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Multilateral Cooperation in Transboundary River Basins

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«Looking at the Earth from afar you realize is it too small for conflict and just big enough for cooperation»

Yuri Alekseyevich Gagarin, Hero of the Soviet Union

ABSTRACT

The aim of this thesis is to understand cooperation in transboundary river basins that present more than two riparians. This work is articulated in a literature review, describing previous research on the subject, an explanation of the methodology employed and the analysis of four selected case studies.

The field of hydropolitics has emerged in the last decades through the "water wars" thesis, sustaining the idea that water will be the *casus belli* for future wars. However, the empirical quantitative studies conducted showed an historical trend towards cooperation, although mild. Moreover, there was no converging trend regarding the principles directly related to water management, equitable use and no harm. Finally, geography in the basin plays a very important role, from the modality in which the river flows (across or along the border) to the spatial distribution of water scarcity.

The idea of conflict and cooperation as the opposite end of a spectrum behind previous research has been however contested by the development of the Transboundary Water Interaction NexuS (TWINS), which depicts the evolution of interactions over water between two actors through a tri-dimensional matrix where the axes are degrees of conflict and cooperation and the robustness of the political economy, which allows a wider range of actions. At the same time, the London Water Research Group explained the relation between conflict and cooperation through the application of hegemonic theory to river basins, elaborating the concept of "hydro-hegemony": the interactions taking place in a basin depend on the ones preferred by the hegemon and its capacity to establish it through military, legal and ideational power. Thus, a downstream hegemon will impose cooperation to the other riparians, while an upstream hegemon will move unilaterally within the basin.

Another explanation for cooperation in river basins may come from game theory, as it is more convenient for all the riparians to share the benefits coming from the joint management of the basin. However, rivers cannot be considered common-pool resources like lakes, because they generate an externality problem imposed by upstream countries to downstream ones: the games generally have a "victim pays" outcome that can be represented through the Prisoner Dilemma, with the upstream country choosing between "share" and "not share" and the downstream country choosing between "side payment" and "no side payment". Although

the predicted equilibrium derived from the dominant strategies is non-cooperative, games are repeated over time and, most importantly, they can be connected with other games, thus reaching the optimal outcome in both games. Moving from bilateral to multilateral interactions the interconnected games become important in the bargaining process for coalition formation within a basin: empirical evidence shows that most of the agreement on water resources are of a bilateral nature, and therefore coalition rarely include the whole basin and are formed mostly around single projects, meaning that alliances are flexible over issues where the upstream/downstream cleavage plays a lesser important role.

Regarding the evolution of legal doctrines and instruments on water resources at the international level, they are placed on a spectrum that goes from absolute State sovereignty to basin-wide management, regardless of borders and States' priorities. Thus, the legal debate has revolved around the relation between the "equitable use" and the "no harm" principles, having the former sustained by upstream countries and the latter by downstream countries. The 1966 Helsinki Rules on the Uses of the Waters of International Rivers adopted by the ILA established no harm as a subordinate of equitable use, a system confirmed by the ICJ sentence on the1997 Gabčíkovo-Nagymaros case. However, the UN Convention on the Law of the Non-Navigational Uses of International Watercourses approved in the same year did not give a clear definition of this relation, resulting in an ambiguity that was necessary to its approval, although it took until 2014 to come into force. This issue is far to be resolved, as the 2004 Berlin Rules, updating the Helsinki ones, has put equitable use and no harm at the same level.

For what regards instead the law and institutions at the basin level, River Basin Organizations (RBOs) have recently become the central unit in the institutions' development at the basin level. However, they broadly vary regarding their organizational setup and governance mechanisms, including membership, functional scope, institutionalization, organizational structure, financing, decision making, information management, dispute resolution and stakeholder involvement, and a superficial classification is attempted.

This study builds on previous research using cooperation, evaluated through the analysis of the institutions and the States' compliance at the basin level, as the dependent variable, while water scarcity, compatibility of water uses and effective information exchange over water issues are employed as the independent variables. Although many factors contribute to

conflict and cooperation over water resources, these three appeared to have the biggest influence on States' behaviour.

Regarding water scarcity, the debate on how to measure it is still ongoing, as simpler indexes fail to comprehend all the aspects related to water, while more holistic indexes compress them in a single number and thus are not very useful for policy-makers. Moreover, some scholars argue that water can be traded through goods, elaborating the concepts of "virtual water", that is, the water needed to produce a certain commodity. For the scope of this study water scarcity is measured in terms of quantity through the Water Risk Index developed by the World Resources Institute in both aggregate and disaggregated forms, which accounts the baseline water stress, inter-annual variability, seasonal variability, flood occurrence, drought severity, upstream storage and groundwater stress, and in terms of quality through the Water Quality Index (WATQI), the only comprehensive index on water quality to date, developed as a component of the Environmental Performance Index (EPI). Then, the scarcity-cooperation nexus is recognized to follow an inverted U-shaped curve, meaning that cooperation takes place only when water is moderately scarce, while it does not when is abundant or extremely scarce because it is not necessary or the benefits deriving from it are too low.

Regarding the compatibility of water uses, the issue is to organize all the human activities along the watercourse in a way that developments upstream do not impair the ones downstream. To solve this issue the concept of Integrated Water Resources Management (IWRM), which is based on economic and ecological sustainability and stakeholder participation. Although many attempts have been made worldwide to implement it, IWRM has become an end in itself, excluding *a priori* other possible water governance practices. Thus, compatibility of water uses is evaluated on a case-by-case basis, analysing the impact of human activities from upstream to downstream.

Regarding the effective information exchange over water resources, quantitative analyses of water treaties show that its presence in the agreements has the highest relation with cooperation over water. Thus, information exchange is considered, assuming that there should be no cooperation without it.

Regarding the case studies, the following criteria were employed: basins with three or more riparians that have a similar number of States within and lacking a hydro-hegemon. The

case studies selected conforming to these criteria were the Kura-Araks basin in the south Caucasus, the Aral Sea basin in central Asia, the La Plata basin in South America and the Sava basin in the Western Balkans.

The Kura and Araks rivers were mostly internal to the Soviet Union which managed them through RBOs, although agreements were in place with Turkey and Iran. After the breakup of the USSR, the newly independent States found themselves heavily reliant on the river waters. Physical scarcity is concentrated downstream and there is an overall low quality in the waters. Moreover, economic activities upstream severely harm downstream areas. There is no agreement in place and no water quality monitoring has been done since 2002, while the water management initiative has been taken by NGOs and partially the EU, although no real cooperation mechanism can be put in place without the will of the riparians.

The Aral Sea basin, composed by the Syr Darya and Amu Darya rivers, was a hydrological system internal at the Soviet Union. During Soviet times the drainage of the Aral Sea was planned through the diversion of the major rivers that fed for agricultural purposes, especially cotton cultivation. After the breakup of the Soviet Union the five new States signed a very advanced water cooperation agreement in 1992, in which they agreed on maintaining the previous allocation system focused on downstream agriculture, but cooperation did not take place because of the end of compensation payments to the upstream States during the Soviet era, leading to an acceleration of the shrinking process. The area is one of the most stressed in the world, both for water quantity and quality. Moreover, development of hydropower and irrigation severely damaged downstream agriculture. Finally, although the agreements provided for information exchange mechanisms, the data provided are often claimed to be false, hampering the debate on water allocation.

The La Plata basin is a complex system composed by the Paranà, Paraguay and Uruguay rivers with their numerous tributaries. There are no outstanding issues regarding water quantity, while in certain zones quality is deteriorated. A comprehensive agreement for the basin was signed in 1969 with the La Plata Basin Treaty, which established the Coordinating Intergovernmental Committee with the task to assist the five countries in the rivers' management. This has provided a framework for several other bilateral and multilateral agreements on single development projects in the basin and the creation of other institutions for sub-basin management. The Itaipu and Yacyreta dams are an interesting case of

cooperation, showing the riparians' will to equally share the benefit of hydropower potential development.

The Sava river is the largest tributary of the Danube and, before the dissolution of Yugoslavia, it was the largest internal river of the Federation. Water in the basin has no outstanding problems regarding quality and quantity. After the wars, the four riparians started a process of joint management of the river that culminated in the 2001 Framework Agreement on the Sava River Basin (FASRB) that established the International Sava River Basin Commission (ISRBC), tasked for monitoring the river status and support the coordination of the riparians activities. The distribution of economic activities along the basin is fairly balanced, as the main issues related to the Sava river are currently on hydroelectric and navigation projects, together with environmental protection. The river management has been also influenced by the related agreements on the Danube river and the EU 2000 Water Framework Directive.

Following the analysis of the case studies, all the hypotheses can be considered confirmed: when water scarcity is extreme, cooperation is highly unlikely to take place, even if coupled with environmental disasters. Moreover, water allocation issues present themselves only when water is rather scarce, otherwise the focus is mostly on hydropower and environmental protection. The compatibility of water uses along the basin proved to be important in reducing the possible tensions arising over and thus in facilitating cooperation. Finally, information exchange did not yield the expected results, concluding that geographical features such as water scarcity play are more relevant in determining cooperation.

What has also emerged in the course of this analysis is that international organizations and external actors may play an important role as well in determining cooperation over transboundary waters. Nevertheless, this work is not comprehensive and further research is needed to better understand these phenomena.

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INTRODUCTION

Rivers' water is the very base of human development: all the great ancient civilizations grew indeed on the banks of the great rivers, the Nile, the Indus, etc. Rivers are also used for frontier demarcation: the *limes* of Roman Empire ran along the Rhine and the Danube, and these watercourses still mark the borders of many countries. Moreover, they are an efficient mean of transport and communication, and a cheap system for waste discharge. Lately, they have become the propellent for the most different economic activities, from mills to mines, factories and hydroelectric dams. Thus, with the demographic and economic growth, river water has become more and more a strategic asset for a country development.

However, not all watercourses lie completely within a State territory: actually, there are 263 transboundary river basins, accounting for far more transboundary rivers. Thus, States interact over this resource, and they do it in very different ways: they may decide to seize it through the use of force or share it with its neighbours, develop joint infrastructure or use it as a weapon. Current research has analysed in depth these interactions in bilateral basins, but few studies have been conducted on the interactions between basin riparians when they are more than two. Thus, the aim of this study is to answer to the following research question: *why and in which modalities do States cooperate on international river basins in which three or more riparians are present?*

Cooperation broadly denotes political actors working together for a common goal: in transboundary river basins, this concept implies sharing the benefits deriving from water uses among all the riparians and the joint management of the water resource itself. Moreover, a cooperative regime is also able to address arising disputes and prevent the eruption of conflicts. Thus, multilateral cooperative transboundary basin is defined in this study as *the establishment and implementation of an inclusive framework for joint water management, benefit sharing, dispute resolution and conflict prevention*.

Cooperation over water resources however, may take place or not for very different reasons, often intertwining among themselves: water scarcity, economic or political issues, ethnic or religious conflicts, territorial disputes, institutional capacity, etc. Thus, to understand how this dependent variable is influenced by the various factor, a qualitative analysis has been conducted, selecting three of them considered the most relevant for the establishment of

positive or negative relations over water: *extreme water scarcity*, *compatibility of water uses* and *information exchange*. Then, several hypotheses have been elaborated to explain how the independent and dependent variables interact:

1) *Water scarcity is a positive driver for cooperation only when it is moderately scarce*

Indeed, countries cooperate because generally the costs of establishing cooperation are outweighed by the gains made form it. For water, cooperation is viable when there is a need to regulate its uses (and thus is not so abundant that riparians do not need to work together) and the share of its benefits is larger than the costs sustained by every country (and thus is not so scarce that there are no gains coming from cooperation).

2) *Compatibility of water uses is a positive driver for cooperation*

Basins in which upstream uses hinder or disrupt activities downstream may generate disputes within the basin and prevent cooperation, as its difficult to reallocate water from one activity to another, especially if it occupies a relevant share of employment or GDP: thus, basins where economic activities are distributed in a way that causes no harm downstream will be more likely to experience cooperation.

3) *Information exchange established in a treaty is a positive driver for cooperation*

The exchange of data on hydrology and precipitation is the fundamental step for the establishment of cooperation, as it builds trust among the riparians and allows the joint management of the basin and the execution of joint projects: thus, countries that include information exchange in their treaties will cooperate.

Since water resources and river basins experience a continuous change in their physical characteristics, including the ones caused by the climatic modifications experienced in the last century, long-term cooperation will be analysed: since most of the basins analysed have experienced very relevant changes in the political boundaries during the early 1990s, the longest timeframe available is 30 years. Then, although water is used and managed form State

to the local level, and thus many actors are present as stakeholders in the basin, the analysis is mostly focused on the States as the primary actors for the cooperation in transboundary river basins. Indeed, even in democratic countries is the State that enters in agreements with its riparians and establishes with them the terms for cooperation. Due to globalization and the increase in number and influence of international and supranational organizations, such as the United Nations, the World Bank and the European Union, governmental and non-governmental organizations have started to influence as well the politics of cooperation in transboundary river basins, being able to compensate the costs for cooperation. Thus, their impact in the basins will be considered as well.

This study in divided in six Chapters: the first will explain the phenomena of conflict and cooperation in transboundary river basins, reviewing the research conducted on the subject. This review will be conducted through an interdisciplinary approach that includes quantitative research, hegemonic theory, game theory and international law. The second Chapter will analyse in depth the three independent variables and their impact on cooperation. The impact of climate change will be evaluated as well, together with the criteria employed for case selection and the results of preliminary research on the cases. Finally, Chapters from four to six are dedicated to an in-depth analysis of the selected cases, discussing the relative influence of the independent variables: the Kura-Araks basin, the Aral Sea basin, the La Plata basin and the Sava basin.

CHAPTER ONE

CONFLICT AND COOPERATION IN TRANSBOUNDARY RIVER BASINS

1.1 Introduction

This chapter introduces the debate on conflict and cooperation in transboundary river basins. The findings coming for the research that stemmed from this debate are fundamental to understand the general trends of interactions between States over freshwater and the present condition of transboundary river basin management. The general belief that water will be the *casus belli* for future wars has been contested by empirical quantitative analyses that later on have been extended to other aspects of cooperation, from legal principles to "structural" factors within the basins, such as geography, that supposedly increase the probability of disputes. Then, the debate on the nature and interrelation of conflictive and cooperative interactions is presented as well, with a focus on power asymmetries between riparians, which are relevant for the selection of cases and a better understanding of how power relations are extended to fields beyond the military and play a pivotal role in the definition of the cooperation, or non-cooperation, regime.

Later, the dilemmas faced by the actors present in the basin are presented through a game theory approach with their available options and preferred strategies. Moreover, this discourse will be enlarged to include more complex interconnected games and theories of coalition formation, explaining how States do cooperate in a multilateral environment.

Finally, an international law perspective is considered, tracking the evolution of legal doctrines on transboundary water and the existing international treaties and case law. Then, a thorough analysis of the institutions and agreement for water management at the basin level

is conducted, in order to understand the legal environment in which riparians move when cooperating over their transboundary basins.

1.2 The Water War Thesis

The Water War Thesis feeds in the stream of the "new security threats" literature in the International Relations discipline that emerged in the early 1990s after the end of the Cold War. More precisely, it belongs to the ecological threats[1] linked to environmental degradation of anthropogenic nature, as the «uncovering of cause-effect relations puts ecological issues more and more into the human, and therefore political, arena»[2]. Based on neo-realist theories of international relations and concepts of non-traditional and environmental security, its main argument is that the great importance that water has for human life and socioeconomic development can lead to violent conflicts between States. Indeed, water is not substitutable in its uses with other elements, is available in limited amounts and has an uneven geographical distribution. Technology can only mitigate the human dependency on water by improving its efficiency and recycling wastes Thus, competition over its control may arise between States and access to it can be seen as a matter of national security, especially in areas where is scarcer[3]. Moreover, when a State relies mostly on an external source of water, as it happens for downstream countries such as Iraq, Egypt, Argentina or Bangladesh, dependency can easily become vulnerability, as upstream water diversion projects can reduce the quantity and quality of the flow provoking serious damages downstream: this is the case of several Turkish and Syrian dams for hydropower and irrigation on the Euphrates that disrupted Iraqi agriculture[4] or the Indian Farakka barrage on the Ganges that caused a major loss for the Bangladeshi economy and a migration crisis, ironically, to the bordering Indian states[5]. Thus, the use of military force, or the threat of using it, to secure this vital resource becomes a likely option for the countries that have sufficient military capacity: as the Egyptian President

[1] Buzan, B. *People, States & Fear: An agenda for international security studies in the post-cold war era*. Harvester Wheatsheaf, 1991, p. 117
[2] *Ivi*, p. 118
[3] Gleick, P. H. "Water and conflict: Fresh water resources and international security". *International security*, Vol.18, No.1, 1993, 79-112.
[4] Al-Ansari, N., Ali, A., Knutsson, S. "Present conditions and future challenges of water resources problems in Iraq". *Journal of Water Resource and Protection*, Vol.6, No.12, 2014, 1066-1098.
[5] Homer-Dixon, T. F. "Environmental scarcities and violent conflict: evidence from cases". *International security*, Vol.19, No.1, 1994, 5-40.

