, sports news, or weather reports.

However, when employing the search string created for this project[88] while trying to exclude as many irrelevant sources as possible, Factiva still returns a huge amount of data with a massive number of irrelevant hits or duplicates of single events.[89] Moreover, we found Factiva's coverage to be problematic, as it translates only a certain share of foreign-language articles into English. This leads to a language bias that is difficult to assess. A large share of firm and company press releases in Factiva causes another bias: these sources cover specific perceptions, they cannot be treated as neutral, hence. Additionally, Factiva – for unknown reasons – dropped parts of its BBC Monitoring sources in 2001.

[86] See www.monitor.bbc.co.uk.
[87] See www.factiva.com.
[88] We describe this search string in the accompanying article.
[89] At a ratio of roughly one relevant media item to a hundred hits, the sheer volume of data turned out to be unmanageable and beyond the scope of our project.

This is challenging because of the coverage inconsistency and because BBC Monitoring is a major worldwide source of daily news.[90]

We therefore investigated BBC Monitoring as an alternative news source. Like Factiva, it provides a comprehensive database of worldwide news at the international and domestic level by collecting information from press, radio and TV stations on a daily basis, which in turn offers a more comprehensive coverage than Western press agencies such as *Reuters*.

As stated, the entire archive of BBC Monitoring is available through Factiva until 2001, but becomes inconsistent thereafter. Although Factiva does cover a larger number of events and picks up relevant events that may not be covered by BBC Monitoring, the inconsistency of reporting, the impossibility of excluding duplicates, and the huge amount of irrelevant items add up to a problematic bias. Knowing the limitations of BBC Monitoring and taking them into account when interpreting results seems to be the more reliable path. We thus chose to base our data collection and coding efforts on BBC Monitoring.

Data Quality – Urban Bias, Regime Type Bias, and Extreme Event Bias

The media reporting varies both in quality and quantity, i.e., in the amount and the precision of information. Users of the dataset should be aware of several potential sources of error, three of which we discuss in the following.

First, there may be an imbalance between reporting from urban and rural areas. Urban areas, with a higher population density, are likely to create more interactions than the periphery. It is also likely that urban news will affect more people than rural news – even if a majority of the population lives in rural areas. Both factors could influence the media coverage. Nevertheless, if our data suffer from urban bias in the media sources, the geographical variables we coded should mirror that. More specifically, we assigned the name and the geographical coordinates of an event's location if this was mentioned in the news item.[91]

Second, differences in regime type could influence the reporting. Many of the countries in our sample impose restrictions on media freedom.[92] We considered a media source to be independent if it is neither owned, nor funded, nor censored by the state. However, even nominally independent news agencies are not necessarily completely autonomous from government interference or self-censorship. For example, many news agencies are politically biased toward a ruling regime or party. These strategies result in two basic conclusions for a possible regime type bias. On one hand, non-democratic regimes could suppress any reporting that is critical of governmental policies. On average, our variable on the intensity of water-related events (*WES)* may be characterized by more positive values than it would be the case under more independent media coverage. On the other hand, the degree of press freedom and independence of news sources may be difficult to assess in some cases. In case of uncertainty about the neutrality of a media source, however, we followed a conservative approach and coded the specific source as non-neutral.

Third, events that influence the nation as a whole, such as the development of very large water projects or severe conflicts, may receive more media attention than events with a smaller impact or intensity. We did encounter events like these with a disproportionate amount of reports. Many media items referring to a much-reported event, for example, actually include references to that specific event, without including the event *per se* as the central part of the text. Events in the West Bank/Gaza Strip or a project on water transportation via balloons and pipelines between Turkey and Cyprus belong to this category. On the other hand, underreporting may also occur for some events, but this is difficult to identify, since we would not be aware of cases that could have been reported. However, either source of extreme-event bias is unlikely to pose major problems as we carefully cross-checked our coding work in order to avoid that the exact same event is included twice in our dataset. In fact,

[90] We also considered random sampling for drawing a suitable number of hits from Factiva. However, we rejected this because of the extremely large share of irrelevant media items and the possibility of an overrepresentation of major conflictive or cooperative events.

[91] If no location is explicitly mentioned in a news item, we used the coordinates of the national capital as the location.

[92] This statement can easily be tested via the Freedom House Index, for example.

Figure 1 of the article shows that our dependent variable (*WES)* is very unlikely to be biased toward either extreme negative or extreme positive values. This further increases our confidence in the coding procedures. Finally, when encountering catastrophic events, for example, where much of the related reporting deals with actions to limit damage, restoration measures, and so forth – without reporting the extreme event as such – we took into account the non-independence of recorded cases via the *cluster* variable.

Data Overview

The data are structured such that there is one observation per distinct event, where the event types are defined by the typology described below. An event may comprise *one-sided actions* by individuals, firms, NGOs, and/or state authorities, but also *interactions* between these kinds of actors. An event is also defined by *temporal and geographical dimensions*, i.e., there are clearly defined temporal starting- and end points, while the event takes place in a pre-defined location or region. Finally, events that merely "happen" without a specific social influence from the actors above are excluded (e.g., any events that are caused by nature *per se*).[93] For example, articles that refer to 1) talks about a the construction of a water-supply network in order to improve the water quality of a region, 2) any agreements on that new project, or 3) the actual realization of the water-supply network construction are all considered as separate events with different values of intensity.[94] However, these events are unlikely to be independent from each other. This has been taken into account by the *cluster* variable.

Data Fields

The following describes what information is included in the dataset.

- *case*: unique numerical case identifier in the form of "ccode-year-four_digit_casenumber," i.e., 64019970001 stands for "Turkey in 1997, first *relevant event* coded."
- *ccode*: numerical Correlates of War country code for the country under study, e.g., 432 signifies Mali.
- *cname*: Correlates of War name of the country under study, e.g., ERI.
- *date*: date of article/event in the form "yyyymmdd." If an event is likely to last longer than one day, the start day is given while – if possible – the *descr* item below provides information on the event's duration.
- *day*: day of event occurrence, e.g., 23.
- *month*: month of event occurrence, e.g., 11 for November.
- *year*: year of event occurrence, e.g., 1997.
- *location*: name for the location of the event in question (as precisely as possible). If a location is unknown, the capital of the country under study is given.
- *lat_coordin:* geo-referencing of an event. This variable provides the latitude coordinates of an event location in the form of decimal degrees with negative signs for South and West, e.g., 15.95 stands for 15° 57′ N.
- *long_coordin:* geo-referencing of an event. This variable provides the longitude coordinates of an event location in the form of decimal degrees with negative signs for South and West, e.g., -3.13 stands for 3° 08′ E.
- *cyprus:* dichotomous indicator identifying the Greek and Turkish parts of the island. This variable receives a value of 0 if an event affects the domestic setting of the Turkish part only, while a value of 1 is assigned to those events that affect the domestic setting of the Greek part of the island (Republic of Cyprus). Otherwise, this variable is set to missing. The importance

[93] In other words, reports on droughts only should not be coded as events. However, this does not pertain to cooperative and/or conflictive (inter-) actions caused by such natural disasters!

[94] These different levels of intensity (or, more precisely, the values of the *WES* item) are described in detail below.

of this variable stems from the fact that most data from other sources exclusively pertain to the Greek part (Republic of Cyprus).

- *cluster*: this variable controls for the non-independence of some events. If some events are somewhat related to each other (i.e., two workshops on water quality organized by the same NGO), these two events get the same value as identified in the *case* variable of the first event. If an event is not related to any other event, the corresponding cell is left blank.
- *event*: short description of the event using the coder's own words.
- *descr*: this variable is again a short description of the event in question, but follows the standardized formulations of the scale's values outlined below.
- *wes*: domestic-level *WES* (Water-Events Scale) that follows the values as outlined below.
- *coop*: dichotomous variable, which gets the value of 1 if an event is cooperative at any level, and 0 otherwise
- *conflict*: dichotomous variable, which gets the value of 1 if an event is conflictive at any level, and 0 otherwise.
- *scale*: this variable pertains to the source level of action, i.e., which actor caused an event (4=government; 3=sub-national authority; 2=firms, companies, NGOs; 1=grass-roots and individuals). If the actors are unknown, we coded this item as 1.
- *impact*: this variable pertains to the target level of action, i.e., which actor was affected by an event (4=government; 3=sub-national authority/region; 2=firms, companies, NGOs; 1=grass-roots and individuals). If the actors are unknown, we coded this item as 1.
- *violence*: if any physical violence occurs over water – if possible – this variables gives a numerical estimate of the casualties (otherwise=missing).
- *actor**: variables describing the actors of an event in question.
- *direction*: this item shows whether a conflictive/cooperative event is directional or mutual. In other words, if the event is caused by one actor only, this variable takes the value of 1, if both/more sides are equally involved it takes the value of 2.
- *international*: variable indicating if some official international influence (1) is present or not (0). An international influence pertains to any third-party influence, where the third party is an actor that is not or does not have its origin in the country under study, e.g., an event referring to the construction of a dam in Greece with the financial support from Japan would receive a value of 1 on this variable
- *int_code*: provides the code identifier as specified below for the international actor (if any). If more than one third party is involved, the actors are separated with ";"
- *neusource*: independence or neutrality of the source newspaper from the government (source is neutral=1; source is not neutral/government-dependent=0)
- *sourceloc*: location of the source in the form of *ccode*
- *source*: name of the source
- *med_cover*: this variable contains information on the total number of articles retrieved through BBC Monitoring per country and per specific year – regardless of the search string. This variable might be used to control for the overall media coverage in a country.