Anwar Sadat said in 1979 after signing the peace treaty with Israel, «the only matter that could take Egypt to war again is water»[6]. As Homer-Dixon summarizes the argument,

> «the renewable resource most likely to stimulate interstate resource war is river water. Water is a critical resource for personal and national survival; furthermore, since river water flows from one area to another, one country's access can be affected by another's actions. Conflict is most probable when a downstream riparian is highly dependent on river water and is strong in comparison to upstream riparians. Downstream riparians often fear that their upstream neighbours will use water as a means of coercion. This situation is particularly dangerous if the downstream country also believes it has the military power to rectify the situation.»[7]

Moreover, Peter Gleick adds that «the characteristics that make water likely to be a source of strategic rivalry are: (1) the degree of scarcity, (2) the extent to which the water supply is shared by more than one region or state, (3) the relative power of the basin states, and (4) the ease of access to alternative fresh water sources»[8]. It is not a case then that the MENA region has been the most studied case in support to this thesis, due to its few and localized water resources and the impressive record of violent conflicts in the last century. Indeed, some authors claim that the Israeli rationale for the Six Days' War was, among the others, to stop a 1965 joint Syrian-Jordanian project for the diversion of the Jordan river away from Israel, depriving it of a strategic source of water: when it is true that the project was already stopped in 1966, although after a fire exchange that included use of tanks and aircrafts[9], is a fact, however, that Israel occupied the Jordan headwaters, located in the Golan Heights in Syria, during the 1967 war and that «almost the entire increase in Israeli water use since 1967 derives from the waters of the West Bank and the upper Jordan river»[10]. It has to be noted however that, according to events' databases on conflicts over water[11], there has not still been a single

[6] Cited by Starr, J. R. "Water wars". *Foreign Policy*, No.82, 1991, 17-36.
[7] Homer-Dixon, T. F. "Environmental scarcities and violent conflict: evidence from cases". *International security*, Vol.19, No.1, 1994, 5-40.
[8] Gleick, P. H. "Water and conflict: Fresh water resources and international security". *International security*, Vol.18, No.1, 1993, 79-112.
[9] Wolf, A. T. "Conflict and Cooperation Along International Waterways". *Water Policy*, Vol.1, No.2, 1998, 251-265.
[10] Gleick, P. H. "Water and conflict: Fresh water resources and international security". *International security*, Vol.18, No.1, 1993, 79-112.
[11] See the Pacific Institute Water Conflict Chronology (http://www.worldwater.org/water-conflict/) and the Oregon State University Transboundary Freshwater Dispute Database (http://transboundarywaters.science.oregonstate.edu/content/transboundary-freshwater-dispute-database)

all-out inter-state war solely for water resources, and its relative importance to other reasons is disputed: for example, South Africa negotiated unsuccessfully for 30 with Lesotho for a water diversion project to meet the needs of the arid Transvaal province, but reached an agreement only two months after a new government was installed by a coup that supported extensively with the motivation that Lesotho was providing a sanctuary for the ANC guerrilla[12].

Water then has been more a tool or a victim of warfare, rather than the objective of war: hydroelectric plants have been targeted to shut down electric supply and flood areas controlled by the enemy, like the attempt to blow up the Peruca Dam during the wars in former Yugoslavia, irrigation and sanitation infrastructures have been damaged to demoralize the population, like the NATO airstrikes in Iraq during the Gulf Wars, or water flow can be stopped to deprive the enemy of a vital resource, like the Turkish proposal to shut down the flow of the Euphrates at the onset of the First Gulf War in 1991 to force Saddam to withdraw from Kuwait[13]. Moreover, especially after 9/11 water infrastructure has become the target of terrorist groups such as al-Shaabab, ISIS and the Talibans and other guerrilla movements such as the FARC in Colombia or the Sendero Luminoso in Peru, although most of the incidents took place in India and Pakistan[14]

Water conflicts, however, are present on a regional and transboundary scale, rather than interstate, because they generally involve units smaller than the States such as regional governments, tribes, or groups based on ethnicity, class or other characteristics. For example, in Western and Eastern Africa clashes between herders and farmers over access to water are becoming more frequent and violent, also due to small arms proliferation, that they have been recognized as major concerns by their respective regional organizations, ECOWAS and IGAD[15], while in India the dispute between the states of Karnataka and Tamil Nadu over the Cauvery river has led to several deaths. Water then can have an indirect impact on provoking conflicts or exacerbating existing ones: losses in agricultural production due to an increase in water scarcity can, for example, put population's food security at odds, generating an

[12] Homer-Dixon, T. F. "Environmental scarcities and violent conflict: evidence from cases". *International security*, Vol.19, No.1, 1994, 5-40.
[13] Gleick, P. H. "Water and conflict: Fresh water resources and international security". *International security*, Vol.18, No.1, 1993, 79-112.
[14] https://www.newsecuritybeat.org/2018/05/global-analysis-finds-water-related-terrorism-rise/
[15] Krampe, F., Scassa, R, and Mitrotta, G. *Regional Institutional Responses to Climate-Related Security Risks in Africa and Asia.* Stockholm: Stockholm International Peace Research Institute, August 2018, forthcoming.

escalation of latent ethnic or religious conflicts or forcing people to resort to criminal activities, thus weakening the stability of the State, as the cases of the Marsh Arabs in southern Iraq and the cultivation of opium poppy in Afghanistan demonstrate[16]. Moreover, a decrease in water quantity and quality can trigger migrations, both within and across State boundaries, that in turn will put more pressure on cities or neighbouring States, thus generating instability: for example, a very important factor that triggered the escalation of the Syrian Civil War has been an extreme drought that was lasting since 2006 and forced 1,5 million of affected farmers to move to the outskirts of the cities, who eventually turned violent facing the inability of the Syrian government to meet their needs[17].

Thus, the Water War Thesis does not completely hold when it comes to comparisons with empirical findings, as the importance of water over other issues as *casus belli* is difficult to ascertain, and does not analyse the conflicts over water at regional and community level where instead they are more likely to erupt, focusing only on the State level. This argument can, however, gain more relevancy in the future, as the developments of climate change and further environmental degradation in numerous parts of the world can make water scarcer and then increase the probability of interstate conflicts.

1.3 The empirical evidence: no war but lack of cooperation

In the late 1990s numerous works emerged contesting the Water War Thesis on the base of empirical findings which show an historical record of cooperation between States in transboundary river basins. This "Cornucopian" branch of Hydropolitics research claims indeed that the costs for a war for the control of water resources would exceed the gains obtained both for strategic (a downstream country starting a war has high risk to disrupt its water source because of river flow) and other reasons such as shared interests, institutional resilience and economic calculations[18]. The Cornucopian stream has mostly evolved around three institutions from which the names of the corresponding schools of thought derive: the

[16] Krampe, F. *Understanding Environmental Peacebuilding*. New York: Cambridge University Press, 2019, forthcoming.
[17] Gleick, P. H. "Water, drought, climate change, and conflict in Syria". *Weather, Climate, and Society*, Vol.6, No.3, 2014, 331-340.
[18] Wolf, A. T. "Conflict and Cooperation Along International Waterways". *Water Policy*, Vol.1, No.2, 1998, 251-265.

Oregon State University, the University of Maryland and the Peace Research Institute Oslo (PRIO). However, while no wars have been fought for water, States are reluctant to cooperate.

1.3.1 The Oregon School

The first empirical analysis on conflict and cooperation on transboundary river basins was started by Aaron T. Wolf at the Oregon State University: the research started, first of all, by the need to map all the transboundary river basins and their relative treaties in the world, as the UN register for transboundary rivers had been updated for the last time in 1978[19] and many domestic river basins started to be shared between two or more countries following the de-colonization and the dissolution of the Soviet Union and the Yugoslavian SFR[20].

After mapping the world transboundary watersheds and the establishment of the Transboundary Freshwater Dispute Database, which is the earliest known centralized repository pertaining conflict and cooperation on transboundary basins, a complete event data analysis on State interactions over freshwater was conducted: drawing information from the CIA Foreign Broadcast Information System (FBIS), the Conflict and Peace Data Bank (COPDAB), the Global Events Data System (GEDS), the above-mentioned TFDD and a rich literature review, a set of 1.831 water-related events was extracted, of which 507 were conflictual, 1.228 cooperative and 96 neutral[21]. The events were then graded on a scale, called Basins at Risk (BAR) scale, of 15 points showing their intensity in the COPDAB scale, with -7 being the most conflictive (war or extensive war acts causing deaths) and 7 the most cooperative (unification in one country)[22]. Also, a Geographic Information System (GIS) was developed, including almost 100 layers of global and regional spatial data, including biophysical, socio-economic and geopolitical features, in order to contextualize historically every event[23].

[19] CNRET *Register of International Rivers*. Oxford: Pergamon, for Centre of Natural Resources, Energy, and Transport of the Department of Economic and Social Affairs of the United Nations, 1978.
[20] Wolf, A. T., Natharius, J. A., Danielson, J. J., Ward, B. S., & Pender, J. K. "International river basins of the world". *International Journal of Water Resources Development*, Vol.15, No.4, 1999, 387-427.
[21] Wolf, A. T., Yoffe, S. B., and Giordano, M. "International waters: identifying basins at risk". *Water policy*, Vol.5, No.1, 2003, 29-60.
[22] *Ibidem*
[23] *Ibidem*

The statistical distribution, showed below together with the complete BAR scale, and the GIS analysis, produced the following findings[24]:

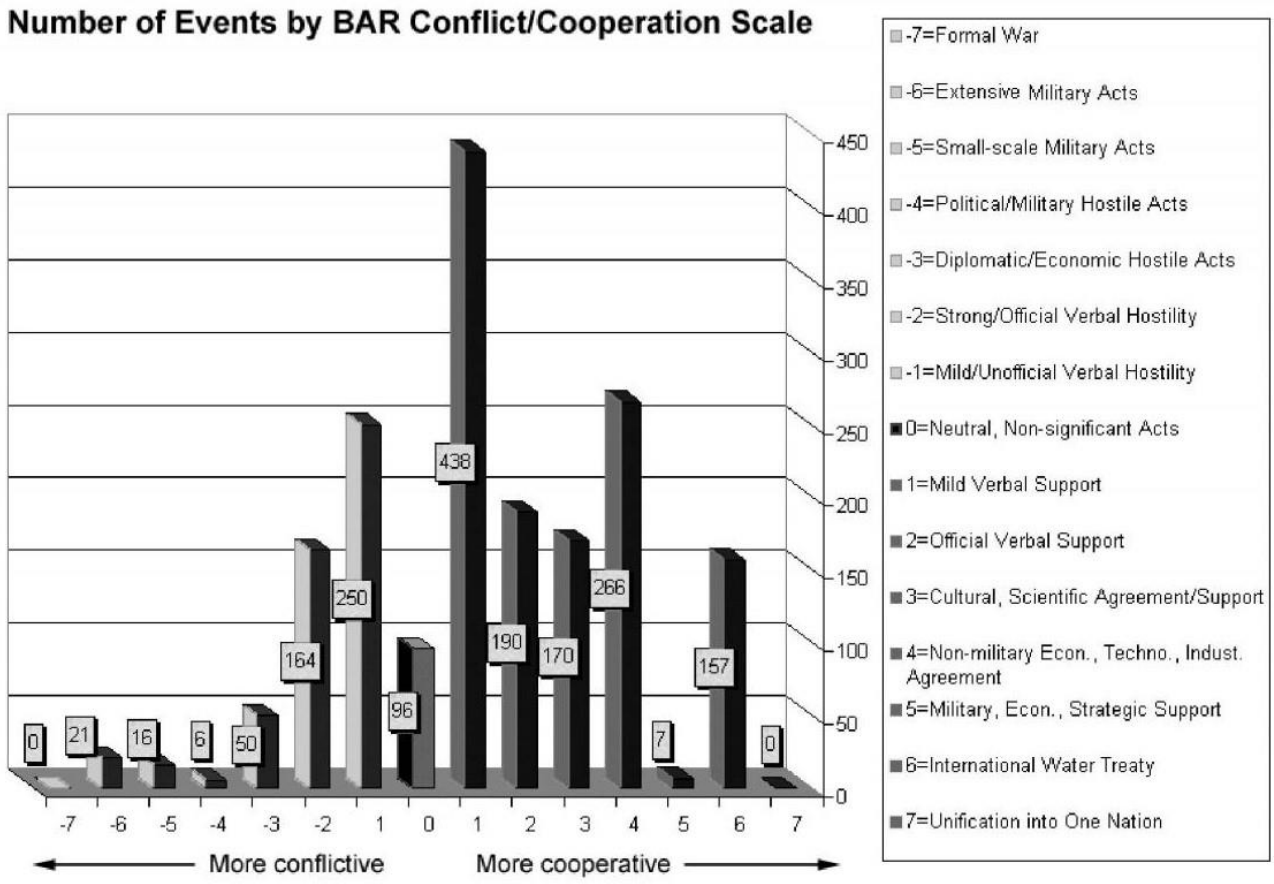

Figure 1.1: Number of events by BAR Scale and relative legend[25].

a) there were no events on the two extremes of the BAR scale in recent time: according to the TFDD, the last "water war" has been fought between the two city-states of Lagash and Umma on the Tigris and Euphrates basin in 2500 BC[26], and no unification happened because of water resources.

b) Most recorded interactions are of a cooperative nature with a ratio of almost 2:1 in favour of cooperation: 1.228 (67,1%) cooperative events compared with 507 (27,7%) conflictive events, with 96 (5,2%) of neutral or non-significant events.

c) Most interactions are mild, with 784 (42,8%) events falling within the BAR scale range of –1 to +1, and 1.138 (62%) events occurring between the –2 and +2 values. Of the 37 recorded acute-level conflicts (–5 and –6 on the BAR scale), 30 are between Israel and its

[24] *Ibidem*
[25] *Ibidem.*
[26] Wolf, A. T. "Conflict and Cooperation Along International Waterways". *Water Policy*, Vol.1, No.2, 1998, 251-265.

various neighbours, with non-Middle East cases relating to only five of the events of this magnitude.

d) Water acts as an irritant between countries if left unaddressed.
e) Water acts as a unifier, even when other political tensions exist between countries, after agreements are signed: the Mekong Committee functioned since 1957 and did not stop during the Vietnam War, while the Indus River Commission survived three wars between India and Pakistan.
f) The major water-related issues are quantity and infrastructure, with 64% of all recorded events falling into these two categories. Quality-related issues are also important, but with only 6% of the recorded events falling into this category.
g) Countries cooperate over a wide variety of issues relating to water, according to the specific features of the river basins and the riparians needs.
h) The major causes of conflictive events are quantity and infrastructure, accounting for 86% of all recorded conflictive events and 100% of events that are associated with high conflict (–6 on the BAR scale).

Building on these core findings, the project focused then on vulnerability, with the goal of identifying the basins at risk. One side of the equation consisted in the physical dimension of water integrating Gleick's four indices of vulnerability – ratio of water demand to supply, water availability per person, fraction of water supply originating outside a nation's borders and dependence on hydroelectricity as a fraction of total electrical supply[27] - with other physical factors such as precipitations and droughts. The other side was instead related to the institutional capacity to absorb the physical stress, which consisted overall relations between riparians, GDP per capita, population density, regime type and presence of joint management bodies or treaties[28]. Finally, the level of analysis considered was the watershed, rather than the single countries, as these factors affect very distinct geographical units that transcend political borders[29]. The working hypothesis that emerged was that «the likelihood and intensity of dispute rises as the rate of change within a basin exceeds the institutional capacity

[27] Gleick, P. H. "Water and conflict: Fresh water resources and international security". *International security*, Vol.18, No.1, 1993, 79-112.
[28] Wolf, A. T., Yoffe, S. B., and Giordano, M. "International waters: identifying basins at risk". *Water policy*, Vol.5, No.1, 2003, 29-60.
[29] *Ibidem*

to absorb that change.»[30] Indeed, when relating the indicators with the event database and the BAR scale, the findings were the following[31]:

a) countries which cooperate in general cooperate about water; countries which dispute in general, dispute over water: comparing general friendship/hostility with BAR events shows only a moderate positive correlation.
b) The higher the per capita GDP, or the lower the population density, the greater the cooperation: there is a weak relationship between a country's per capita GDP and the level of water related cooperation with its neighbours. Similar relationship exists between the level of conflict/cooperation, population density and population growth rates.
c) Regardless of how it is measured, water stress is not a significant indicator of water dispute: simple water stress (water availability per capita), by country or basin, don't have a direct relationship with conflict/cooperation levels.
d) Neither government type nor climate show any patterns of impact on water disputes: autocratic countries are only barely less cooperative than the strongest democracies and there is little perceptible difference between most climate types.
e) The greater the fluctuation in any given year either towards drought or towards flood, the more tense the basin: not surprisingly, years of normal precipitation tend to be the most cooperative.