Event Typology – Water-Events Scale

Here, we provide descriptions of the different types of events that we want to consider. This domestic *WES* follows an 11-point scale, where +5 stands for the most cooperative event and -5 signifies the most conflictive activity at a domestic level. In general, this scale considers the intensity/impact dimension (i.e., how significant is the effect/impact of an event in question). More specifically:

+5 Events that are likely to or do result in substantial improvement with respect to water quality/quantity in the country as a whole

Items in this category describe a very extensive role for any kind of actor (government, IOs, firms, etc.) in trying to initiate or implement policies, programs, or actions that substantially improve the

quality or quantity of water for the whole country. Note that events in this category may include the assistance of an outside actor as well (i.e., countries, third-state companies, etc.) and should imply substantial initiatives to reduce water-related victimization in the society. Examples include laws enacted to protect the water supply for the population, (e.g., national water plans such as in Spain 2001), initiation of extensive water-related programs or policies, programs aimed to reduce inequalities of water quality/quantity in a country, guarantee of water supply to all parts of the country/society, and extensive water-related programs and laws that affect the whole country/society.

+4 Events that are likely to or do result in substantial improvement with respect to water quality/quantity at the regional level within the respective country

This category is substantially similar to the previous category. Unlike value +5, however, this value rather focuses on laws, actions, and/or programs (initiated by any actor) that do not affect a country/society at large, but sub-state regions (i.e., state, Kanton, Bundesland, etc.). In other words, the whole country *per se* is not affected by an action, but a sub-state region, etc. As for value +5, category-+4 actions may pertain to events that are partially influenced by outside (international) actors. For instance, the "Southern Nations, Nationalities, and Peoples" region in Ethiopia saw the inauguration of multiple and relatively large-scale potable water projects in November 2001.

+3 Events of moderate intensity that *may* result in an improvement with respect to water quality/quantity at the regional or national level within the respective country

This category encompasses all measures, which *moderately* contribute to the improvement in the water quality and/or quantity of a country or a sub-state region. Any activity, program, or policy that adds to this should be considered part of this category. Next to the moderate or medium-intensity characteristic of this value, we also consider events that entail some sort of probabilistic element, i.e., events that only *may* positively influence water quality/quantity of the nation or sub-national region(s). Examples include: the exploration, discovery, or technological harnessing of water resources; the construction of dams or other water-related facilities; the improvement of water-related technology; granting of loans or investment money for water projects that are above the threshold of 1m USD.

+2 Agreements signed or other measures formally adopted that signal commitment to improvement with respect to water quality/quantity at the regional or national level

Events in this category exclusively pertain to signed agreements between actors that do not operate at the local level. These signed agreements must pertain to some sort of commitment to increase water quality/quantity at a sub-national regional or countrywide domestic level. Two states signing an agreement to cooperate on irrigation technologies belong to this category. Also, we coded events where a government signed a contract with a company for the construction of a water-supply network. For example, Albania and Macedonia signed a cooperation agreement to protect Lake Ohrid in June 2004.

+1 Events that are likely to or do result in a very small improvement with respect to water quality/quantity at the local level

Events in this category include actions and statements, which either occur at the grass-roots level and/or have a minimal impact as such, but are nevertheless nominally positive. Also, the events in this category are characterized by the support given by the local public, or firms and interest groups for those activities, which are intended to increase water quality/quantity at the grass-roots level and/or with minimal impact. For example: individuals (e.g., farmers or citizens) agree on cooperation in local towns or villages; water-specific NGOs or interest groups are formed; water-related infrastructure are established at a local level (e.g., village or small town).

0 Routine and purposive actions on water issues that have no identifiable positive or negative impact on water quality/quantity

Events in this category are actions, which have neither a positive nor a negative impact on the water quality/quantity at the domestic level, yet are superficially related to this. Examples: government reshuffles if including water minster and if caused by some water-related event (irrelevant if a regular cabinet reshuffle); government and opposition talk about mutual water concerns; government, firms, NGOs, or individuals discuss water conditions; reporting, informing, announcing or making declarations on water topics, which reflect neither cooperation nor conflict (i.e., do not signal any kind of commitment). Most prominently, this category comprises pure issue-specific rhetorical statements.

-1 Events that are likely to or do result in a very small negative impact on water quality/quantity at the local level

Events in this category pertain to conflictive interactions, difficulties, or small-scale crises at the grass-roots level (i.e., individuals such as farmers, firms, companies, NGOs, and any actor below the sub-governmental level). Examples include the pollution of a well or fountain in a town/village; tensions between local farmers over water irrigation, actions that create tension between individuals, the destruction of water infrastructure in a village/small town.

-2 Tensions within government (intra-state) or between countries (inter-state) that may affect water quality/quantity at a domestic level

Events in this category are those which deal with official governmental and generally administrative difficulties or crises either within a specific government or between different administrations of distinct countries. For instance, we code intra-/inter-governmental accusatory statements on water-related events; and resignations of officials in protest at governmental actions or policies on water; tensions between two countries over the use of a water source; inter-governmental criticisms over the water policies of a country. These intrastate/interstate tensions must not have a substantial immediate impact on the water quality/quantity of a country, otherwise they would be coded as -4 or -5.

-3 Large-scale and general opposition of the public towards policies and actions that have negative implications for water quality/quantity at the regional to national level

This category refers to actions undertaken by individuals or groups of individuals (including firms and companies) which are not part of the government. They comprise the political opposition, unions, or organized rebel groups, who oppose the administration (or any other official domestic entity) due to its water policies. Unlike category-1, this value pertains to those activities, primarily verbal – such as threats, demands, acts of protest, marches, and strikes – which do not result in physical violence and are directed against policies and actions that decrease water quality/quantity not at a local level (i.e., primarily actions that may negatively affect regions or the entire country at large). Examples include strikes or threats of strikes due to water shortage or poor water quality; the calling for a general strike or open public opposition to the government due to water issues.

-4 Events that are likely to or do result in a deterioration with respect to water quality/quantity at the regional level within the respective country

Events in this category pertain to (inter-) actions that have a negative impact upon segments of the nation (or regions) in terms of water quality or quantity. Put differently, this category refers to those events, which restrict water-related rights, access, or freedoms of the population at the sub-national level (i.e., state, Kanton, Bundesland, etc.). Examples include, most prominently, restrictions on water access or water shortages for people in an entire region (not the entire country or local villages). For instance, virtually the entire water-supply network of the Gaza region was destroyed during an Israeli air raid in January 2009. As this action negatively affected the water supply of an entire region, we coded this as a -4 event.

-5 Events that are likely to or do result in a deterioration with respect to water

quality/quantity at the national level; physical violence associated with water problems

Events in this category refer to a negative impact on the water quality/quantity of the country at large and/or it is the population at large who is being acted upon. Also, this category includes actions of overt violence precipitated by governments, groups, institutions, or individuals over water resources (e.g., access to water). All actions that disclose instability and initiate physical conflict over water are included herein. Thus, examples include the restriction of the water supply of citizens at large without compensation, the imposition of taxes/fees on water supply, violence over water. Consider Somalia here in our data. There are several occasions where tribes or rebel groups actually fought over the access to water. In many cases, these events even experienced casualties.

Country Codes

2	USA	United States of America	01:01:1816	01:11:2008
20	CAN	Canada	01:07:1867	01:11:2008
31	BHM	Bahamas	10:07:1973	01:11:2008
40	CUB	Cuba	20:05:1902	01:11:2008
41	HAI	Haiti	01:01:1816	04:07:1915
41	HAI	Haiti	15:08:1934	01:11:2008
42	DOM	Dominican Republic	27:02:1844	01:11:2008
51	JAM	Jamaica	06:08:1962	01:11:2008
52	TRI	Trinidad and Tobago	31:08:1962	01:11:2008
53	BAR	Barbados	30:11:1966	01:11:2008
70	MEX	Mexico	01:07:1821	01:11:2008
80	BLZ	Belize	21:09:1981	01:11:2008
89	UPC	United Provinces of Central America	01:07:1823	31:12:1839
90	GUA	Guatemala	01:01:1840	01:11:2008
91	HON	Honduras	01:01:1840	01:11:2008
92	SAL	El Salvador	01:01:1840	01:11:2008
93	NIC	Nicaragua	01:01:1840	01:11:2008
94	COS	Costa Rica	01:01:1840	01:11:2008
95	PAN	Panama	03:11:1903	01:11:2008
99	GCL	Great Colombia	30:08:1821	22:09:1830
100	COL	Colombia	23:09:1830	01:11:2008
101	VEN	Venezuela	01:01:1829	01:11:2008
110	GUY	Guyana	26:05:1966	01:11:2008
115	SUR	Surinam	25:11:1975	01:11:2008
130	ECU	Ecuador	13:05:1830	01:11:2008
135	PER	Peru	09:12:1824	01:11:2008
140	BRA	Brazil	07:09:1822	01:11:2008
145	BOL	Bolivia	06:08:1825	01:11:2008
150	PAR	Paraguay	01:01:1816	01:11:2008
155	CHL	Chile	01:04:1818	01:11:2008
160	ARG	Argentina	09:07:1816	01:11:2008
165	URU	Uruguay	26:05:1830	01:11:2008
200	UKG	United Kingdom	01:01:1816	01:11:2008
205	IRE	Ireland	06:12:1921	01:11:2008
210	NTH	Netherlands	01:01:1816	01:11:2008
211	BEL	Belgium	04:10:1830	01:11:2008
212	LUX	Luxembourg	11:05:1867	01:11:2008

220	FRN	France	01:01:1816	01:11:2008
225	SWZ	Switzerland	01:01:1816	01:11:2008
230	SPN	Spain	01:01:1816	01:11:2008
235	POR	Portugal	01:01:1816	01:11:2008
240	HAN	Hanover	01:01:1816	17:01:1871
245	BAV	Bavaria	01:01:1816	17:01:1871
255	GMY	Germany (Prussia)	01:01:1816	07:05:1945
260	GFR	German Federal Republic	21:09:1949	01:11:2008
265	GDR	German Democratic Republic	05:10:1949	02:10:1990
267	BAD	Baden	01:01:1816	17:01:1871
269	SAX	Saxony	01:01:1816	17:01:1871
271	WRT	Württemberg	01:01:1816	17:01:1871
273	HSE	Hesse-Kassel (Electoral)	01:01:1816	17:01:1871
275	HSD	Hesse-Darmstadt (Ducal)	01:01:1816	17:01:1871
280	MEC	Mecklenburg-Schwerin	01:01:1816	17:01:1871
290	POL	Poland	11:11:1918	01:11:2008
300	AUH	Austria-Hungary	01:01:1816	13:11:1918
305	AUS	Austria	14:11:1918	01:11:2008
310	HUN	Hungary	03:11:1918	01:11:2008
315	CZE	Czechoslovakia	01:01:1919	31:12:1992
316	CZR	Czech Republic	01:01:1993	01:11:2008
317	SLO	Slovakia	01:01:1993	01:11:2008
325	ITA	Italy/Sardinia	01:01:1816	01:11:2008
327	PAP	Papal States	01:01:1816	22:09:1870
329	SIC	Two Sicilies	01:01:1816	16:03:1861
332	MOD	Modena	01:01:1816	16:03:1861
335	PMA	Parma	01:01:1816	16:03:1861
337	TUS	Tuscany	01:01:1816	16:03:1861
338	MLT	Malta	21:09:1964	01:11:2008
339	ALB	Albania	01:01:1913	01:11:2008
341	MNG	Montenegro	01:01:1868	01:07:1915
341	MNG	Montenegro	03:06:2006	01:11:2008
343	MAC	Macedonia (Former Yugoslav Republic of)	20:11:1991	01:11:2008
344	CRO	Croatia	25:06:1991	01:11:2008
345	SER	Serbia	13:07:1878	01:10:1915
345	SER	Serbia (Yugoslavia)	01:12:1918	01:11:2008
346	BOS	Bosnia-Herzegovina	03:03:1992	01:11:2008
347	KOS	Kosovo	17:02:2008	01:11:2008
349	SLV	Slovenia	25:06:1991	01:11:2008
350	GRC	Greece	17:05:1827	01:11:2008
352	CYP	Cyprus	16:08:1960	01:11:2008
355	BUL	Bulgaria	03:03:1878	01:11:2008
359	MLD	Moldova	27:08:1991	01:11:2008
360	RUM	Rumania	13:07:1878	01:11:2008
365	RUS	Russia (Soviet Union)	01:01:1816	01:11:2008
366	EST	Estonia	11:11:1918	01:06:1940
366	EST	Estonia	06:09:1991	01:11:2008
367	LAT	Latvia	01:11:1918	01:06:1940
367	LAT	Latvia	06:09:1991	01:11:2008

368	LIT	Lithuania	16:02:1918	01:06:1940
368	LIT	Lithuania	06:09:1991	01:11:2008
369	UKR	Ukraine	01:12:1991	01:11:2008
370	BLR	Belarus (Byelorussia)	25:08:1991	01:11:2008
371	ARM	Armenia	23:09:1991	01:11:2008
372	GRG	Georgia	06:09:1991	01:11:2008
373	AZE	Azerbaijan	30:08:1991	01:11:2008
375	FIN	Finland	06:12:1917	01:11:2008
380	SWD	Sweden	01:01:1816	01:11:2008
385	NOR	Norway	26:08:1905	01:11:2008
390	DEN	Denmark	01:01:1816	01:11:2008
395	ICE	Iceland	17:06:1944	01:11:2008
402	CAP	Cape Verde	05:07:1975	01:11:2008
404	GNB	Guinea-Bissau	10:09:1974	01:11:2008
411	EQG	Equatorial Guinea	12:10:1968	01:11:2008
420	GAM	Gambia	18:02:1965	01:11:2008
432	MLI	Mali	22:09:1960	01:11:2008
433	SEN	Senegal	04:04:1960	01:11:2008
434	BEN	Benin	01:08:1960	01:11:2008
435	MAA	Mauritania	28:11:1960	01:11:2008
436	NIR	Niger	03:08:1960	01:11:2008
437	CDI	Cote D’Ivoire	07:08:1960	01:11:2008
438	GUI	Guinea	02:10:1958	01:11:2008
439	BFO	Burkina Faso (Upper Volta)	05:08:1960	01:11:2008
450	LBR	Liberia	26:07:1847	01:11:2008
451	SIE	Sierra Leone	27:04:1961	01:11:2008
452	GHA	Ghana	06:03:1957	01:11:2008
461	TOG	Togo	27:04:1960	01:11:2008
471	CAO	Cameroon	01:01:1960	01:11:2008
475	NIG	Nigeria	01:10:1960	01:11:2008
481	GAB	Gabon	17:08:1960	01:11:2008
482	CEN	Central African Republic	13:08:1960	01:11:2008
483	CHA	Chad	11:08:1960	01:11:2008
484	CON	Congo	15:08:1960	01:11:2008
490	DRC	Congo, Democratic Republic of (Zaire)	30:06:1960	01:11:2008
500	UGA	Uganda	09:10:1962	01:11:2008
501	KEN	Kenya	12:12:1963	01:11:2008
510	TAZ	Tanzania/Tanganyika	09:12:1961	01:11:2008
511	ZAN	Zanzibar	19:12:1963	26:04:1964
516	BUI	Burundi	01:07:1962	01:11:2008
517	RWA	Rwanda	07:01:1962	01:11:2008
520	SOM	Somalia	01:07:1960	01:11:2008
522	DJI	Djibouti	27:06:1977	01:11:2008
530	ETH	Ethiopia	11:02:1855	01:11:2008
531	ERI	Eritrea	24:05:1993	01:11:2008
540	ANG	Angola	11:11:1975	01:11:2008
541	MZM	Mozambique	25:06:1975	01:11:2008
551	ZAM	Zambia	24:10:1964	01:11:2008
552	ZIM	Zimbabwe (Rhodesia)	11:11:1965	01:11:2008