Thus, it appeared to be a general convergence of the abovementioned exacerbating factors, but none of them emerged alone as a driver of conflict. Therefore, given the moderating effect of institutional capacity, the most significant indicators should represent extremely rapid changes, either physical or institutional: for what regards the former, the development of a large-scale dam or water diversion project was considered, showing some degree of correlation that is partially countered by institutions, as unilateral projects in absence of a treaty or institutionalized cooperation create a more conflictive environment[32]. Regarding the former, the most rapid institutional change was associated with the "internationalization" of the basin, that is, «basins whose management institution was developed under one single jurisdiction, but which was dramatically altered as that

[30] *Ibidem*
[31] *Ibidem*
[32] *Ibidem*

jurisdiction suddenly became divided among two or more nations.»[33] However, it has to be noted that, as treaties mitigate the conflictive effects of unilateral development, so water scarcity increases the level of conflict in a recently internationalized basin.

Overall, the abovementioned findings seem to be consistent with the historical trends: as shown in the figure, the least cooperative periods (1948-1970 and 1987-2000) correspond with de-colonization and the dissolution of the Soviet Union[34].

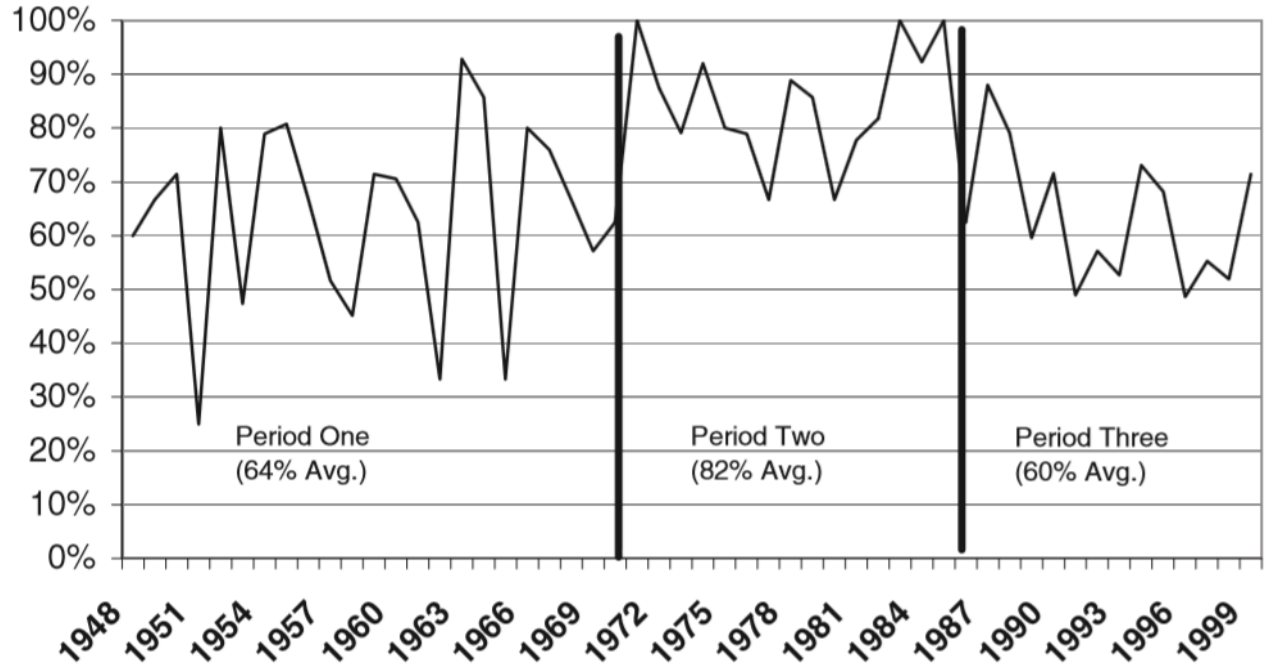

Figure 1.2: Cooperative events as a percentage of total events, 1948-1999[35].

A more recent study[36] compared the findings from the 2000-2008 period with the previous 1948-1999 one:

a) although positive BAR events are still outweighing negative ones, «the less cooperative trend that started in 1987 has not yet concluded, since positive events on average counted for only 63% of the total events during that period of time»[37].
b) Almost all negative events registered were between -1 and -3 on the BAR scale, without any event for the -7 level, confirming the previous observations.
c) Infrastructure and water quantity remain the most conflictive issue, although also joint management, water quality and hydropower have shown a decrease in cooperative events.

[33] *Ibidem*
[34] *Ibidem*
[35] *Ibidem*
[36] De Stefano, L., Edwards, P., De Silva, L. *et al*. "Tracking cooperation and conflict in international basins: historic and recent trends". *Water Policy*, Vol.12, No.6, 2010, 871-884.
[37] *Ibidem*

d) There is a general shift in issues from water quantity to infrastructure, joint management, flood control and water quality.

Overall, the findings of the Oregon State University demonstrate a general inconsistency of the Water War Thesis (at least when only States are considered), showing a more cooperative trend on water-related issues. However, a lack of wars over water does not automatically imply that tensions do not exist on transboundary river basins.

1.3.2 The Maryland School

Recognizing the discovery of a more cooperative trend on transboundary river basins, Ken Conca and his team from the Maryland University focused on the modalities of cooperation between States, looking at the possible convergence of norms and values in basins' governance to discover if a cluster of guiding principles was emerging on the issue, forming the base of a global regime for transboundary river basins.

Using FAOLEX, FAO online legal database, and the TFDD as primary sources of information, 62 agreements were extracted for the 1980-2000 period and subjected to a statistical analysis with reference to the core principles of the 1997 UN Convention on the Law of the Non-Navigational Uses of International Watercourses: participation, equitable use, no significant harm, sovereign equality and territorial integrity, information exchange, consultation, prior notification, environmental protection and peaceful dispute resolution[38]. These 62 agreements however covered only 36 of the 263 transboundary river basins (14%), meaning that norm diffusion has been contained to basins with a prior history of cooperation, as 46 over 62 agreements (74%) were produced in basins that already had at least one[39]. Then, cooperation itself appeared to be fragmented: even though the majority of agreements took place in multilateral basins (49 over 62), two thirds of them are of bilateral nature, implying the exclusion of one or more riparians[40]. However, there has been a slight increase of multilateral agreements after the signature of the 1992 UN Convention on the Environment and Development (UNCED), which contributed also to the overall increase of agreements

[38] Conca, K., Wu, F., and Mei, C. "Global regime formation or complex institution building? The principled content of international river agreements". *International Studies Quarterly*, Vol.50, No.2, 2006, 263-285.
[39] *Ibidem.*
[40] *Ibidem*

that took place after 1992[41]. Regarding the signature of an agreement instead, no variable appeared to be significant, consistently with the studies of the Oregon School.

Looking at the principles articulated in the agreements, consultation, environmental protection, peaceful dispute resolution and information exchange were the most frequent, while prior notification, equitable water use, no significant harm and sovereign/territorial rights were the least invoked[42]. However, when considering their evolution over time, environmental protection and territorial/sovereign rights had a significant growth during the study period, while all the others remained stable[43]: although these two trends can appear contradictory at a first glance, the fact that a greater emphasis on transnational environmental responsibilities generates a countervailing emphasis on States' rights is consistent with the developments in international environmental regimes. Indeed, the shift from the Kyoto Protocol to the Paris Agreement was characterized, among other features, by an increase in transnational «common but differentiated»[44] environmental responsibilities, this time for all the world countries and, at the same time, an increase in independence for the States to submit and implement their own national plans.

Overall, two different clustered sets of principles seemed to emerge at the basin level, one focused on affirming the States' water rights and the other on affirming the duties on transparency and sustainability of water uses[45]. Then, some controversial principles, such as equitable use and no significant harm, remain ambiguous, so that they cannot be included in any of the two clusters: this is especially true for these two mentioned principles, as equitable use is mostly advocated by upstream States, while no significant harm is advocated by downstream States. Thus, this conflict between these two principles, both affirmed in the UN Convention on the Law of the Non-Navigational Uses of International Watercourses has resulted in their unclear definition. Therefore, the evidence is that there is no move towards a common normative structure and that international legal principles are deepening or moving towards an identifiable direction[46].

[41] *Ibidem*
[42] *Ibidem*
[43] *Ibidem*
[44] Paris Agreement, 2015.
[45] Conca, K., Wu, F., and Mei, C. "Global regime formation or complex institution building? The principled content of international river agreements". *International Studies Quarterly*, Vol.50, No.2, 2006, 263-285.
[46] *Ibidem.*

1.3.3 The Oslo School

Starting from a premise similar to that of the Oregon School, that is, the increasing gap between empirical studies and theory in the Water Wars Thesis, the PRIO team of scientists, led by Neils Peter Gleditsch, developed its own datasets and path of research, confronting its findings with the ones made at the Oregon State University. The focus was mostly on the possible causes of conflict, using the findings by Homer-Dixon that water has the greatest potential of violence among the non-renewable resources as the starting point for further analysis[47].

A first study was launched, based on the UN *International Rivers Register*[48] and other sources for more recent developments and the Asian rivers[49], confronting data on militarized international disputes from the Correlates of War project[50] with different variables such as regime type, presence of a major power, level of development, alliances, historical relations and number of shared rivers[51]. The initial findings of this study showed that sharing a river doubles the probability of an interstate militarized dispute, that the presence of a State with low water availability is associated with higher risk of conflict and that physical geography plays an important role, as a river that flow across the border is more conflictive than one flowing along it[52]. However, 39% of the rivers didn't fall in either category, being the so-called «fuzzy boundaries»[53], thus opening a new unexplored scenario.

A new study was launched to analyse this and other problem that arose, for example to what extent the military disputes are on water resources rather than on frontier demarcation when a river flows along the border[54]. An updated dataset was tested against the TFDD, resulting in 51 missing basins and several coding and naming differences, which eventually brought to the creation of a new dataset based on the TFDD, but including also all the

[47] Gleditsch, N. P., Furlong, K., Hegre, H. *et al*. "Conflicts over shared rivers: Resource scarcity or fuzzy boundaries?" *Political Geography*, Vol.25, No.4, 2006, 361-382.
[48] CNRET *Register of International Rivers*. Oxford: Pergamon, for Centre of Natural Resources, Energy, and Transport of the Department of Economic and Social Affairs of the United Nations, 1978.
[49] Toset, H. P. W., Gleditsch, N. P., and Hegre, H. "Shared rivers and interstate conflict". *Political Geography*, Vol.19, No.8, 2000, 971-996.
[50] See the project website: http://www.correlatesofwar.org/
[51] Toset, H. P. W., Gleditsch, N. P., and Hegre, H. "Shared rivers and interstate conflict". *Political Geography*, Vol.19, No.8, 2000, 971-996.
[52] *Ibidem.*
[53] *Ibidem.*
[54] Gleditsch, N. P., Furlong, K., Hegre, H. *et al*. "Conflicts over shared rivers: Resource scarcity or fuzzy boundaries?" *Political Geography*, Vol.25, No.4, 2006, 361-382.

tributaries and sub-basins of the 263 known transboundary rivers. The findings showed that historical peaceful relations are the strongest predictors of peace. Regarding regime type, the riskiest combination was of two inconsistent regimes, followed by two autocracies and the democracy-autocracy/inconsistent dyad, in line with the democratic peace theory. The level of development was insignificant instead, explained by the robust correlation between development level and regime type, being consolidated democracies the most developed countries. The other factors tested, such as the presence of alliances or major powers in the basin, resulted as not significant. Regarding the fuzzy boundary scenarios, the findings suggested that border itself is not important: instead, what appeared to really matter was the water resources, as «the combined resources present in a basin, including both fresh and groundwater, present a potential source of conflict.»[55] Moreover, it has to be considered not only water *per se*, but also «the resources or the production of goods indirectly based on the availability of water and water transportation, such as high population densities, fisheries, fertile agricultural areas, or cities and industrial sites located by rivers because of their historical economic importance.»[56] Thus, the water resource and its size appeared to be the driver for conflict, rather than the boundary issues. However, when looking at the impact of water scarcity, the «dyads with low average rainfall have a higher risk of interstate conflict only if they do *not* share a river basin»[57], meaning that «countries with endemic water scarcity and shared basins have long-term incentives to invest in water management measures and avoid conflict that other basin-sharing dyads do not.»[58] Thus, this ambiguous result does not put a final word on the relation between water scarcity and conflict. Indeed, what appears, consistently with the findings from the Oregon School, is that no wars have been fought on water, but it can stimulate rivalries and be a hidden factor for other conflicts.

[55] *Ibidem.*
[56] *Ibidem.*
[57] *Ibidem.*
[58] *Ibidem.*

1.3.4 The Transboundary Waters Interaction NexuS (TWINS) model

Given the empirical evidence found on transboundary water relations, the idea that conflict and cooperation are the opposite ends of a spectrum has been gradually rejected. Instead, it has been argued that conflict and cooperation coexist at the same time: indeed, the already mentioned cases of the Indus River Commission and the Mekong Committee show that institutions for water cooperation has been working even in times of war. As John Craig put it, «conflict is a concept that is independent of co-operation; not always opposite to it. In certain circumstances, conflict may be an integral part of inducing and sustaining co-operative behaviour, and the two may coexist in various social settings.»[59] Thus, when both cooperation and conflict levels are low, there is little interaction between the actors, while when they are both high they may reflect a strong commitment by the participant to achieve a goal, but at the same time a strong disagreement over its definition or the means to achieve it. However, this second case is extremely rare in the empirical world. When instead only the conflict or the cooperation level is high, there are the more common cases of respectively unstable or stable relations between the actors.

From this starting point on transboundary water relations, Naho Mirumachi and Antony Allan developed the so-called Transboundary Waters Interaction NexuS (TWINS) model that feeds conflict, cooperation and the political economy into a tridimensional matrix. Drawing upon the security theories of the Copenhagen School[60], applied then to interactions over transboundary waters[61], four levels of conflict intensity, based on the States' perceptions of the issue, were identified: "non-politicized", when are not in the public domain, "politicized", when they become part of public policy and require national resources allocation, "securitized", when they become an existential threat, allowing emergency actions, and "violised", when they become *casus belli* and spark armed conflict[62]. On the other hand, five levels of cooperation intensity were identified, analysing the presence or not of four factors:

[59] Craig, J. G. *The nature of co-operation.* Montréal: Black Rose Books, 1993, p. 15.
[60] See Buzan, B., Wæver, O. and de Wilde, J. *Security: A New Framework for Analysis.* Lynne Rienner Publishers, 1998.
[61] Warner, J. "Water, wine, vinegar and blood. On politics, participation, violence and conflict over the hydrosocial contract". *Proceedings from Water and Politics Conference* (26–27 February 2004, Chap. 3). Marseilles, France, 15 March 2004.
[62] Mirumachi, N., and Allan, J. A. "Revisiting transboundary water governance: Power, conflict cooperation and the political economy". *Proceedings from CAIWA International Conference on Adaptive and Integrated Water Management: Coping with Scarcity*. Basel, Switzerland, 12–15 November 2007.

«common goals, joint action, intention of contributing to collective action and the belief that the other actor will contribute to collective action.»[63] These level are "confrontation of the issue" (mere acknowledgment of the issue), "*ad hoc* interaction" (joint action but no shared goals), "technical cooperation" (shared goals but no joint action, more intense than the *ad hoc* interaction because is not occasional), "risk averting" (shared goals, joint action and belief that the other actor will contribute as expected) and "risk taking" (an ideal form of cooperation in which States will assume costs without clear reciprocation)[64]. Thus, rather than evaluating the single interaction between riparians, the TWINS model allows to analyse the state of current relations, together with their evolution through time and different phases. Moreover, the third dimension of the robustness of the political economy shows the limits that the economy poses on the range of choices available: indeed, «the richer the riparian, the more it is able to achieve its water security» and «have the resources to devote to cooperative initiatives over transboundary waters than do the leaders of economically and institutionally challenged poor countries.»[65] As the figure summarizes[66] the whole TWINS matrix, by strengthening the political economy, the riparians can move from resource capture to resource sharing and then to resource alternatives through trade and technology (for example, desalination plants can reduce the reliance on transboundary rivers and groundwater, thus reducing their strategic importance for the States and moving down on the conflict intensity scale).

[63] *Ibidem*
[64] *Ibidem.*
[65] *Ibidem.*
[66] *Ibidem.*

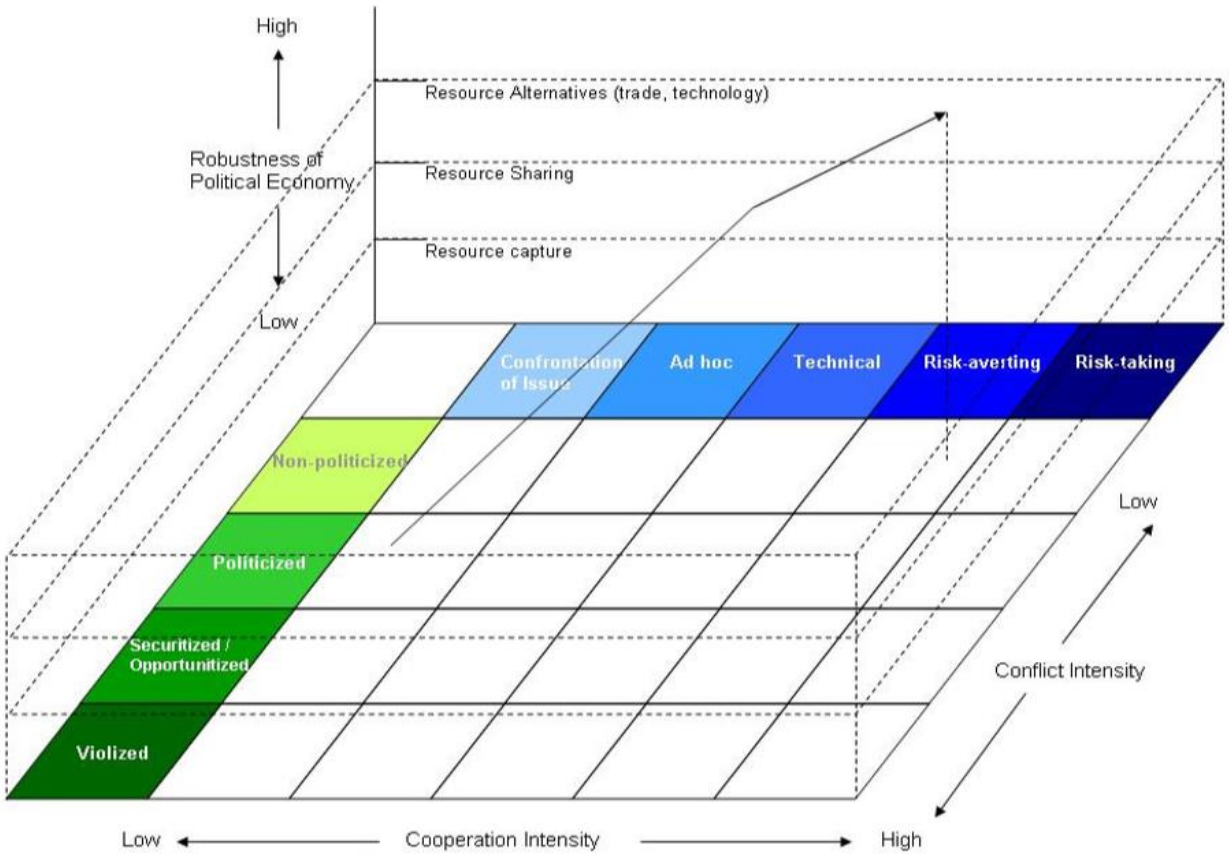

Figure 1.3: The TWINS matrix[67].

1.4 The role of power asymmetries: Hydro-Hegemony

Power relations within a river basin have been mostly ignored or underscored by the studies mentioned previously, but they are the main explanation for conflict and cooperation in many basins. Thus, the London Water Research Group, led by Mark Zeitoun and Jeroen Warner, has investigated in detail the relation between water conflict/cooperation and power in detail, applying a critical theory approach and using insights from International Relations theories and International Political Economy. The most important notion that resulted from this theoretical and empirical[68] work is the concept of hydro-hegemony that will be discussed in this section.

[67] *Ibidem*

[68] For the theoretical framework see Zeitoun, M., and Warner, J. "Hydro-hegemony–a framework for analysis of trans-boundary water conflicts". Water policy, Vol.8, No.5, 2006, 435-460. For the empirical analysis see *Water Policy*, Vol.10, No.S2, 2008, dedicated to Hydro-Hegemony and with selected study cases on the Nile, the Orange and the Amu Darya rivers.

As demonstrated by the statistical studies, there are no water wars, but what is possible to call "water tensions" within, however, a cooperative framework. Thus, «the reason these conflicts fall short of war and are largely silent may have much more to do with the imbalance of power between the riparians than with a perceived cooperation between them.»[69] Indeed, the more or less cooperative outcome depends on the power relations between the riparians: for example, Turkey is able to build its GAP by virtue of its largely superior military capabilities *vis-à-vis* Iraq and Syria and get political leverage, while Ethiopia or Sudan are no match for Egypt, which indeed gets most of the Nile's water. Briefly resumed, «upstreamers use water to get more power, downstreamers use power to get more water.»[70]

A hydro-hegemon is a riparian that can establish its preferred form of water interaction in a transboundary river basin. This can be, in different degrees, positive, if the hegemon uses its leadership to grant public goods for all the riparians, or negative, if it uses its stronger position to exert more power and resources from its neighbours: «most configurations of hydro-hegemony, of course, fall somewhere between the poles of enlightened leadership and oppressive domination.»[71]

Hegemonic power in the basin can be categorized through the three dimensions defined by Steven Lukes[72]: force, deals and ideals. The first one is probably the most evident, as it can be assimilated to what is generally known as "hard power", that is, the ability of the State to possess and mobilize its capabilities, both military, economic or of other nature, including features like riparian position or size and value of its territory. The second dimension is instead related to the control over the rules of the game, which consists of «stripping the weaker party of the ability to choose between compliance or non-compliance with the stronger party's command»[73], defining which kind of decisions will be taken and which ones will not even reach the agenda However, this kind of power is available also to the weaker party, as it can compensate the weakness in the water sector with the strength in another sector through

[69] Zeitoun, M., and Warner, J. "Hydro-hegemony–a framework for analysis of trans-boundary water conflicts". Water policy, Vol.8, No.5, 2006, 435-460.
[70] *Ibidem.*
[71] *Ibidem.*
[72] Steven, L. *Power: A radical view.* London and New York: Macmillan, 1974.
[73] *Ibidem.*

issue-linkage[74], although this can also be substantially considered as a bribe[75]. Moreover, this bargaining power can be increased through a reference to international law: since upstreamers and downstreamers advocate for different principles[76] in river management, the affirmation of one of these legitimizes a State's claim on its water rights. The third, and perhaps most important, dimension of power is the one of ideas, which allows the hegemon to ensure the *willing compliance* of the non-hegemons, preventing «people, to whatever degree, from having grievances by shaping their perceptions, cognitions and preferences in such a way that they accept their role in the existing order of things.»[77] Obviously, hegemony is established and maintained through a combination of these three dimensions of power, with the first shaping the representation of the world according to the hegemon and the second and third making this representation accepted and reproduced by those not in power. Thus, «those in power within the institution of the hegemonic state become the deans of world politics, the administrators, regulators and geographers of international affairs.»[78]

Combining the previously discussed concepts with the competitive/cooperative interactions between riparians, the resulting control over the water resource can be of three different types: shared, when there is some form of cooperation; consolidated in favour of the stronger riparian, when competition is eliminated but cooperation is kept at the minimum; contested, when there is indeed high competition. At the ends of this spectrum lie the two forms of hydro-hegemony that is, positive leadership, meaning that the water-sharing benefits are distributed among the non-hegemonic actors and the allocation is perceived as fair, and dominative, meaning that the stronger competitor generates a relative water scarcity for the weaker. However, given the lack of institutionalization of the latter and the dynamic nature of hegemony, the dominative form is the most unstable, as a change in the political geography or the power relations between the riparians can lead to conflict, a transition towards progressive leadership or a reversal of itself.

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[74] Zeitoun, M., and Warner, J. "Hydro-hegemony–a framework for analysis of trans-boundary water conflicts". Water policy, Vol.8, No.5, 2006, 435-460.
[75] Bennett, L. L., Ragland, S. E., and Yolles, P. "Facilitating international agreements through an interconnected game approach: The case of river basins". In Just, R. E., and Netanyahu, S. (Eds.), *Conflict and cooperation on trans-boundary water resources* (pp. 61-85). Berlin: Springer Science & Business Media, 1998.
[76] Conca, K., Wu, F., and Mei, C. "Global regime formation or complex institution building? The principled content of international river agreements". *International Studies Quarterly*, Vol.50, No.2, 2006, 263-285.
[77] Steven, L. *Power: A radical view*. London and New York: Macmillan, 1974.
[78] O'Tuathail, G., and Agnew, J. "Geopolitics and discourse: practical geopolitical reasoning in American foreign policy". *Political geography*, Vol.11, No.2, 1992, 190-204.

Given the hegemon's objective of consolidated control, different strategies and tactics can be employed to produce compliance from the non-hegemonic actors: these have been classified by Lustick[79] in a frame of increasing efficiency. The three strategic outcomes individuated are resource capture, containment and integration. The first is mostly related to the dominative form of hydro-hegemony, as it is characterized by a unilateralist behaviour, and consists in land acquisition or construction of large-scale infrastructure projects that enables control or access to the water resource, changing the hydropolitical reality and presenting the new situation as a *fait accompli*, as the occupation of the Golan Heights or the GAP project show. The second consists in the co-optation of the weaker competitors in the order preferred by the hegemon engaging in bilateral and multilateral use of a wide range of tactics, from coercion to treaty signature and discourse sanctioning. Finally, the third consists in obtaining compliance through the concession of incentives and privileges offered by the hegemon in virtue of its relative power not only regarding simple water sharing, but also the distribution of benefits deriving from water uses, as can be the construction of hydroelectric plants in the weaker riparian whose electricity can be bought by the hegemon in an exclusive way or at preferential prices as in the case of the Itaipu Dam built by Brazil and Paraguay. Then, the non-exhaustive list tactics employed to reach these strategic outcomes can be divided in four categories: coercive, utilitarian, normative and hegemonic. These reflect the abovementioned three dimensions of powers as coercive tactics, including the use of military force and covert operations, falls in the first dimension, utilitarian and normative tactics, consisting in the concession of incentives and treaties, represents the second dimension, and the hegemonic tactics are consistent with the third dimension. These have been discussed more in detail, as they are more various and efficient in creating the willing compliance of the weaker riparians: indeed, they substantially silence the possible discourses and actions alternative to those desired by the hegemon, including securitization, knowledge construction and sanctioned discourse, but also mobilization of international support and financial resources. Thus, a first tactic is to securitize the discourse around water, that is, bringing it into the realm of national security, equating criticism to treason and thus creating «a normative delimitation separating the types of discourse perceived to be politically acceptable

[79] Lustick, I. S. "Hegemony and the riddle of nationalism: the dialectics of nationalism and religion in the Middle East". *Logos*, Vol.1, No.3, 2002, 18–44.

from those that are deemed politically unacceptable at a specific point in time»[80], that is in general what is defined as knowledge construction. Then, the hegemonic discourse eclipses all the other possible alternatives within the normative boundaries constructed, given the constrains imposed upon those who present opposing viewpoints: for example, the emphasis posed on the merits of cooperation of the Nile Basin Initiative or the Palestinian-Israeli Joint Water Committee by the official narratives underscores the fact that in the first case cooperation is relative only to Egypt and Sudan, excluding Ethiopia and other 6 riparians, and in the second case the Palestinian population is deprived even of the water resources present in Gaza and the West Bank. Furthermore, the discourse is sanctioned also by the international community, both in the form of powerful allies or former colonial overlord (e.g. Egypt has been greatly favoured by the UK in the form of the 1929 and 1959 water-sharing agreements and by the US in terms of financial and political support relatively to the other riparians) and of financial support, as the weaker riparians are often forced to rely on donors and abide to their rules, which eventually refrain the hegemonic discourse. Finally, de-politicization is used to subtract certain issues from the debate, appealing to the "technical" or "natural" aspects of water management and thus excluding them from the political process[81]. This is the case, for example, of the concepts of Integrated Water Resource Management (IWRM) and Multi-Stakeholder Platforms (MSP): both are presented as "natural", "logical" and "technical", excluding *a priori* the possible alternatives. However, both have important pitfalls that should be addressed: first, IWRM takes the river basin as a single unit, but its boundaries are often blurred and change because of natural or human activity, making the delimitation of basins controversial (it has been showed also by the differences between the Oregon and Oslo datasets). Then, it applies optimization models based on a trade-off between contradicting rationalities, that is, economic development, environmental sustainability and social equity, that however is not a result of an open bargaining process between interested stakeholders but rather of competition between governmental agencies. Second, MSP don't assure a democratic water management, as they can be designed to exclude certain stakeholders for political reasons such as the indigenous Mapuche minority in Argentina[82] or

[80] Feitelson, E. "Social norms, rationales and policies: reframing farmland protection in Israel". *Journal of Rural Studies*, Vol.15, 1999, 431–446.
[81] Warner, J., Wester, P., and Bolding, A. "Going with the flow: river basins as the natural units for water management?" *Water Policy*, Vol.10, No.S2, 2008, 121-138.
[82] *Ibidem.*

privilege those who have higher capabilities to capture water resources if they don't take in account social and economic cleavages. Another example of this kind of establishment of hegemonic discourse is the progressive commodification of water and the consequent privatization of the water sector, making it an economic rather than a social good[83], based on the neoliberal belief that economy is a natural science and the market is the most efficient system for resource allocation: this however excludes many parts of the global population from access to water because it's not economically viable to bring it to small, remote locations and to those households who can't afford for it. Then, it's also against basic human rights, given the fundamental role of water in sustaining life.

If this hydro-hegemony is perceived as negative, non-hegemonic actors have the possibility to resort to counter-hegemonic tactics, related mostly to the second dimension of power because of the restrained options in using the first and the third given the high disparity in military and ideational capabilities[84]. Thus, these are based on the bargaining power available, consisting in appeals to international law, delays, alternative funding sources such as cryptocurrencies, generation of positive sum outcomes and issue-linkage. Moreover, they can create coalitions both at the basin and the global level, creating the critical mass necessary to oppose the hegemon and its discourse: this is the case of Ethiopia, that is currently spearheading a coalition of upstream countries within the Nile Basin Initiative, opposed by Egypt and Sudan that benefit from the current arrangement, for a more equitable share of water, and the Andean countries that presented at the 2006 World Water Forum a narrative based on indigenous values and a spiritual concept of water as opposed to the neoliberal one[85].

Combining the three forms of hydro-hegemony, positive, negative and contested, with the three strategic outcomes, resource capture, containment and integration, it is possible to see that a positive hegemon will deploy an integration strategy resulting in shared control and positive interaction, while the other two forms of hegemony imply a mix of resource capture and containment strategy. However, the negative hegemon will establish a consolidated

[83] Warner, J., Mirumachi, N., Farnum, R. L. *et al.* "Transboundary 'hydro-hegemony': 10 years later". *Wiley Interdisciplinary Reviews: Water*, Vol.4, No.6, 2017.
[84] Zeitoun, M., and Warner, J. "Hydro-hegemony–a framework for analysis of trans-boundary water conflicts". Water policy, Vol.8, No.5, 2006, 435-460.
[85] Warner, J., Mirumachi, N., Farnum, R. L. *et al.* "Transboundary 'hydro-hegemony': 10 years later". *Wiley Interdisciplinary Reviews: Water*, Vol.4, No.6, 2017.

control, resulting in the simultaneous presence of a minimum amount of cooperation and mild conflict, while the contested hegemon will be more likely to experience more intense conflict.