553	MAW	Malawi	06:07:1964	01:11:2008
560	SAF	South Africa	31:05:1910	01:11:2008
563	TRA	Transvaal	01:01:1852	30:05:1910
564	OFS	Orange Free State	28:03:1854	30:05:1910
565	NAM	Namibia	21:03:1990	01:11:2008
570	LES	Lesotho	04:10:1966	01:11:2008
571	BOT	Botswana	30:09:1966	01:11:2008
572	SWA	Swaziland	06:09:1968	01:11:2008
580	MAG	Madagascar (Malagasy)	01:01:1816	05:08:1896
580	MAG	Madagascar	26:06:1960	01:11:2008
581	COM	Comoros	06:07:1975	01:11:2008
590	MAS	Mauritius	12:03:1968	01:11:2008
600	MOR	Morocco	01:01:1816	01:01:1904
600	MOR	Morocco	02:03:1956	01:11:2008
615	ALG	Algeria	01:01:1816	05:07:1830
615	ALG	Algeria	05:07:1962	01:11:2008
616	TUN	Tunisia	01:01:1816	12:05:1881
616	TUN	Tunisia	01:01:1956	01:11:2008
620	LIB	Libya	01:01:1816	31:12:1834
620	LIB	Libya	24:12:1951	01:11:2008
625	SUD	Sudan	01:01:1956	01:11:2008
630	IRN	Iran (Persia)	01:01:1816	01:11:2008
640	TUR	Turkey (Ottoman Empire)	01:01:1816	01:11:2008
645	IRQ	Iraq	03:10:1932	01:11:2008
651	EGY	Egypt	01:01:1827	31:12:1855
651	EGY	Egypt	28:02:1922	01:11:2008
652	SYR	Syria	01:01:1946	01:11:2008
660	LEB	Lebanon	22:11:1944	01:11:2008
663	JOR	Jordan	25:05:1946	01:11:2008
666	ISR	Israel	14:05:1948	01:11:2008
667	WBG	West Bank / Gaza Strip	01:01:1997	31.12.2009
670	SAU	Saudi Arabia	23:09:1932	01:11:2008
678	YEM	Yemen (Arab Republic of Yemen)	30:10:1918	01:11:2008
680	YPR	Yemen, People's Republic of	30:11:1967	21:05:1990
690	KUW	Kuwait	19:06:1961	01:11:2008
692	BAH	Bahrain	15:08:1971	01:11:2008
694	QAT	Qatar	03:09:1971	01:11:2008
696	UAE	United Arab Emirates	02:12:1971	01:11:2008
698	OMA	Oman	01:01:1816	01:11:2008
700	AFG	Afghanistan	01:01:1816	30:12:1888
700	AFG	Afghanistan	01:05:1919	01:11:2008
701	TKM	Turkmenistan	27:10:1991	01:11:2008
702	TAJ	Tajikistan	09:09:1991	01:11:2008
703	KYR	Kyrgyz Republic	31:08:1991	01:11:2008
704	UZB	Uzbekistan	31:08:1991	01:11:2008
705	KZK	Kazakhstan	16:12:1991	01:11:2008
710	CHN	China	01:01:1816	01:11:2008
711	TBT	Tibet	01:01:1913	01:10:1950
712	MON	Mongolia	13:03:1921	01:11:2008

713	TAW	Taiwan	08:12:1949	01:11:2008
730	KOR	Korea	01:01:1816	22:08:1910
731	PRK	Korea, People's Republic of	09:09:1948	01:11:2008
732	ROK	Korea, Republic of	15:08:1948	01:11:2008
740	JPN	Japan	01:01:1816	01:11:2008
750	IND	India	15:08:1947	01:11:2008
760	BHU	Bhutan	01:01:1949	01:11:2008
770	PAK	Pakistan	14:08:1947	01:11:2008
771	BNG	Bangladesh	16:12:1971	01:11:2008
775	MYA	Myanmar (Burma)	01:01:1816	31:12:1885
775	MYA	Myanmar (Burma)	04:01:1948	01:11:2008
780	SRI	Sri Lanka (Ceylon)	04:02:1948	01:11:2008
781	MAD	Maldives	26:05:1965	01:11:2008
790	NEP	Nepal	01:01:1816	01:11:2008
800	THI	Thailand	01:01:1816	01:11:2008
811	CAM	Cambodia (Kampuchea)	09:11:1953	01:11:2008
812	LAO	Laos	01:05:1954	01:11:2008
815	VNM	Vietnam (Annam/Cochin China/Tonkin)	01:01:1816	01:01:1893
816	DRV	Vietnam, Democratic Republic of	01:05:1954	01:11:2008
817	RVN	Vietnam, Republic of	01:05:1954	30:04:1975
820	MAL	Malaysia	31:08:1957	01:11:2008
830	SIN	Singapore	09:08:1965	01:11:2008
835	BRU	Brunei	01:01:1984	01:11:2008
840	PHI	Philippines	04:07:1946	01:11:2008
850	INS	Indonesia	17:08:1945	01:11:2008
860	ETM	East Timor	20:05:2002	01:11:2008
900	AUL	Australia	01:01:1901	01:11:2008
910	PNG	Papua New Guinea	16:09:1975	01:11:2008
920	NEW	New Zealand	01:09:1907	01:11:2008
940	SOL	Solomon Islands	07:07:1978	01:11:2008
950	FJI	Fiji	10:10:1970	01:11:2008

List of Microstates

54	DMA	Dominica	03:11:1978	01:11:2008
55	GRN	Grenada	07:02:1974	01:11:2008
56	SLU	Saint Lucia	22:02:1979	01:11:2008
57	SVG	Saint Vincent and the Grenadines	27:10:1979	01:11:2008
58	AAB	Antigua & Barbuda	01:11:1981	01:11:2008
60	SKN	Saint Kitts and Nevis	19:09:1983	01:11:2008
221	MNC	Monaco	01:01:1816	01:11:2008
223	LIE	Liechtenstein	01:01:1816	01:11:2008
331	SNM	San Marino	01:01:1816	01:11:2008
232	AND	Andorra	01:01:1816	01:11:2008
396	ABK	Abkhazia	26:08:2008	01:11:2008
397	SOT	South Ossetia	26:08:2008	01:11:2008
403	STP	São Tomé and Principe	12:07:1975	01:11:2008
591	SEY	Seychelles	29:06:1976	01:11:2008
935	VAN	Vanuatu	30:06:1980	01:11:2008

970	KBI	Kiribati	12:07:1979	01:11:2008
971	NAU	Nauru	31:12:1968	01:11:2008
972	TON	Tonga	04:06:1970	01:11:2008
973	TUV	Tuvalu	01:10:1978	01:11:2008
983	MSI	Marshall Islands	21:10:1986	01:11:2008
986	PAL	Palau	01:10:1994	01:11:2008
987	FSM	Federated States of Micronesia	03:11:1986	01:11:2008
990	WSM	Samoa/Western Samoa	01:01:1962	01:11:2008

List of Global / Cross-Regional Actors

1000: League of Nations
1010: United Nations (UN), International Community, any other global organization
1015: International Court of Justice
1020: Permanent Court of Arbitration (PCA)/"Hague Tribunal"
1030: Commonwealth of Nations/"British Commonwealth"
1040: Vatican / Catholic Church [NGO]
1050: Non-Aligned Movement (NAM)
1060: North Atlantic Treaty Organization (NATO)
1070: Organization for European Economic Cooperation (OEEC)/Organization for Economic Cooperation and Development (OECD)
1080: Organization of the Islamic Conference (OIC)

List of Regional/IO Actors

2000: Organization of American States (OAS)
2005: Rio Pact / Inter-American Treaty of Reciprocal Assistance
2010: Pan American Union / International Union of American Republics
2015: Inter-American Conference on Conciliation and Arbitration ("Pan American Arbitration Conference," from 1923 Gondra Treaty)/Permanent Commission on Inter-American Conciliation (from 1929 Washington Conference)
2020: US-Canada International Joint Commission (IJC)
2021: US-Mexico International Boundary Commission (IBC)/International Boundary and Water Commission (IBWC)
2050: Organization of Central American States (ODECA)
2055: Central American Court (established by 1907 Central American conference)
2056: International Central American Tribunal (established by 1923 conference)
2057: Central American Court of Justice (CACJ)
2060: Caribbean Community (CARICOM)
2100: South American Community of Nations
2110: Andean Community (CAN)
2220: European (Economic) Community/European Union (EEC/EC/EU)
2230: Council of Europe (COE)
2240: Council on Security and Cooperation in Europe (CSCE) /Organization for Security and Cooperation in Europe (OSCE)
2250: West European Union (WEU)
2260: Central Rhine Commission / Central Commission for Navigation on the Rhine (CCNR)
2310: Commonwealth of Independent States (CIS)
2311: Collective Security Treaty Organization (CSTO)
2315: GUAM/GUUAM / Organization for Democracy and Economic Development

2320: Baltic Assembly
2330: Stability Pact for South Eastern Europe/Balkan Stability Pact
2335: Southeast European Cooperation Process (SEECP)
2400: Organization of African Unity (OAU)/African Union (AU)
2410: African and Malagasy Union (UAM)/African and Malagasy Union for Defense (UAMD)
2420: Economic Community of West African States (ECOWAS)
2430: Economic Community of Central African States (ECCAS)
2431: Customs and Economic Union of Central Africa (UDEAC) / Economic and Monetary Community of Central Africa (CEMAC)
2435: International Conference on the Great Lakes Region (ICGLR)
2440: Common Market for Eastern and Southern Africa (COMESA)
2450: Southern African Development Community (SADC)
2460: Community of Sahel-Saharan States (Cen-Sad/COMESSA)
2600: Arab League / League of Arab States
2610: Gulf Cooperation Council (GCC)
2800: South Asian Association for Regional Cooperation (SAARC)
2850: Association of Southeast Asian Nations (ASEAN)
2900: Shanghai Cooperation Organization (SCO)
2910: Conference on Interaction and Confidence-Building Measures in Asia (CICA)

7. Appendix B

Demand, supply, and restraint: Determinants of domestic water conflict and cooperation

Online appendix – Robustness checks

First, using yearly fixed effects does not change the results. We do also not find evidence for a detrimental impact of heteroskedasticity or high leverage data points. Our model specifications may further suffer from unit roots, i.e., the individual time series might not be stationary to the extent that their expected values and population variances are not independent of time. Tests indicate that our dependent variable is stationary, though.[95]

Second, Lagrange Multiplier Tests suggest that a small, but statistically significant amount of serial correlation remains.[96] The results for our explanatory variables do not change independent of whether we combine the Prais-Winsten models with panel-corrected standard errors, robust standard errors clustered on individual countries, or use a lagged dependent variable, however. Parameter heterogeneity does not constitute a problem for our findings either. We added interaction terms between a) *Democracy*, *GDP per capita*, and *Agricultural Productivity* and b) 5-year period dummies to our models. The null hypothesis that all interaction terms are simultaneously equal to zero could not be rejected at the 5% level for any model.

Third, we checked whether the use of different cut-off values for *Democracy* or the inclusion of a binary variable representing anocracies change our findings in relevant ways. This is not the case. Using the Freedom House index instead of the Polity IV data produces very similar results as well.

Fourth, considering the SPI6 index instead of our climate variability indicators does not make any difference. The SPI6 is a standardized probability index that measures variation in precipitation and indicates the monthly deviation from normal rainfall during the six preceding months. Negative values indicate a period of drought and positive values indicate wet conditions. We aggregated the monthly SPI measures by creating a variable that takes the value of 1 if at least three consecutive months have

[95] We estimated all models including the lagged dependent variable on the right hand side only. F-tests allow us to reject the null hypothesis of the lagged dependent variable's coefficient being equal to 1 for all estimated models above.

[96] A regression of the residuals obtained from Model 1 on the lagged residuals and all the other right hand side variables results in a significant coefficient estimate for the lagged residuals ($p<0.001$). We obtained similar results for the other models.

an SPI smaller than -1, which corresponds to weather conditions equivalent to a moderate drought or worse and 0 otherwise

While most theorizing on the environment-conflict nexus argues that environmental degradation is likely to affect conflict risk indirectly, that is, via effects on economic performance, migration, and other intervening variables, only very few empirical studies examine such indirect effects. To assess indirect effects of climate variability on water-related conflict and cooperation, we use a two-stage procedure to take into account the possibility that domestic water-related conflict or cooperation and the state of the economy are not independent of each other. We use our measures of precipitation and temperature to estimate *GDP per capita* in a first stage of the empirical model. We then estimate the effect of predicted *GDP per capita* and a predicted interaction term for *GDP per capita* and *Democracy* in the second stage of the model. Both equations in this two-stage procedure follow the Prais-Winsten specifications used above. However, explicit modeling of potential indirect effects of climate variability on water-related conflict, and of potential endogeneity of regime type and water conflict does not lead to different results.

Some authors have pointed out that there might be reciprocal dynamics at play. On one hand, water-related conflict and cooperation may have an impact on institutional effectiveness of countries, notably a country's water distribution capacity. On the other hand, such institutional capacities may affect the resource distribution *per se*, the perception of resource availability, and ultimately domestic water conflict and cooperation. This implies that our dependent variable and the political institutions of a country might be interrelated in an endogenous system. To examine this possibility, we employ a simultaneous equation model. Here, political regime type affects domestic water-related conflict and cooperation – and vice versa. All other variables are treated as exogenous influences. The simultaneous equations approach produces similar findings as the ones we presented above, though.

Moreover, unreported models also include a covariate, which controls for the share of 0-events in a country-year as characterized by the *WES*. As noted above, 47% of all water-related events in our sample are neither cooperative nor conflictive (i.e., *WES*=0). Although any statistical effect of this indicator is difficult to interpret, it appears important to control for this factor. Yet, our results do not change.

In a final robustness check of the supply and 'climate breeds conflict'-argument, we change the unit of analysis to uncover whether the country-level approach may disguise a relationship at the local level. We integrate the geo-coded location of the severe conflictive events (WES <-2) into a spatio-temporal data structure and assign each event to 0.5 x 0.5 degree grid cells covering all terrestrial areas in the study region (Tollefsen, Strand and Buhaug 2012). In a set of multilevel regression models we test the effect of short-term temperature and precipitation variability on the local likelihood of experiencing one or several conflictive events. However, the results from the disaggregated analysis on local climate-conflict dynamics do not differ from the non-finding at the country-level.

8. Appendix C

Figure 18. *Mean annual precipitation and long-term mean in Morocco (Rudolf et al., 2010; Rudolf and Schneider, 2005).*

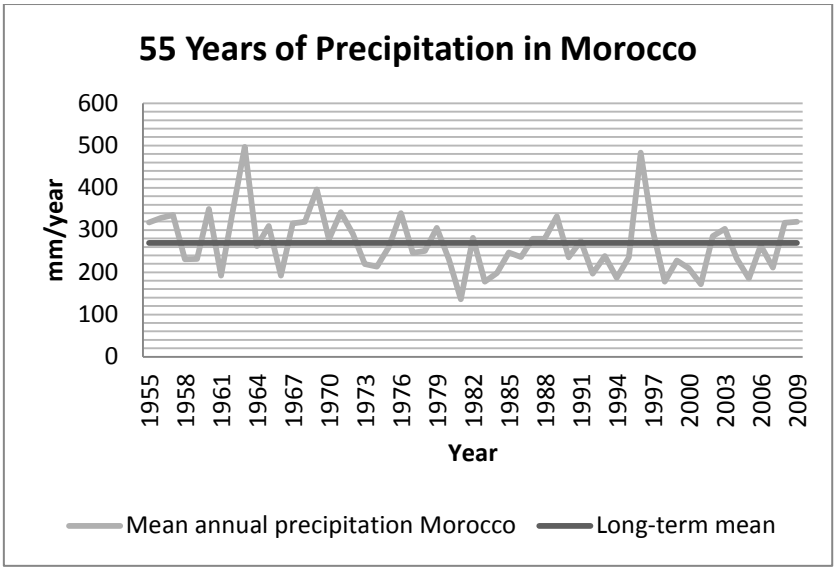


Figure 19. *WARICC data Morocco.*

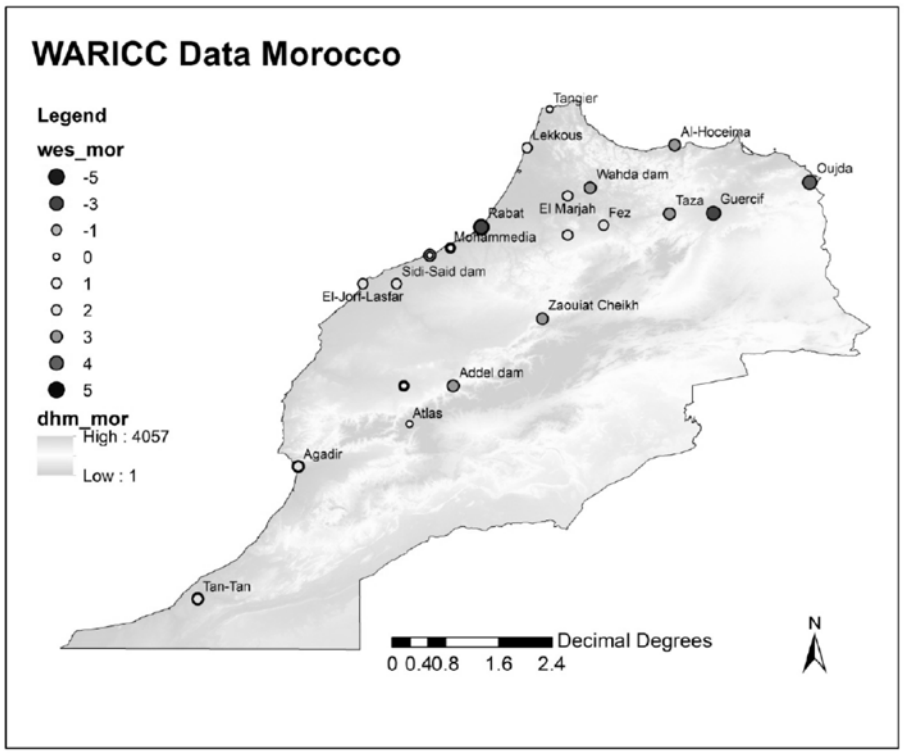


Figure 20. *Existing small-scale and planned large-scale water transfers in Morocco.*