Although hydro-hegemony represents a clear explanation of many conflict and cooperation patterns, power relations alone are not enough when a basin is lacking a hegemon, and thus is necessary to look at other factors. Indeed the absence of a hegemon in the basin is one of the features of the cases selected for this study.

1.5 Game theory in transboundary river basins

Game theory has been largely employed the interaction between state and non-state actors over transboundary natural resources: indeed, both renewable and non-renewable transboundary natural resources generally fall in the category of common-pool resources, as they are non-excludable and highly subtractable[86]. Regarding water resources, these characteristics describe very well lakes and aquifers. However, rivers don't belong to this category: indeed, if in a lake the externalities affect equally all the stakeholders by reducing the overall resource pool, in rivers the unidirectional flow of the resource is such that the externalities are imposed from upstream countries to downstream countries. As Klaphake and Scheumann pointed, «externality problems are harder to solve than collective ones because, in general, only one party could gain from cooperation while the other will risk to lose.»[87] Thus, water resources in the form of a transboundary river can be considered only partially as common-pool resources, being them only partially excludable and partially subtractable, unless the upstream country has the capability to completely block the flow, which is however unlikely.

This unique characteristic of rivers generates a situation of dependence between upstream and downstream countries, as the former can choose which externality, positive or negative, to impose on the latter. The insights from the previous paragraph show how upstream countries are more prone to impose negative externalities on the other riparians, thus generating a "victim pays" outcome when traditional game theory is applied, meaning that

[86] Ostrom, E., Gardner, R., and Walker, J. *Rules, games, and common-pool resources.* Ann Arbor: University of Michigan Press, 1994.
[87] Klaphake, A., and Scheumann, W. "Understanding transboundary water cooperation: Evidence from Africa". *Working Paper on Management in Environmental Planning 013*. Berlin: TU Berlin, 2006.

the downstream country is substantially bribing the upstream country to get water. Indeed, in a simple static game, represented in the figure[88], the upstream country has a dominant strategy that is "not share", while on the other hand the downstream country has a dominant strategy of "no side payment", assuming that paying may encourage the other to share water but does not assure that *tout court*. Thus, in this game that resembles the Prisoner's Dilemma, the two dominant strategies produce a suboptimal or Nash equilibrium. Both countries could receive higher payoffs if they could accept to choose to cooperate. However, each country has an incentive to cheat, that is, to free-ride, if it believes that the other country will choose a cooperative action. This translates into mutual defection and lower payoffs.

		Downstream Country	
		Side Payment	**No Side Payment**
Upstream Country	**Share**	1,1	-1,3
	Not Share	2,-2	0,0

Figure 1.4: An upstream/downstream Prisoner dilemma.

A solution to this dilemma is to model the game as a repeated one: this is also grounded in reality, as countries often do not interact on a "single shot" basis. Thus, a repeated game gives the opportunity to observe past action and condition the players' behaviour, rewarding cooperative actions and punishing defection. However, this embodies a "victim pays" outcome that is rational but does not abide to the principles of international law: indeed, using water quality instead of quantity in this game, it is needed to consider that the United Nations would prefer the application of the "polluter pays" principle, forcing the upstream country to clean up water without receiving side payments[89].

Nevertheless, the "victim's" negotiation position can be improved, when possible, by linking water issues with others more or less related, transforming them in "chips" that is possible to trade. Translated into game theory, this means linking two otherwise independent

[88] Bennett, L. L., Ragland, S. E., and Yolles, P. Facilitating international agreements through an interconnected game approach: The case of river basins. In Just, R. E., and Netanyahu, S. (Eds.), *Conflict and cooperation on trans-boundary water resources* (pp. 61-85). Berlin: Springer Science & Business Media, 1998.
[89] *Ibidem*

games with Nash equilibrium to move both games to a Pareto equilibrium. Thus, actions in different games are conditioned in a way that allows to obtain an optimal outcome. This holds true especially in more complex transboundary hydrological systems in which countries are upstreamers and downstreamers in different rivers such as the Colorado-Rio Grande between the US and Mexico or the South African Hydrological Complex that comprises 14 rivers and 11 countries.

Another coordination game related to water resources can be the Stag-Hunt or assurance game, in which two countries share a lake fed by two rivers, one for each country[90]: in order to avoid the complete desiccation of the lake due to evaporation and consumptive use, both have to increase their water releases. Here, the payoffs showed in the matrix[91] are the economic and environmental benefits deriving from the survival of the lake that offset the losses deriving from reduced consumption. However, if only one country chooses to cooperate the problem is partially solved and the environmental benefits are minimal or non-existent.

		Country 2	
		Increase	**Don't Increase**
Country 1	**Increase**	3,3	1,2
	Don't Increase	2,1	1,1

Figure 1.5: A Stag-Hunt game with a transboundary lake fed by two rivers.

Generally, if one player observes signs of cooperation from the other, he will be keener to cooperate as well. Thus, negotiations, agreements and cooperative signals, together with the repetition of the game, help the two players to reach a Pareto equilibrium.

The analysis of bilateral games done until this point is important for two reasons when looking at multilateral cooperation: first, even in basins with more than two riparians bilateral interactions are the most likely[92], and second, these interactions have spill-over effects on

[90] Madani, K. "Game theory and water resources". *Journal of Hydrology*, Vol.381, 2010, 225-238.
[91] *Ibidem*
[92] Conca, K., Wu, F., and Mei, C. "Global regime formation or complex institution building? The principled content of international river agreements". *International Studies Quarterly*, Vol.50, No.2, 2006, 263-285.

other dyads' relations, thus conditioning the actions undertaken by the various riparians especially in complex hydrological systems. However, in river basins with more than two riparians there is the possibility of coalition formation between two or more countries: examples can be identified in the Mekong River Commission formed by all the Mekong riparians apart from upstream China, or the already discussed Nile River Commission initiative. Nevertheless, a coalition can form also on single projects, rather than the establishment of broader and deeper cooperation.

Empirical data suggest that grand coalitions comprising the whole basin are very rare, and even in that case they mostly often need bilateral agreements or multilateral coalitions within[93]. In general, «a set of countries will form a coalition when each country realizes potential gains in forming the coalition that could not be obtained if it were to engage in any alternative coalition possibility.»[94] Thus, a grand coalition may not maximise the potential gains that can be obtained, while a smaller coalition that does not comprise all the players in the basin may do. The reasons why riparians engage in smaller coalitions depend on the transaction costs for cooperation: the higher the number, the lower the compliance monitoring ability and thus the higher the incentives to free ride. Indeed, especially when it comes to large basins with numerous riparians and very different geographic and economic units upbringing different needs and interests, such as the Danube or the Nile, coordinating efforts and comprehensive treaties can be very difficult to achieve and lead instead to conflicts.

1.6 Legal doctrines and the evolution of international law

Taking international law into consideration, today there is no international agreement that has been ratified by enough countries to indicate which legal rules govern transboundary river basins, especially regarding non-navigational uses. Thus, it is necessary to analyse the different legal doctrines that emerged throughout history and if they have become part of the international customary law. Generally speaking, these legal doctrines are placed in a spectrum that goes from absolute national sovereignty on one hand, to the affirmation of the

[93] Just, R. E., and Netanyahu, S. International water resource conflicts: experience and potential. In Just, R. E., and Netanyahu, S. (Eds.), *Conflict and cooperation on trans-boundary water resources* (pp. 61-85). Berlin: Springer Science & Business Media, 1998.
[94] *Ibidem.*

basin as a single unit on the other. All these legal doctrines have originated recently: indeed, for most of history water rights have been related to navigation issues. It is not a case that the oldest river basin commission is the Central Commission for Navigation on the Rhine, which was established during the 1815 Congress of Vienna with the purpose of granting freedom of navigation on the Rhine. An explanation for this development is that overall water resources were not put under serious pressure until the Industrial and the more recent Green Revolutions, which largely increased water consumption due to economic activities and population growth and thus creating the necessity for legislation to regulate non-navigational uses of water. «Obviously, rules relating to navigation, which were well-developed and broadly accepted, could not simply be transplanted to the field of non-navigational uses»[95], so States had to rely on other accepted principles of international law such as sovereignty

A first legal doctrine is the so called "Harmon" doctrine, named after US Attorney General Judson Harmon, who first proposed this legal reasoning in 1895 during a dispute with Mexico over the Rio Grande[96]: according to it, the State has absolute sovereignty on the water resources within its territory, thus meaning that it can undertake any action on them regardless of the effects beyond its borders. This means also that, while can dispose freely of its internal waters, it has no right to demand an uninterrupted flow from upstream countries. Obviously, this doctrine has been advocated by this category of States, such as Turkey[97] and China[98]. Opposed to this legal reasoning there is the "absolute territorial integrity" or "riparian rights" doctrine, which instead states that upstream countries cannot alter the quality and/or quantity of water flowing downstream in order to maintain the «absolute integrity of the watercourse.»[99] Obviously, this doctrine has been advocated by downstream countries, adducing either economic or environmental reasons to justify that claim. However, the symmetric opposition and incompatibility of these claims and counterclaims provides then that none of these will prevail, unless it is supported by outstanding power in the form of military capabilities or other instruments of coercion. Thus, the solution is often found on a

[95] McCaffrey, S. C. "The Harmon doctrine one hundred years later: buried, not praised". *Natural Resources Journal*, 1996, 549-590.
[96] *Ibidem*
[97] Al-Ansari, N., Ali, A., and Knutsson, S. "Present conditions and future challenges of water resources problems in Iraq". *Journal of Water Resource and Protection*, Vol.6, No.12, 2014, 1066-1098.
[98] Nickum, J. E. The upstream superpower: China's international rivers. In O. Varis, C. Torajada, & A. K. Biswas, *Management of transboundary rivers and lakes* (pp. 227-244). Berlin: Springer Science & Business Media, 2008.
[99] Dellapenna, J. W. "The customary international law of transboundary fresh waters". *International Journal of Global Environmental Issues*, Vol.1, 2001, 264-305.

common ground that is the "limited sovereignty" or "equitable use" doctrine: according to this legal reasoning, riparians are entitled of a "fair" share of the basin's waters, defined on a case-by-case basis, in order to satisfy the riparians' needs and maximize their benefits. This is generally coupled with the "no harm" principle, resumed by the Latin maxim *sic utere tuo ut alienam non laedas*, meaning that upstream project should not cause disruption downstream.

The last and most recent doctrine is the "community of interests", which claims that river basins should be considered as single management units regardless of State boundaries, implying that riparians should implement basin-wide development programmes, managing the basin through consultations and cooperation. This principle is being more often included in the international agreements regarding river basin governance and in the national legislations on internal waters.

Codification of international customary law on transboundary waters has not resulted in a global binding regime, but the attempts made to set a "gold standard" for the principles governing transboundary waters has later influenced the drafting of international treaties within the river basins. A first attempt was made by the International Law Association (ILA) with support from the UN, which formulated in 1966 the Helsinki Rules on the Uses of the Waters of International Rivers. The document enshrined equitable use as the paramount principle regulating international treaties, stating in Article IV that «each basin State is entitled, within its territory, to a reasonable and equitable share in the beneficial uses of the waters of an international drainage basin.»[100] However, it does not give a definition of "reasonable and equitable share", but rather enlists in Article V 11 relevant factors to be weighted differently in each particular case: geography, hydrology and climate of the basin, past utilization of the waters, economic needs of the riparians, population dependent on the waters for each State, comparative costs of alternative means of satisfying the economic and social needs of each riparian, availability of other resources, avoidance of unnecessary waste, practicability of compensation to solve and avoid conflicts and degree of satisfaction of the States without causing substantial injury to any. Thus, the Helsinki Rules posed the no harm principle as subordinated to equitable use, seeing harm «as only one factor to be taken into

[100] Helsinki Rules on the Uses of the Waters of International Rivers, 1966

account in determining whether a particular utilization is equitable.»[101] Overall, the Rules were a cautious approach from the ILA because they did not give a clear definition of what equitable use is and did not included those aquifers that are not connected to the drainage basin, a flaw that was integrated 20 years later with the adoption of the Seoul Rules on the Law of International Groundwater Resources, thus extending the Helsinki principles also to all the transboundary aquifers[102].

The Helsinki Rules served as a base for the 1997 UN Convention on the Law of the Non-Navigational Uses of International Watercourses, known as the International Watercourses Convention, whose elaboration started in 1970 when the General Assembly tasked the International Law Commission (ILC) to prepare a draft for the possible articles[103]. The document added to the already established principles the obligation of consultations, prior notification, information exchange and participation (intended as inclusion of all the riparians), while at the same time introducing also the concepts of sustainable development and environmental protection, thus reflecting the developments of international environmental law that took place in those years. Regarding the more controversial points of equitable use and no harm, Article 5 established a tripartite goal of «optimal and sustainable utilization […], considering the interests of the watercourse States concerned, consistent with adequate protection of the watercourse»[104], together with «the right to utilize the watercourse and the duty to cooperate in the protection and development»[105] to all the riparians. Although it was one of the most debated articles, the only additions to the original draft were only the ones regarding environmental protection and the interests of the States concerned, while the criteria defining equitable use established in Article 6 were kept unchanged from the Helsinki Rules. On the no harm principle, Article 7 stated that «States shall […] take all appropriate measures to prevent the causing of significant harm to other watercourse States»[106] and that compensation or mitigation of harm already caused shall be agreed upon negotiations. This provision, being the outcome of a fierce debate, is rather ambiguous because is affecting the

[101] McCaffrey, S. C. "An assessment of the work of the International Law Commission". *Natural Resources Journal*, 1996, 297-318.
[102] Dellapenna, J. W. "The customary international law of transboundary fresh waters". *International Journal of Global Environmental Issues*, Vol.1, 2001, 264-305.
[103] Schroeder-Wildberg, E. "The 1997 International Watercourses Convention–Background and Negotiations". *Working Papers on Management in Environmental Planning*. Berlin: Technical University, 2002.
[104] Convention on the Law of the Non-Navigational Uses of International Watercourses, 1997
[105] *Ibidem*
[106] *Ibidem*

State's sovereignty and leaves large gaps that will be filled by case law, given the fact that, for example, with this wording an underdeveloped upstream country may be see its projects blocked claiming they will cause harm downstream. Moreover, the Convention did not clearly sanction the pre-eminence of equitable use over no harm or vice versa, although the International Court of Justice referred only to equitable use when deciding on the 1997 Gabčíkovo-Nagymaros case[107]. Unfortunately, this is still unique in transboundary waters case law: indeed, most of the disputes brought to the ICJ or other tribunals are related to the demarcation of borders over rivers and navigation rights. The only other cases related to water resources are the 2003 Pulp Mills on the River Uruguay *(Argentina v. Uruguay)* on consultation and prior notification issues[108], the 2013 Indus Waters Kishenganga Arbitration *(Pakistan v. India)*[109], although strictly related to the 1960 Indus Waters Treaty, and the 2016 Dispute over the Status and Use of the Waters of the Silala *(Chile v. Bolivia)* on the recognition of the Silala river as an international watercourse under the UN International Waters Convention, but still under proceeding[110].

Overall, the Convention was approved by the General Assembly with 103 votes in favour, 27 abstention and 3 against: by disaggregating the votes it appears clear that downstream countries mostly voted in favour, while against there were China and Turkey, which was expected given their position in the respective basins, plus the surprise of Burundi. Interesting was instead the group of abstained, which comprised both downstream countries in disagree with the Convention for different reasons (among the others Egypt, Argentina, Azerbaijan, Uzbekistan and Pakistan) and several upstream countries that did not opposed it openly (among the others Israel, Bolivia, Ethiopia and India)[111]. The Convention entered officially into force only in 2014, when Côte d'Ivoire became the 36th Party, but is severely limited by the fact that there is no upstream country among its Parties: the reason for this very low number of ratification resides in its ambiguity, especially in the core Articles 5, 6 and 7. Indeed, if on one hand it helped to reach a compromise and finally approve the document, on

[107] Salman, S. M. "The United Nations Watercourses Convention ten years later: why has its entry into force proven difficult?" *Water International*, Vol.32, No.1, 2007, 1-15.
[108] http://www.icj-cij.org/en/case/135. For selected international water case law see the website of the International Water Law Project: https://www.internationalwaterlaw.org/
[109] https://www.pcacases.com/web/view/20.
[110] http://www.icj-cij.org/en/case/162. Accessed on 07/06/2018
[111] Schroeder-Wildberg, E. "The 1997 International Watercourses Convention–Background and Negotiations". *Working Papers on Management in Environmental Planning*. Berlin: Technical University, 2002.

the other hand this compromise has left no one satisfied. Moreover, the uncertainties generated by this wording pushes the States to rely on more "predictable" sources of law, be they specific agreements within the basin or legal doctrines. Nevertheless, the UN Water Convention has been very influential, being often considered as a benchmark for the drafting of new water treaties or the revision of old ones: the most striking example is probably the South African Development Community (SADC) Water Protocol, which is an almost exact copy of the UN Convention and influenced the pre-existent agreements in the numerous basins of the region[112].