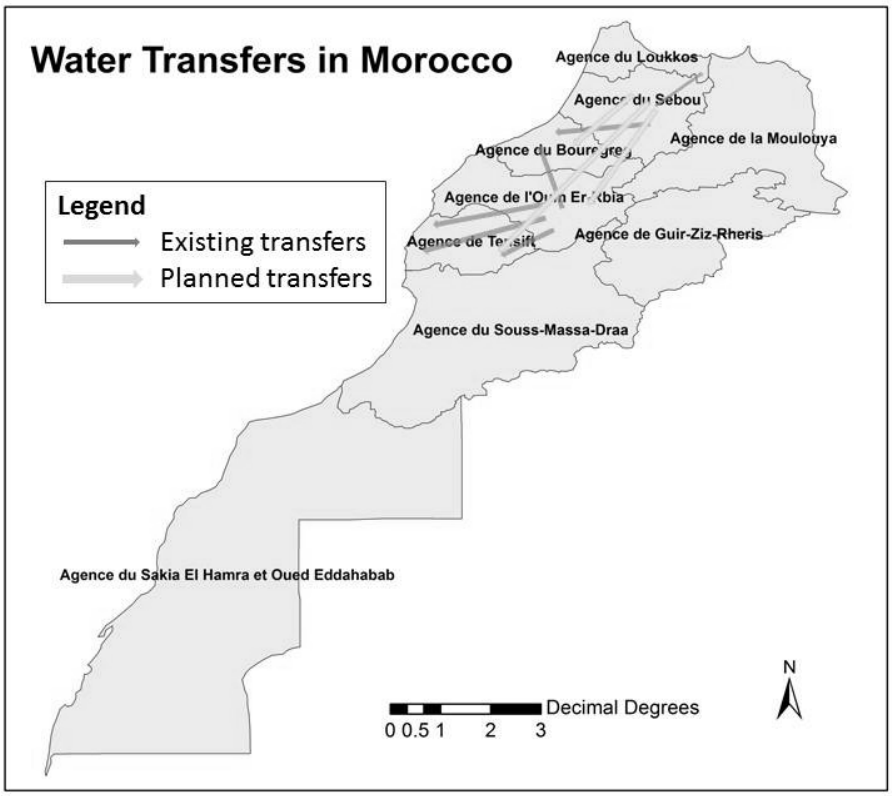


Figure 21. *Population development and estimates by the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2010 Revision, http://esa.un.org/unpd/wpp/index.htm.*

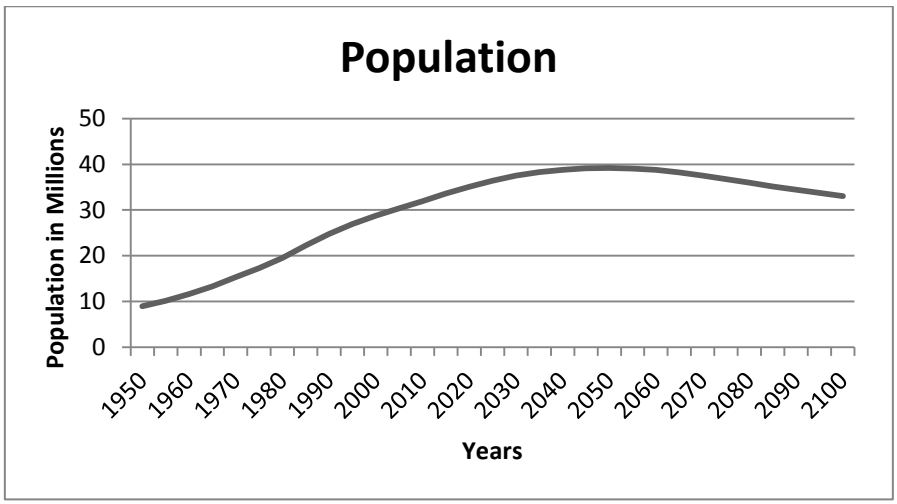


Figure 22. *Water usage development and expectations until 2020 for Morocco by the FAO Water Report 29 (2005).*

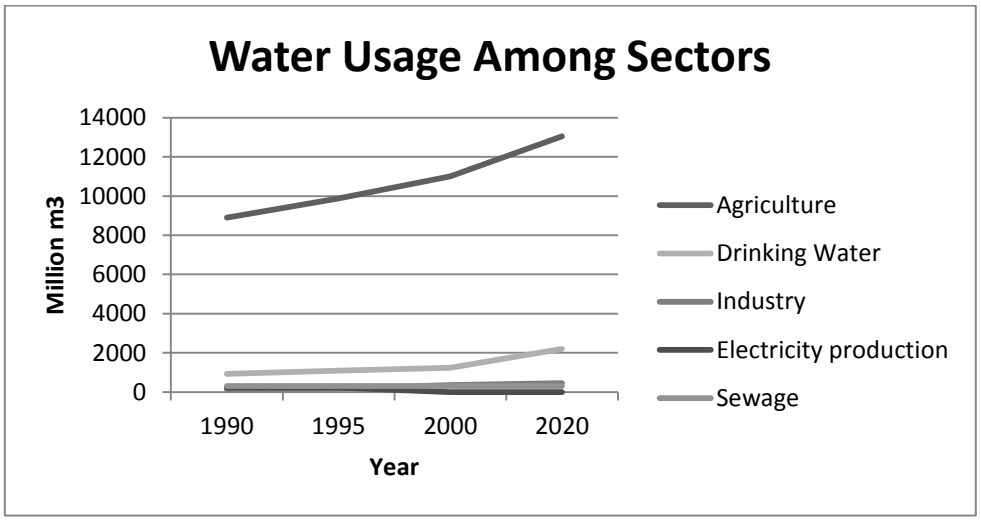


Figure 23. *Total cam capacity since 1960 for Morocco, http://www.fao.org/nr/water/aquastat/main/index.stm.*

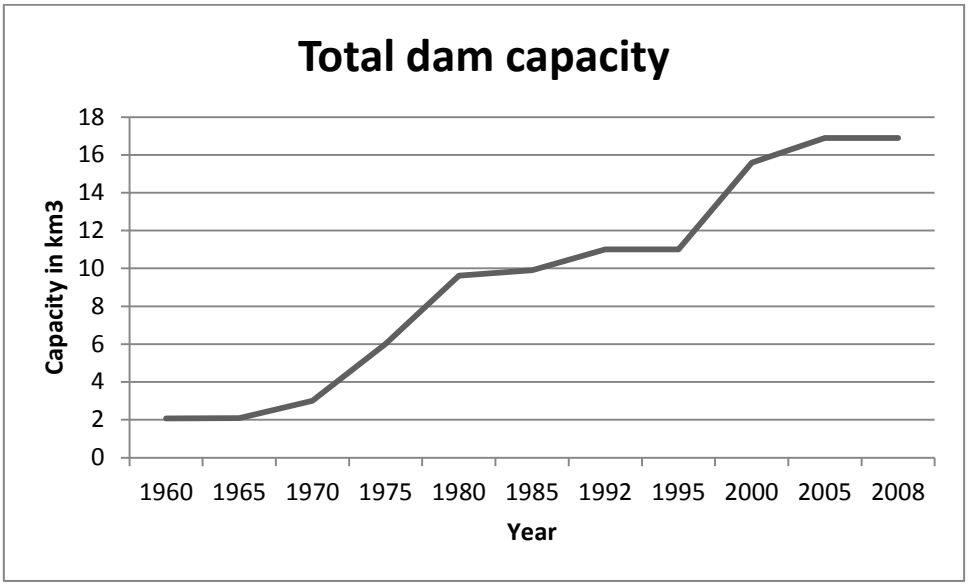


Figure 24. *Government debt in Morocco as percent of GDP. World Economic Outlook database April 2012, International Monetary Fund (IMF).*

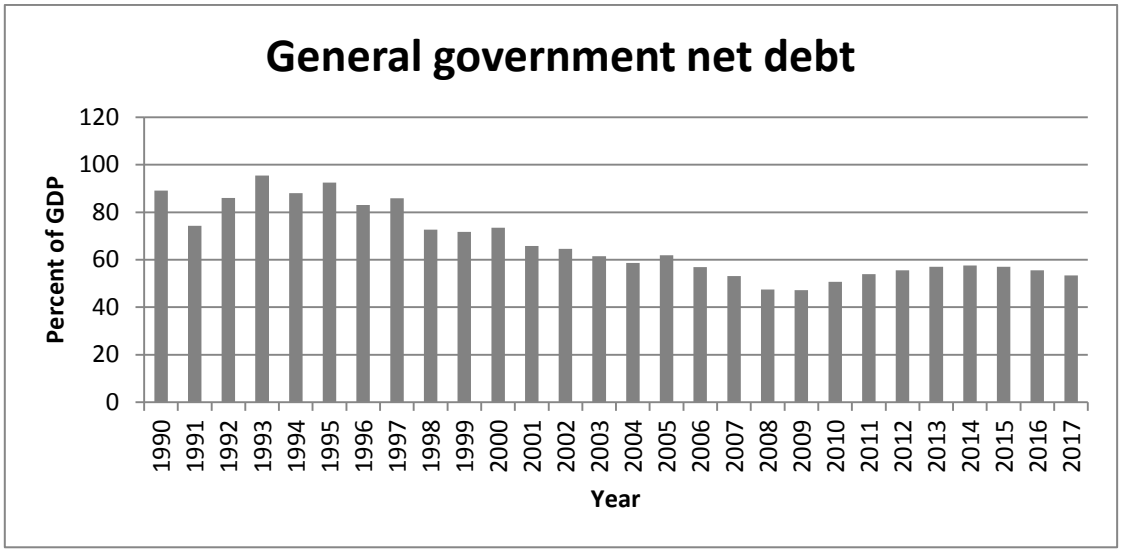


Figure 25. *Mean annual precipitation and long-term mean in Portugal (Rudolf et al., 2010; Rudolf and Schneider, 2005).*