In 2004 the Helsinki Rules have been updated and replaced by the Berlin Rules on Water Resources: the main differences with the previous document are the applicability of the Rules to both national and transboundary water resources, the public participation of persons likely to be affected by decisions concerning the management of waters, the conjunctive and integrated management of surface waters together with other natural resources (e.g. wood), as well as the sustainable management of water and the prevention or minimization of environmental harm[113]. Moreover, the Berlin Rules present a shift within the equitable use doctrine, moving from "sharing" to "managing" the waters in a reasonable and equitable manner: this change can be attributed to the development of water policies, especially in Africa, where agreements have been focused con benefits sharing, rather than water sharing, making cooperation possible even in water scarce environment, although many of them lack the financial capacity to implement these far-sighted agreements. However, the Berlin Rules depart from the Helsinki Rules and the UN Water Convention regarding the relationship between equitable use and no harm: indeed, they seem to pose the two principles on the same level, which creates confusion when applying the norms and has raised dissenting opinions within the ILA[114], without mentioning the sharp contrast with the already mentioned Gabčíkovo-Nagymaros sentence.

The evolution of international water law has progressed through the compromise between claims and counter-claims for absolute rights, either to State sovereignty or territorial integrity. However, the debate is still clustered around the two milder doctrines, that is,

[112] Turton, A. The southern African hydropolitical complex. In O. Varis, C. Torajada, and A. K. Biswas, *Management of transboundary rivers and lakes* (pp. 21-79). Berlin: Springer Science & Business Media, 2008.
[113] Salman, S. M. "The Helsinki Rules, the UN Watercourses Convention and the Berlin Rules: perspectives on international water law". *Water Resources Development*, Vol.23, No.4, 2007, 625-640.
[114] Bourne, C. "Dissenting opinion on the Berlin Rules". *Paper Submitted to the International Law Association*, 2004.

equitable use and no harm, which reflects with good approximation the different position of upstream and downstream countries that surfaced during the drafting and approval of the UN Water Convention. Moreover, the specific natural and political features of the different transboundary river basins characterize the diverse issues arising within them, which hamper the creation of a global regime if not very loose. Thus, it is necessary to analyse treaties at the basin level and look at the different regimes and institutions that has been established there.

1.7 Regimes and institutions for transboundary river management

Given the large differences between the transboundary river basins, the regimes and institutions for water management aim to address particular problems which, in turn, depend on the specific geographical and political context of the basin. However, it is possible to classify the different regimes by their practice of management and their institutionalization, that is, what is the governance of the river basin and if a treaty establishes also a River Basin Organization (RBO), which bodies compose it and which powers are conferred.

Regarding the practices of management, three broad categories can be identified, based on the level of cooperation required[115]: agreements stopping short of formal allocation, agreements allocating water between riparians and agreements for joint management of shared waters. The first category comprises all the agreements that do not go beyond single scopes which require few cooperative efforts, such as freedom of navigation or pollution prevention: they generally do not impose restriction of sovereignty and are thus easier to negotiate and agree *ceteris paribus*. Examples can be the Elbe and the Rhine, whose agreement are indeed limited to navigation and pollution prevention and do not have joint development purposes. The second category comprises the agreements allocating water between States: these are also very narrow agreements in their scope and entail a very limited cooperation, but at the same time impose some restrictions to States' sovereignty. Being these agreements the most controversial, the water allocation quotas are generally a creative solution: they can be specified amounts of waters, a percentage of the river flow or even the division of the tributaries between the riparians. Some may also include seasonal variations,

[115] Kliot, N., Shmueli, D., and Shamir, U. "Institutions for management of transboundary water resources: their nature, characteristics and shortcomings". *Water Policy*, Vol.3, No.3, 2001, 229-255.

depending on the geography of the basin and the States' needs. Nevertheless, this practice entails a simple "pacific coexistence" between the riparians, which is more desirable than conflict, but is still a "divided" rather than joint management. The last category comprises all the other agreements for joint management of shared waters: these follow the community of interests doctrine, managing the basins as single units and thus sharing the costs and benefits for multipurpose projects. Moreover, they also always include provisions for peaceful dispute settlement.

For what regards the institutionalization of these practices, there is still not a clear definition for RBOs, although they are widely promoted by international organization and NGOs[116]: Hooper defines RBOs as «societal [entities] created to manage, develop or monitor natural water resources in a large watershed»[117], without clearly outlining the types of social entities he refers to and how they differ from other institutions; the Global Water Partnership, an international institution promoting RBOs, refers to RBOs as «umbrella organisations for basin management […] on basin-wide water issues»[118]; Ines Dombrowsky defines RBOs as «institutions, […] humanly devised rules that constrain human interaction, including the rules that constitute organizations»[119], failing to differentiate the specifics of RBOs as opposed to other institutions and international water treaties; Gerlak and Grant regard RBOs simply as cooperative institutional arrangements, «defined as a permanent organizational structure established by riparian states with the intended purpose of promoting cooperation and dialogue around an international river»[120]; more recently, in an attempt to capture their legal and political nature within the international system, Susanne Schmeier defines RBOs as «institutions that provide a set of institutionalized principles, norms, rules and river basin mechanisms around which actors' expectations converge in the issue area of water resources governance.»[121]

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[116] Cosgrove, W., and Rijsberman, F. *World water vision: Making water everybody's business*. London: Earthscan, 2000.
[117] Hooper, B. "Key performance indicators of river basin organizations". *Research paper 2006-VSP-01*. US Army Corps of Engineers Visiting Scholar Program, 2006.
[118] Global Water Partnership (GWP). *The handbook for integrated water resources management in basins*. 2009, p. 33. Link: http://www.unwater.org/downloads/gwp_inbo%20handbook%20for%20iwrm%20in%20basins_eng.pdf.
[119] Dombrowsky, I. *Conflict, cooperation and institutions in international water management: An economic analysis*. Cheltenham: Edward Elgar Publishing, 2009, p. 2.
[120] Gerlak, A., and Grant, K. The correlates of cooperative institutions for international rivers. In T. J. Volgy, Z. Šabič, P. Roter, *et al*. (Eds.), *Mapping the New world order* (pp. 114–147). Oxford: Wiley, 2009.
[121] Schmeier, S. *Governing international watercourses: river basin organizations and the sustainable governance of internationally shared rivers and lakes*. London: Routledge, 2013, p. 23.

This last definition has been later enlarged and deepened, bringing to the foundation of a theoretical conceptualization of RBOs, which will be employed in this study, that defines them as «institutionalized forms of cooperation that are based on binding international agreements covering the geographically defined area of transboundary river or lake basins characterized by principles, norms, rules and governance mechanisms.»[122] Currently, of the potential 124 RBOs, 81 fulfil all the criteria required by the definition[123], while the others are deficient in one or more of them: some are not binding, being just *fora* for water cooperation, some have a regional, rather than a basin focus or are related only indirectly to water, others lack a necessary institutionalization or simply has stopped to function, etc.

RBOs also broadly vary regarding their organizational setup and governance mechanisms, including membership, functional scope, institutionalization, organizational structure, financing, decision making, information management, dispute resolution and stakeholder involvement[124]. Apart from RBOs in basins with only two countries, which are inclusive by definition, they can include all the riparians or exclude some, relevant or not relevant, being this a possible indicator for the difficulty and the effectiveness of cooperation. The issues addressed are specific for every basin, so the RBOs may deal with one or few issues specifically related to water resources or focus on a broad number of sectors that are not necessarily interlinked, a feature more typical of the ones implementing IWRM. However, most of RBOs address few interdependent issues such as navigation, environmental protection, water quantity/quality and flood management.

Regarding their institutionalization, RBOs can be equipped with legal personality, establishing them as independent actors in the international system, and be either Authorities, Commissions or Committees, depending on the level of cooperation that the riparians want to achieve: Authorities have more power *vis-à-vis* their member States and generally an independent implementation role, Commissions are the most common type of RBO and are somewhere in between completely independent and intergovernmental bodies, while Committees represent the lowest level of cooperation, having only very limited

[122] Schmeier, S., Gerlak, A. K., and Blumstein, S. "Clearing the muddy waters of shared watercourses governance: conceptualizing international River Basin Organizations". *International Environmental Agreements: Politics, Law and Economics*, Vol.16, No.4, 2016, 597-619.
[123] *Ibidem*
[124] Schmeier, S. "The institutional design of river basin organizations–empirical findings from around the world". *International Journal of River Basin Management*, Vol.13, No.1, 2015, 51-72.

responsibilities. Nevertheless, they generally have a similar threefold setup to take decision and implement them: a high-level decision-making body (Council or Commission) in which member States are represented by the related ministers or Heads of State, an intermediate body (Committee, Expert or Working Group) that operationalizes the political decisions in programmes and activities of the RBO that is composed by technical experts from the government or other institutions, and a Secretariat providing administrative support. This last body has very different responsibilities and functions throughout the RBO population, ranging from the mere provision of administrative and financial services to the execution of full-fledged project implementation activities including their monitoring and reporting or the engagement in scientific research and data analysis and provision. Then, the budget for RBOs is provided mostly by member States, although in the developing world is more common to see a relevant share provided by donors, given the lack of fund to provide for their correct functioning. Moreover, the costs may be shared equally or according to different weights such as the share of the basin's territory, population, GDP or the benefits deriving from the RBO's activities.

Regarding the decision-making mechanisms, nearly half of the RBOs do not specify any, indicating a low level of institutionalization. Among the ones that specify it, most use consensus or unanimity, while just a small number employ majority voting. In the same way, only half of RBOs specify how the information are managed and shared: among these, most collect and disseminate data through the RBO, while a smaller but relevant number rely on bilateral exchange, limiting the role of the institution. Similarly, only half of RBOs are equipped with a dispute resolution mechanism of which three categories can be identified: by the RBO, bilateral or by third party, which in turn can be combined creating a second level of jurisdiction. Most of these mechanisms are however based on bilateral negotiations between the disputing parties, reflecting the overall tendency for bilateral cooperation and the States' reluctance to delegate these issues to external bodies. Lastly, the stakeholder involvement of civil society, NGOs, epistemic communities and other external actors is very limited, granting some obligations of consultation, information sharing or observer status in a very small number of cases. Thus, the interdependence of different actors within and contiguous to the basins is not reflected by the institutional setup, generating some overlap and need for coordination to achieve sustainable development.

Overall, the varying characteristics of RBOs reflect the differences between river basins, although more research is needed to understand the conditions for their creation and their effectiveness, assuming that especially in this case is not possible to develop a one-fits-all model.

1.8 Conclusion

The idea that water is a catalyser for conflicts has been rejected by the first empirical analysis on the interactions between co-riparians. However, the lack of war did not result in high levels of cooperation: most of interactions were mild, although trending towards the cooperative side. Then, it has been found out that there is no overarching legal principle regulating transboundary water management: rather, international water agreements have clustered around either the equitable use or the no harm principle. Most interestingly, the more recent agreements are including at the same time environmental protection duties and affirmation of States' sovereignty, two provisions generally considered as conflicting. Finally, the geographic setup of the basin matters, although border disputes occur because of the water resource and not because of frontier demarcation.

Then, power asymmetries proved to have a primary role in the relations within a basin: a hydro-hegemon will impose, through different tools of power, its preferred regime according to its needs and its position. An upstream hydro-hegemon will act unilaterally, having everything to lose and nothing to gain from cooperation, while for a downstream hydro-hegemon active collaboration with its co-riparians is vital to ensure that water flows in the country. However, while the concept of hydro-hegemony is extremely useful in these cases, the limit of power asymmetries is that they do not give a clear explanation when it comes to basins that lack a hegemon: therefore, in the next chapter the factors enhancing cooperation in this context will be discussed.

Game theory instead gives more specific insights about the interactions between riparians, showing dominant strategies and preferred actions. Moreover, an interconnected game approach seems to solve the dilemmas faced by players, thus maximizing utility for both in games that otherwise would have led to a Nash equilibrium. Moreover, in basins with more than two riparians interactions occur either through bilateral relations or coalition formation.

Nevertheless, stable coalitions encompassing the whole basin are pretty rare, as they generally form over single projects, given the fact that over a certain threshold the transaction costs for maintaining it increase together with incentives for free-riding. Thus, smaller coalition are deemed to be more efficient.

The legal doctrines in international law regarding transboundary water management have evolved as a synthesis between absolute State sovereignty and community of interests: the result is that two principles, equitable use and no harm, have emerged. The codification of these principles in international law has not resulted in the creation of a global regime and it is rather open, as there has been a gradual shift in the hierarchical relation between equitable use and no harm. The 1966 Helsinki Rules put the latter as a subordinate of the former, an order that was confirmed by the ICJ 1997 Gabčíkovo-Nagymaros sentence. However, in the same year the UN Convention on the Law of the Non-Navigational Uses of International Watercourses put them in a very ambiguous form in order to reconcile the upstream/downstream cleavage that emerged in the debate and thus gained the approval from the General Assembly. Then, the more recent 2004 Berlin Rules replace the Helsinki document, putting equitable use and no harm on the same level, thus creating serious confusion in their application and inclusion in international water agreements. Finally, international water law developed itself mostly at the basin level with treaties related to single issues, water allocation or joint management of the basin, reflecting the degree of cooperation between riparians. Then, these agreements have been institutionalized through the creation of RBOs, bodies that preside the water management in the basin. However, the lack of general principles in their establishment, together with the uniqueness of context in most basin has caused them to vary in almost all their possible features. Thus, this and other issues introduced in this chapter will be more deeply analysed in the next chapter, looking at how they improve or hinder cooperation in transboundary river basins.

CHAPTER TWO

MAIN DRIVERS FOR COOPERATION

2.1 Introduction

This chapter analyses the factors that affect cooperation in transboundary river basins employed as independent variables in this study. The importance of these selected variables over others available has been deducted through the literature review and the analysis of the cases.

The first to be analysed is the concept of water scarcity, with the issues regarding its measurement and its relation with conflict and cooperation. Indeed, since water is fundamental for an impressive variety of human activities, any attempt to develop a standard index for its scarcity either excludes some aspects or is so inclusive that it becomes of difficult use in policymaking. Then, the relation between water scarcity and cooperation is not linear or inverse, as it is commonly believed.

The second selected variable is the compatibility of water uses within the basin, defined as the correct sequencing of activities along the stream in a way that upstream uses do not hinder downstream ones. Then, the analysis is enlarged with a critical discussion of principles and implementation of Integrated Water Resource Management (IWRM), considered the best practice to date and the almost the only one advocated by international organizations and donors.

The third variable is the exchange of hydrological data between the riparians, whose effects on long-term cooperation are discussed with other common treaties provision. Moreover, the impact of RBO features on the overall institution effectiveness are discussed as well, completing the analysis started in the previous chapter.

Finally, the other minor factors that may influence cooperation, such as culture, domestic structures and external actors, are discussed, together with the impact of climate change on river basins and the current institutions' resilience. Finally, the criteria for the selection of the case studies is explained, together with the rationale to chose them among the available pool.

2.2 Water scarcity

General water scarcity is an issue arisen only in the last century: indeed, the construction of hydraulic infrastructures by the first civilizations onwards was driven by the need to regulate and stabilize the flow of rivers with a high seasonal variability to provide water for irrigation throughout the whole year and avoid harmful floods that may disrupt the crops. Then, from the fall of the Roman Empire to the end of the Middle Age river engineering did not advance much and agriculture remained the most important use of water[1]. However, the Industrial Revolution brought an enormous change in water use and consumption: factories and mines were mostly located close to rivers, withdrawing increasing amounts of water for their functioning. In turn, these developments generated a demographic and urbanization boom during the 19th century, which increased the domestic use. Finally, to sustain the growing population agricultural production was increased by irrigation improvements and higher withdrawals of water[2]. Thus, these phenomena reinforced each other in an exponential growth that was stopped by the two World Wars and took pace again in the 1950s with the spread in the Third World of industrialization, hydroelectric dams and the Green Revolution, which introduced irrigation on large scale, increasing the water needs for agriculture and sustaining the demographic boom of the time.