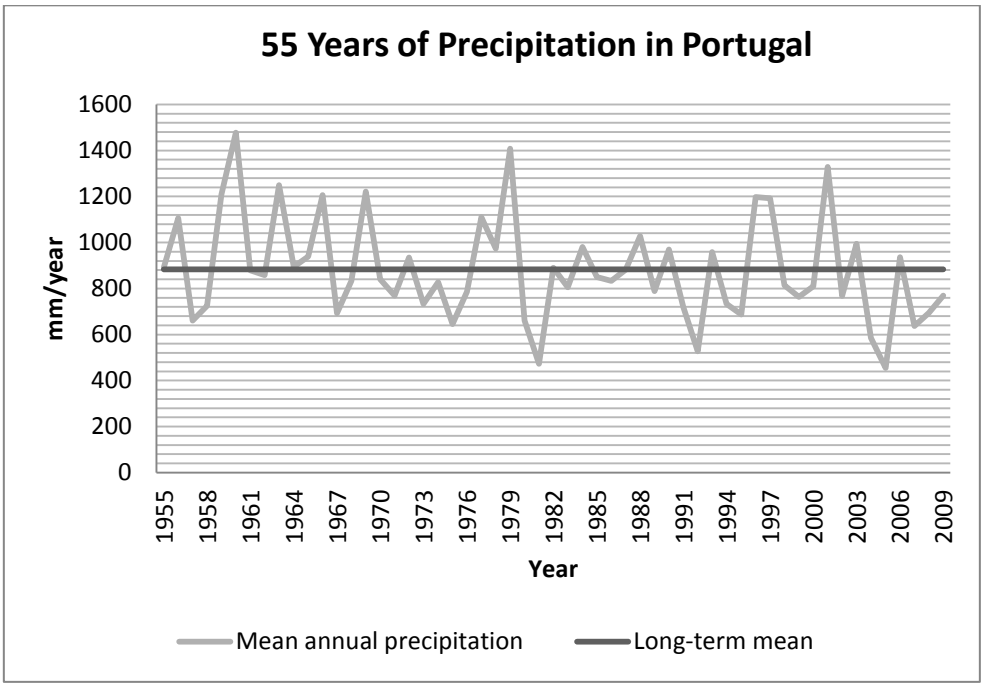


Figure 26. *WARICC data and places visited in Portugal.*

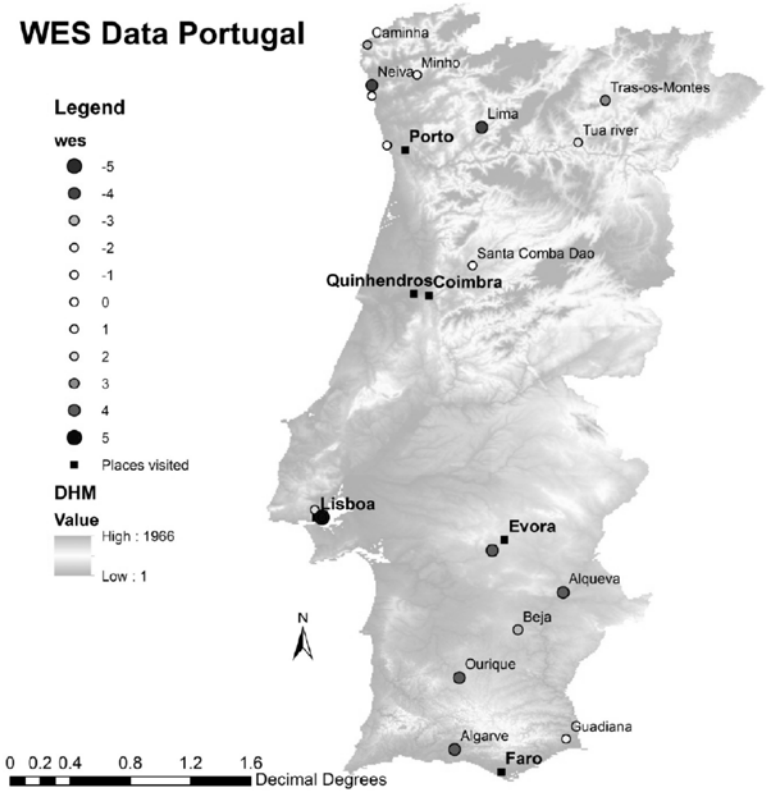


Figure 27. *Development of connection to water supply and wastewater treatment in Portugal in % of the population (Eurostat).*

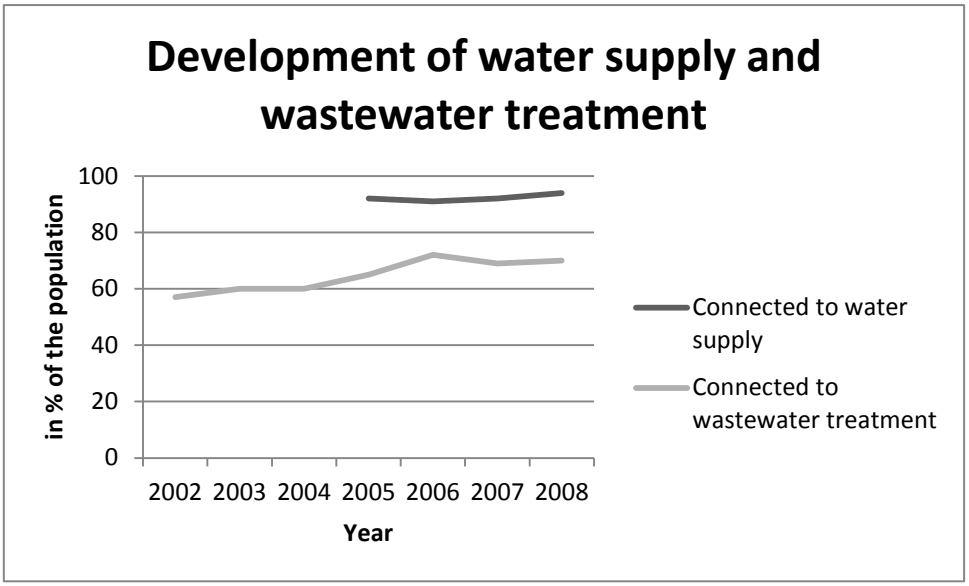


Figure 28. *Population development and estimates for Portugal by the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2010 Revision, http://esa.un.org/unpd/wpp/index.htm.*

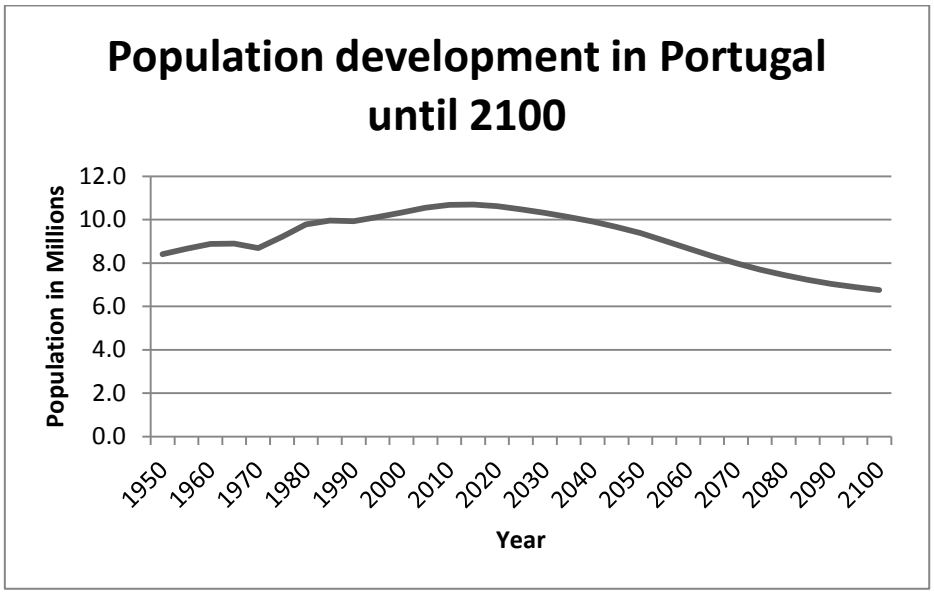


Figure 29. *Total cam capacity since 1960 in Portugal, http://www.fao.org/nr/water/aquastat/main/index.stm.*