[1] Biswas, A. K. *History of Hydrology*. Amsterdam: North-Holland Publishing Companny, 1970, p. 132.
[2] Zanden, J. V. "The first green revolution: the growth of production and productivity in European agriculture, 1870-1914". *The Economic History Review*, Vol.44, No.2, 1991, pp.215-239.

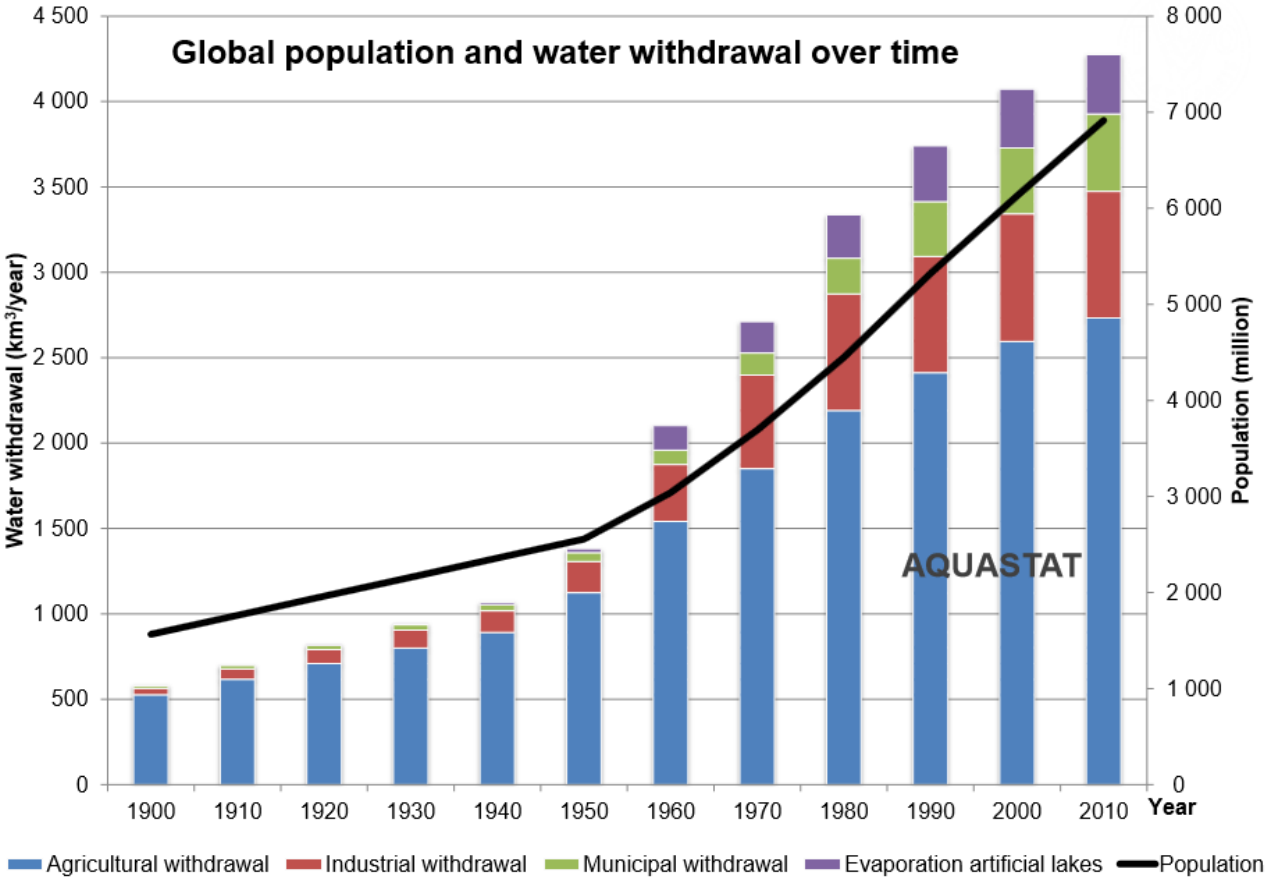


Figure 2.1: Global water withdrawals and population growth, 1900-2010[3].

However, being water a finite resource, there is an upper limit for consumption and degradation beyond which choices about allocation have to be made to rationalize the use and technology has to be improved to move up the limit. The contradiction between finite natural resource and unlimited exponential economic and demographic growth has been scientifically explored as early as the '70s by the Club of Rome with the report on *The Limits to Growth*, which states that

> «There is an upper limit to the fresh water runoff from the land areas of the earth each year, and there is also an exponentially increasing demand for that water. […] It is also possible to avoid or extend these limits by technological advances that remove dependence on the land (synthetic food) or that create new sources of fresh water (desalinization of sea water). […] For the moment it is sufficient to recognize that no new technology is spontaneous or without cost. The factories and raw materials to produce synthetic food, the equipment

[3] Source: FAO AQUASTAT, http://www.fao.org/nr/water/aquastat/water_use/index.stm.

and energy to purify sea water must all come from the physical world system.»[4]

The report however does not take in account, apart from few intuitions on pollution, the effects of climate change on water resources that are evident in the present days. Nevertheless, it clearly shows how economic and population growth will generate a situation of scarcity.

More recently a group of Earth system and environmental scientists, building on the ideas of *The Limits to Growth*, proposed in 2009 a system of nine planetary processes with relative thresholds called "Planetary Boundaries" which, if crossed, «could generate unacceptable environmental change.»[5] Among these, a global freshwater use of 4000Km^3/year has been identified as a threshold, with a consumption of 2600Km^3/year as of 2009[6]. Although the methodology for these calculations is debatable (see footnote), water resources are unevenly distributed in the world, resulting in water scarce and water abundant regions. Thus, the question then is how to define scarcity and if and when it will result in a more cooperative or conflictive environment.

2.2.1 Defining water scarcity

Given the many roles played by water in human activities, a clear and comprehensive definition of water scarcity is still object of debate between scholars. It has to be said, however, that any compression of this multi-faceted and complex concept to a single index is, at best, very reductive. Thus, the indexes exposed and utilized in this work will serve as an approximate indication of the overall state of the art. They can be roughly divided between indexes based on human water requirements and holistic metrics that take in account other aspects such as social capabilities, access to water and the environmental footprint.

The first index to be developed was the "Water Stress Index" or "Falkenmark Indicator", that divides water available, defined by the Mean Annual River Runoff (MARR) as precipitation plus inflows minus evaporation and outflows, over population in a year, so

[4] Meadows, D. H., Meadows, D. L., Randers, J. *et al*. *The limits to growth*. New York: Universe Books, 1972, pp.53-54.
[5] Rockström, J., Steffen, W., Noone, K. *et al*. "A safe operating space for humanity". *Nature*, Vol.461, No.7263, 2009, 472-475.
[6] *Ibidem.* These numbers account only for "Blue water" (surface and groundwater) consumption and must not be confused with FAO AQUASTAT numbers, which also include "Green water" (from precipitations) and account for the water withdrawals instead, thus for both consumptive and non-consumptive use (accounting for more than 4000Km^3/year). Moreover, withdrawn water is mostly often degraded when returned to the source.

m^3/capita/year[7]. Then, given this measure, thresholds are identified for "No Stress" (>1.700 m^3/capita/year), "Stress" (1.000-1.700 m^3/capita/year), "Scarcity" (500-1000 m^3/capita/year) and "Absolute Scarcity" (<500 m^3/capita/year)[8]. Then, a benchmark indicator of 1000m^3/capita/year has been set as the minimum required for a developed country[9]. However, it has to be noted that water requirements highly vary depending on climate, development, culture, etc. and indeed these thresholds have been established using Israel, an industrialized country in a semi-arid region with sophisticated water management that had 500m^3/capita/year, as a reference point[10]. Moreover, it does not reflect inter-seasonal and inter-annual variability, which heavily influence water availability in many basins. Overall, it is a very simple index to understand and helps in differentiating climate and man-made scarcity. Nevertheless, the Water Stress Index has been globally adopted without almost any critical discussion, underscoring the flaws coming from such simplistic indicator[11]. Another indicator based on human water requirements is the "Water Resource Vulnerability Index", known also as the "Withdrawal to Availability" ratio (WTA), that is the ratio of water withdrawn for domestic, industrial and agricultural use divided by the MARR, showing how much of the renewable water supply is actually withdrawn. Then, a country is considered scarce if its WTA is higher than 0,4, meaning that more than 40% of the annual renewable supply has been withdrawn[12].

These first reflections on water scarcity brought to the introduction of the concept of "virtual water", that is, the water used for the production of traded goods (mostly agricultural, as this sector accounts for most of the withdrawals): in this way, water poor countries can import water from water rich countries in the form of foodstuffs, thus avoiding the cost of mobilizing internal water to produce it and mitigating the water deficit. This practice then produces a net water saving in the world system, but however, there are several problems arising. First, it is very difficult to exactly quantify the amount of water required, as it depends

[7] Falkenmark, M. "The massive water scarcity now threatening Africa: why isn't it being addressed?". *Ambio*, Vol.18, No.2, 1989, 112-118.
[8] *Ibidem.*
[9] Gleick, P. H. "Basic water requirements for human activities: Meeting basic needs". *Water International*, Vol.21, No.2, 1996, 83-92.
[10] Falkenmark, M., and Widstrand, C. "Population and water resources: a delicate balance". *Population bulletin*, Vol. 47, No.3, 1992, 1-36.
[11] Damkjaer, S., and Taylor, R. "The measurement of water scarcity: Defining a meaningful indicator". *Ambio*, Vol.46, No.5, 2017, 513–531.
[12] Brown, A., and Matlock, M. D. "A review of water scarcity indices and methodologies". *White paper No.106*, 2011.

on the type of crop, climate and technology: although some calculations have been made by Arjen Hoekstra[13], they are not sufficient to have a comprehensive assessment on virtual water trade because the larger the country, the more distorted is average water requirement given the higher variation in the abovementioned factors that influence it. Second, higher water availability is not directly related with higher agricultural production and food self-sufficiency, as many water rich countries such as Nepal may lack the arable land necessary for it. Indeed, «virtual water often flows out of "water-poor" but "land-rich" countries to "water-rich", but "land-poor" countries.»[14] Thus, the overall compensation in the world water system does not really take place, although water availability remains an upper limit in certain cases. Then, «decisions regarding crop production and marketing would be influenced by public policy regarding the economy, international trade and the prices of inputs and outputs»[15], without considering that the saved water may not be available for other use, thus moving away from the comparative advantages that should characterize virtual water trade. Thus, even though it can be an instrument to assess water scarcity, virtual water trade does not represent the solution for it because is not the most important constraint for food production and there are other uses that characterize and are influenced by water scarcity.

In order to put together the many aspects of water, different holistic indexes have been developed going beyond the just physical amount available at country or per capita level. The WSI has been integrated with the UNDP Human Development Index (HDI) to consider how economy, technology and other means affect the overall water availability in a region, thus generating a "Social Water Stress Index" that measures also the adaptive capacity of a society[16]. Another addition made to the WSI has been the subtraction from the MARR of the "environmental water requirement" (EWR) that is the percentage of river runoff that should be reserved for environmental purposes[17], thus decreasing the overall water available for withdrawals. However, this index starts from the untrue assumption that water is firstly allocated to the environment (e.g. ecosystem preservation), but on the other hand adds the

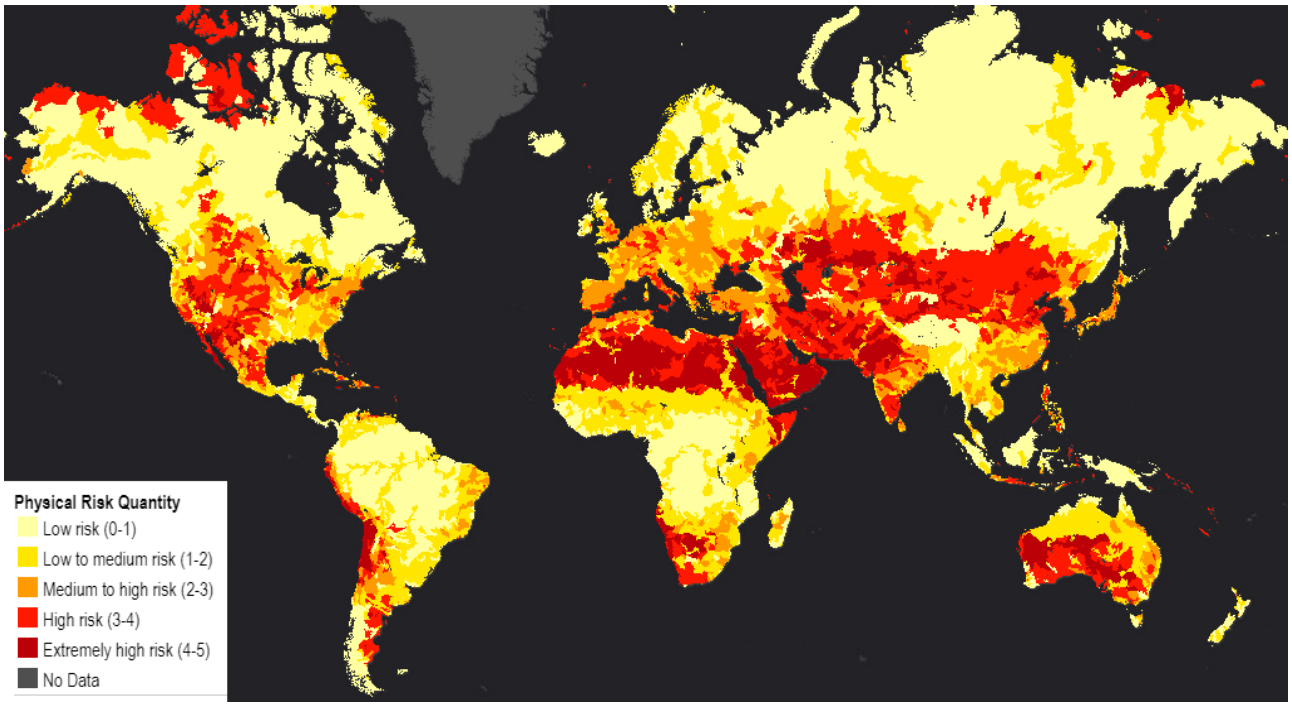
[13] Hoekstra, A. Y., and Hung, P. Q. "Virtual water trade. A quantification of virtual water flows between nations in relation to international crop trade". *IHE Delft Value of water research report series*, No.11, 2002.
[14] Kumar, M. D., and Singh, O. P. "Virtual water in global food and water policy making: is there a need for rethinking?" *Water Resources Management*, Vol.19, No.6, 2005, 759-789.
[15] *Ibidem.*
[16] Ohlsson, L. "Water conflicts and social resource scarcity". *Physics and Chemistry of the Earth, Part B: Hydrology, Oceans and Atmosphere*, Vol.*25, No.*3, 2000, 213-220.
[17] Brown, A., and Matlock, M. D. "A review of water scarcity indices and methodologies". *White paper No.106*, 2011.

costs of environmental services to the global water requirements. Despite these first attempts to include other aspects in the measurement of water scarcity, none of them has moved beyond the idea that it is only related to the amount available: instead, scarcity can depend also on the access to the resource or its quality, as there are thresholds for the presence of salts and other substances above which it is no more suitable for irrigation or drinking unless it gets purified first. Thus, a Water Poverty Index has been elaborated based on five parameters composed by several other subcomponents: physical resource availability (internal resources and external inflows), access to water (percentage of population with access to safe water, percentage of population with access to sanitation and an index that relates irrigated land to internal resources), capacity to manage water (GDP per capita adjusted for the PPP, under-5 mortality rate, UNDP Education Index and the Gini coefficient), different uses of water (yearly domestic, industrial and agricultural use per capita) and the environment (water quality, pollution, environmental regulation, informational capacity and biodiversity)[18]. Notwithstanding the ambition of such complex indicator, the reduction of all the aspects overlooked to a single number is too simplistic and it is more useful to consider the disaggregated parameters to understand which factors contribute to water scarcity (or poverty) in a specific context.