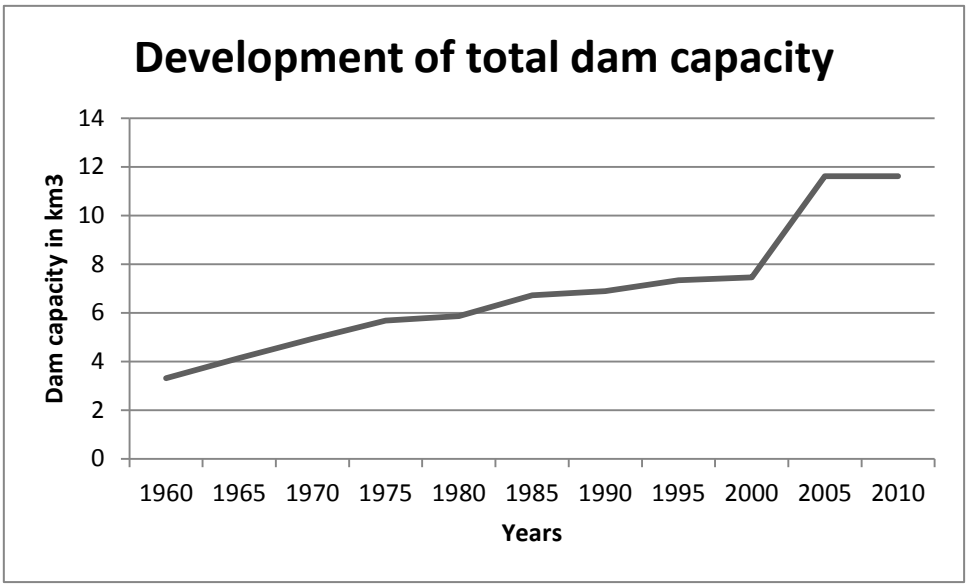
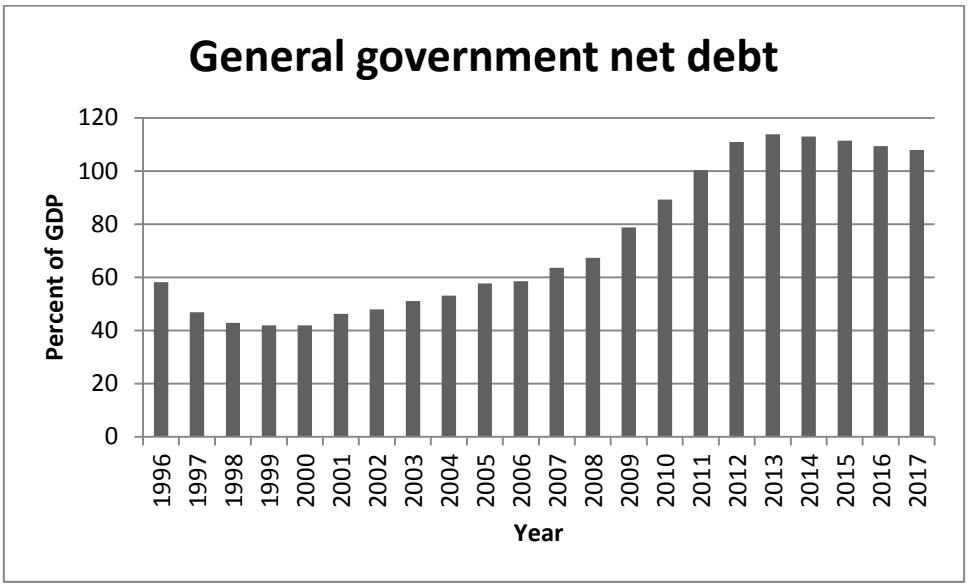


Figure 30. *Government debt in Portugal as percent of GDP. World Economic Outlook database April 2012, International Monetary Fund (IMF).*



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10. Curriculum Vitae

Theresa Margarete Tribaldos

ETH Zurich
Center for Comparative and International Studies (CIS)
Haldeneggsteig 4, 8092 Zürich, Switzerland
Tel: +41 44 632 63 86
Email: theresa.tribaldos@ir.gess.ethz.ch

Education

03/2010 – 08/2013	**PhD Student** at the Chair of International Relations, ETH Zurich. Topic: "Conflict and Cooperation over Domestic Water Resources in the Mediterranean, the Sahel Area, and the Middle East: Drivers and Structural Alternatives for Conflict-Reducing Management"
10/2012 – 03/2013	**Research Stay** at the Hebrew University of Jerusalem, Israel. Papers worked on: "Does conflict resolution benefit from decentralised water management structures? The cases of Morocco and Portugal" and "Stakeholder leverage in a centralised system: Israeli water management"
09/2007 – 09/2008	**MA in Geopolitics, Territory and Security**, King's College London. Specialisation in Border Studies, Sovereignty, Conflict Resolution, Civil Wars. Master thesis on "The impact of internal conflict on the sovereignty of Colombia and its surrounding neighbours"
09/2001 – 04/2007	**MSc UZH**, Physical Geography, University of Zurich. Specialisation in Glaciology, Geobotany. Majors in Geomorphology, Biogeography, Climatology, GIS, and Hydrology. Master thesis on "Distributed mass-balance modeling in the Bernina group, Swiss Alps, between 1850 and 2000"
08/1997 – 06/2001	**Matura Type A**. Alte Kantonsschule Aarau

Working Experience

10/2008 – 12/2008	**Internship** at the London Borough of Richmond upon Thames. Work on several projects for sustainable development of private households, education, and businesses in the Borough
06/2007 – 08/2007	**Scientific Assistant** at the Department of Geography, University of Zurich. Work on distributed mass-balance modeling of glaciers in the Bernina group, Swiss Alps
02/2003 – 03/2003	**Internship** at the Laboratory of Hydraulics, Hydrology, and Glaciology (VAW) of the ETH Zurich. Assistant to several hydraulic and hydrologic experiments
2002 – 2007	**Editor** of the student magazine "geoscope" of the Student Association at the Department of Geography, University of Zurich

Theresa Margarete Tribaldos

Teaching Experience

09/2010 – 01/2011	**Teaching Assistant**: "Politikwissenschaft: Grundlagen"
04/2013	**Guest Lecturer**: "International Environmental Politics II"

Additional Academic Training

11/2011	**Essentials of Interview-Based Qualitative Research**. Methods course at the University of Zurich, taught by Liz Spencer
06/2011 – 07/2011	**ICPSR Summer Program** in Quantitative Methods of Social Research. Courses in regression analysis and mathematics for the social sciences at the University of Michigan, Ann Arbor
11/2010 – 05/2011	**Certificate of Advanced Studies ETH (CAS)** in Spatial Information Systems
10/2010 – 09/2011	**Fix the Leaky Pipeline Program** at the ETH. Coaching program for time management and career promotion for women in science

Publications and Conference Attendance

Bernauer, Thomas, **Theresa Tribaldos**, Carolin Luginbuehl, and Michael Winzeler. 2011. Government Regulation and Public Opposition Create High Additional Costs for Field Trials With GM Crops in Switzerland. *Transgenic Research*, DOI: 10.1007/s11248-011-9486-x.

Bernauer, Thomas, Tobias Böhmelt, Halvard Buhaug, Nils Petter Gleditsch, **Theresa Tribaldos**, Eivind Berg Weibust, and Gerdis Wischnath. 2012. Water-Related Intrastate Conflict and Cooperation (WARICC): A New Event Dataset. International Interactions 38, p. 529-545. I presented this paper at the *ISA Montreal, Canada* in March 2011.

Tobias Böhmelt, Thomas Bernauer, Halvard Buhaug, **Theresa Tribaldos**, Gerdis Wischnath: Demand, Supply, and Restraint: Determinants of Domestic Water Conflict and Cooperation. Manuscript.

Theresa Tribaldos: Does conflict resolution benefit from decentralised water management structures? The cases of Morocco and Portugal. Manuscript. Presented at the ISA San Francisco, USA in April 2013.

Theresa Tribaldos: Stakeholder leverage in Israeli water management. Manuscript.

Grant

Swiss National Science Foundation (SNSF) Fellowship for Prospective Researchers, Project "Domestic water-related conflict and cooperation in Morocco, Portugal, and Israel: 3 case studies", October 2012 - March 2013, Jerusalem, Israel

Skills

Computer:	MS Office, ArcGIS, STATA	
Languages:	German	Native Speaker
	English	Excellent
	French	Very good
	Spanish	Good
	Italian	Good
	Hebrew	Beginner

Other

01/2009 – 11/2009	**Gap year**. Traveling in New Zealand, Australia, Japan, and Switzerland