The debate over the measurement of water scarcity is still not concluded: a complete definition, encompassing all the complexities reflected by this concept and obtaining consensus from the scientific and policy-making communities, is far to be developed. Thus, for the scope of this study several indexes will be employed, in order to obtain from data the most precise picture of the water resources in the basins: more specifically, four aspects of water will be looked at, namely physical availability, quality, access to water and socioeconomic capacity to manage. Regarding physical availability, the "Physical Risk Quantity" component of the World Resources Institute's Aqueduct Water Risk Atlas[19] has been chosen and a GIS file produced by WRI has been used to show the spatial distribution of scarcity in the basins analysed. This indicator of physical risk is based on five parameters: baseline water stress (ratio of annual water withdrawals to an annual 1950-2010 average blue water supply), inter-annual variability (variation in natural water supply between years),

[18] Lawrence, P. R., Meigh, J., and Sullivan, C. "The water poverty index: an international comparison". *Keele Economics Research Papers*, No.19, 2002.
[19] See the project homepage: http://www.wri.org/our-work/project/aqueduct/

seasonal variability (monthly variation in natural water supply), flood occurrence (number of floods occurred between 1985 and 2011), drought severity (mean severity of drought events from 1901 to 2008), upstream storage (ratio of upstream and within-basin storage capacity to annual blue water supply) and groundwater stress (ratio of groundwater withdrawal relative to its sustainable recharge rate over a given aquifer)[20]. The index however shows only the overall water availability, but not water demand and consumption, which will be analysed case by case, or technology and water management, which will be observed through the "access to water" and "capacity to manage water" parameters of the WPI.



Map 2.1: Global physical water risk[21].

Regarding water quality, the difficulties on data collection, especially for underdeveloped and developing countries, have hampered the efforts for a global country-level assessment on water quality. Thus, the only global index available, calculated for every country, is the Water Quality Index (WATQI) developed as a component of the Environmental Performance Index (EPI) from Yale University. It considers dissolved oxygen, electrical conductivity, pH, total

[20] Gassert, F., Luck, M., Landis, M. *et al*. "Aqueduct global maps 2.1: Constructing decision-relevant global water risk indicators". *World Resources Institute Working Paper*, 2014, available at: http://www.wri.org/publication/aqueduct-global-maps-21-indicators.

[21] Source: http://www.wri.org/applications/maps/aqueduct-atlas/#x=-170.94&y=3.57&s=ws!20!28!c&t=waterrisk&w=def&g=1&i=BWS-16!WSV-4!SV-2!HFO-4!DRO-4!STOR-8!GW-8!WRI-0!ECOS-0!MC-0!WCG-0!ECOV-0!&tr=ind-1!prj-1&l=2&b=national-geographic&m=group

phosphorus and total nitrogen, with a hot-deck imputation for missing data[22]. Thus, it will be used to have an approximation of the overall water quality in the basins: countries with values under 60 will be considered as having heavily degraded water resources.

Having defined the metrics employed to measure and understand water scarcity, its role as a driver for conflict and/or cooperation needs to be explored.

2.2.2 The scarcity-cooperation nexus

The link between water scarcity and conflict is not as obvious as it may have appeared to the public opinion. Indeed, it can be either the direct or indirect cause of conflicts: they may arise with access to water or diversion projects as the main goal, or the lack of water may cause migration, being the deep root for a conflict in another region, or reinforce latent fundamentalist or nationalist movements, thus causing indirectly an ethnic or religious conflict. Moreover, it intertwines with other factors, making it difficult to assess how much water scarcity has contributed to the eruption of the conflict: this has been recognized as the biggest limit for qualitative research[23], but at the same time make quantitative analysis irrelevant, as correlation does not correspond with causation.

Then, it is needed to distinguish between intra-national or transnational and international conflicts, considering their scale and the role of the States: indeed, the formers are more frequent and easier to detonate, being circumscribed in their local (internal or transboundary) realities and implying the use of unsophisticated weaponry that generally does not include heavy equipment or explosives. On the other hand, the destructive potential of the States is such that, especially in more recent times, they tend to avoid direct confrontation. Moreover, institutions provide means to prevent or resolve conflict, both at the international and national level: it is not a case that almost all of the non-State conflicts over water took place in institutionally weak regions[24]. Thus, the focus of this study will be only at the State level.

[22] Srebotnjak, T., Carr, G., de Sherbinin, A. *et al.* "A global Water Quality Index and hot-deck imputation of missing data". *Ecological Indicators*, Vol.17, 2012, 108-119.
[23] Homer-Dixon, T. F. "Environmental scarcities and violent conflict: evidence from cases". *International security*, Vol.19, No.1, 1994, 5-40.
[24] According to the Pacific Institute Water Conflict Chronology, of the 224 conflictive events triggered by water in history, 106 have taken place in Africa (of which 83 in the sub-Saharan region) and 99 in Asia (of which 39 in the southern region).

Despite a very low record of State conflict over water, it is important to understand which relations they have with water scarcity and if it is the main cause of disputes: according to a large-N study, «river claims seem to be more likely both to begin and to become militarized where water is scarce and where the demand for water is high.»[25] Given this correlation, the study also suggests that «militarization of a claim is more likely when the subject of the claim is considered more salient or valuable to the claimants»[26]: thus, given the importance of water for human life and activities, it is more likely that, when is extremely scarce, States will fight over it. On the other hand, the historical record has showed a major tendency towards cooperation, even in scarce regions. An explanation for this phenomenon can be found by looking the level of scarcity, meaning that in order to observe cooperation water should not be depleted to an extent that few or no benefits can be gained from sharing it. On the other hand, when water is abundant, there is no need for regulating or sharing it and conflicts may arise only around issues not related with water consumption such as navigation or border demarcation: as the history of water use has showed, it was only when it became moderately scarce that agreements for sharing it started to be signed. Thus, «the scarcity-cooperation relationship should, then, follow an inverted U-shaped curve»[27], having the probability of cooperation in a direct relation to scarcity until a threshold over which the relation becomes inverse. However, this relationship varies with the type of scarcity: if it is sharper for cooperation over water quantity, it is not when it comes to water quality or other uses. Shlomi Dinar has identified quantity, hydropower, flood control and pollution, stating that for the last three «the right side of the scarcity-cooperation continuum may not curve downwards as sharply because such issues are not subject to the same fixed characteristics as water quantity stocks.»[28]

[25] Hensel, P. R., and Brochmann, M. "Armed conflict over international rivers: The onset and militarization of river claims". In *Annual Meeting of the International Studies Association*, 2007.
[26] *Ibidem.*
[27] Dinar, S. "Scarcity and cooperation along international rivers". *Global Environmental Politics*, Vol.9, No.1, 2009, 109-135.
[28] *Ibidem.*

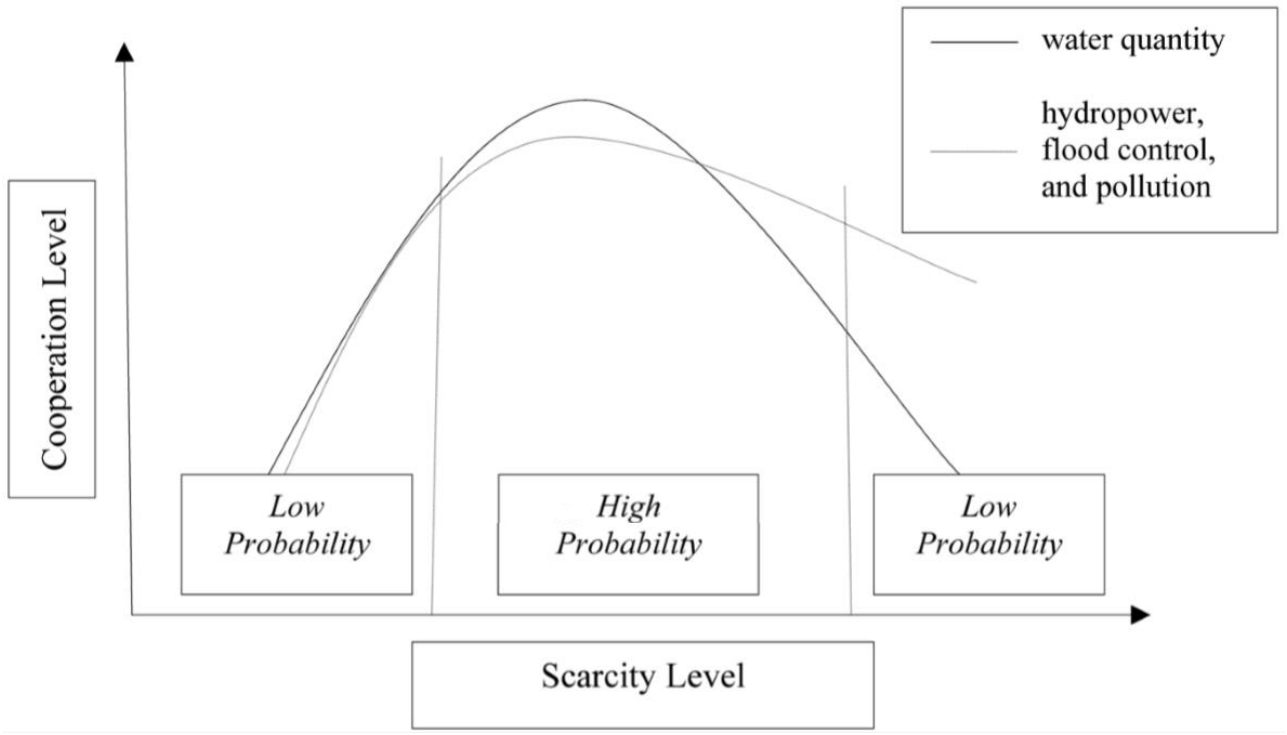


Figure 2.2: The scarcity-cooperation nexus[29].

Although it holds true for water quantity, the analysis of the relation between cooperation and different water uses should be deepened by further research, as for example hydropower generation depends on the water level of the reservoir to determine how much electricity is produced and therefore is affected by water quantity. Nevertheless, these scarcities are mostly often interlinked, therefore a decoupled analysis of their different relationship with cooperation may not be enough.

2.3 Water uses and their compatibility

Water is an extremely versatile resource for a very wide range of human activities, from drinking and domestic use to agriculture, electricity production and cooling of factories and power plants. However, all these uses are not always compatible, meaning that for a given amount of water there is a trade-off between the different possible utilizations that need also to be rightfully sequenced, because a certain use upstream may inhibit another one downstream.

[29] *Ibidem.*

First, water uses have to be distinguished between water withdrawal and consumption: while the former is just water removed from the source, the latter is the share of water lost because it evaporated, embedded in plants or goods, or consumed by people and livestock. Thus, the water that is not consumed is the return flow, although it is generally altered in its temperature and composition. This should not be underscored, as it may have harmful effects on the ecosystems nearby because an increase of one or two degrees destabilizes the fragile aquatic environment. To this non-consumptive use category belong wastewater discharge (from municipal, industrial or agricultural use), cooling for factories and power plants. To the consumptive use category instead belong irrigation, livestock, industrial production employing water as an input, municipal use for drinking and hydroelectric production because of the reservoir evaporation.

Then, timing and sequencing for these different uses should be analysed. Upstream wastewater discharges are not compatible with downstream irrigation, livestock and drinking uses, unless it is first purified. At the same time, water releases from upstream reservoirs for hydropower generation should also take in account irrigation needs to avoid waterlogging or crop destruction because of lack of water: indeed, the electricity production mostly needed during winter clashes with the water requirements for summer irrigation. Moreover, hydropower generation is best suitable on mountains, exploiting natural waterfalls, otherwise the costs for building and maintenance will greatly increase: costly structures like the Aswan High Dam and the Mosul Dam can be only justified by the downstream position of both Egypt and Iraq and by the difficulties faced in achieving basin-wide cooperation. Thus, the distribution and compatibility of the economic activities along the stream is important for the establishment of cooperation, as there will be less conflicts around water uses. Moreover, States will be less likely to undertake projects incompatible with their position within the basin, being less costly to reach an agreement with its co-riparians. Therefore, the more a basin is rationally organized in its water uses along the stream, the more likely cooperation is, given the fact that conflicts arise around specific economic activities utilizing water. Then, it is also necessary to consider how much a certain sector depending on the basin's water has an impact on GDP and employment, making its water allocation more or less costly in political and economic terms. The same reasoning goes for the share of hydropower over the total electricity production and demand growth, making the construction of dams more or less

crucial for the States. Thus, to the compatibility criterion it has to be added the relative importance of these water uses for economies and societies, a factor that can be used as a proxy to predict the willingness of a riparian to give concessions to co-riparians regarding water allocation, pollution abatement etc. by increasing the costs for its own population.

To establish a framework for the rational management of river basins, taking in account all the issues arising around water, the concept of Integrated Water Resources Management (IWRM) has been elaborated: it has been defined as «a process, which promotes the co-ordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystem.»[30] Therefore, the main pillars on which is based are: management of the basin as a single unit, right to access to water, economic efficiency and ecological sustainability[31]. Thus, its implementation relies on the creation of administrative units at the basin level for the development of harmonized plans, but at the same time decentralize the water management through the creation of water users' associations in order to include all the possible stakeholders. Moreover, to enhance economic efficiency all the water services shall be privatized and fees shall be charged to the beneficiaries. Finally, the ecosystem shall be considered a water user in the planning phase of IWRM.

This concept was implemented for the first time in the 1930s with the creation of the Tennessee Valley Authority, which became an agency for the economic development of the region. Then, during the 1990s international advocacy for IWRM brought to its adoption during the 1992 Dublin Conference on Water and Environment[32], which served as preparatory work for the Rio Conference, and successive international meetings. After the 2002 World Summit on Sustainable Development IWRM became a global policy goal, being formally included in the Article 26 of the resulting Plan of Implementation for the final agreement with the specific objective to «develop integrated water resources management and water

[30] GWP *IWRM at a Glance: Technical Advisory Committee*. Stockholm: Global Water Partnership Secretariat, 2000.
[31] Rahaman, M. M., Varis, O., and Kajander, T. "EU water framework directive vs. integrated water resources management: The seven mismatches". *International Journal of Water Resources Development*, Vol.20, No.4, 2004, 565-575.
[32] ICWE *The Dublin statement on water and sustainable development*. Dublin: International Conference on Water and the Environment, 1992.

efficiency plans by 2005.»[33] Thus, IWRM has been considered not only as a one-fits-all model for water management, but also a mean in itself, rather than one of the possible solutions to the different basin-wide problems, also thanks to the fact that almost all international organizations, financial institutions and donors pose IWRM as the conditionality for funding water projects[34]. This holds true especially for the less developed countries in Asia and Africa, being the ones more in need of financial aid. Moreover, the implementation of IWRM is far from resolving their water-related problems, as they may not need the establishment of RBOs, stakeholder associations and privatization of the water sector because they may need, for example, better infrastructure, or they already have functioning management ensured by successful community practices and informal rights that are completely substituted by the IWRM approach[35]. The institutional redundancy also reflects itself in the consideration of the basin as a single unit: while it is rational to manage water holistically in scarce basins with numerous uses, it is an avoidable cost in rich basins where there is no need for water allocation and cooperation revolves around few activities. Then, while there is a focus on the water sector, there is no integration of other economic activities and relative rights (e.g. land), so that the possible gains, if there are any, are highly reduced. In order to solve the water-related problems in a basin, the challenges faced in that specific context must be looked upon, developing relative solutions that do not respond to a political or apolitical universal scheme.

2.4 The effects of treaty design

The signature of treaties over transboundary river basins has always been considered a sufficient indicator for cooperation. However, given the fact that treaties and institutions persist notwithstanding the presence of conflict or may solidify power imbalances within the basin, it is necessary to look at their content in order to understand which institutional factors enhance stable cooperation, which conflict and non-compliance and which are ineffective towards one direction or another. The most important and common provisions that can be included in a water treaty, and thus discussed here, are, monitoring of party compliance,

[33] UN *Plan of implementation of the World Summit on Sustainable Development in Johannesburg, South Africa*, 2002, available at: http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/WSSD_PlanImpl.pdf
[34] Giordano, M., and Shah, T. "From IWRM back to integrated water resources management". *International Journal of Water Resources Development*, Vol.30, No.3, 2014, 364-376.
[35] *Ibidem.*

conflict resolution mechanism, enforcement mechanism, information exchange and the establishment of an RBO. The rationale for their inclusion is that «to overcome collective actions problems, States need an institution to monitor members' activities, make commitments more credible, sanction defectors, establish the focal points for coordination, lower transaction costs, and gather information.»[36] Then, an effective institution is able to peacefully resolve disputes between its members and improve cooperation among them in the long term, although it can also vary[37]. Thus, the more effective provisions are the ones that grant a more stable cooperation in the long term.

In water treaties, monitoring is «the ability to travel throughout the river system to gather pertinent information on member State's activities»[38], in order to assess the accuracy of exchanged data and compliance with commitments over infrastructural and maintenance works, thus reducing uncertainties on the others' intention and favouring a more cooperative spirit. Conflict resolution mechanisms impact conflict reduction by granting a formal path towards a peaceful resolution of the disputes that, inevitably, arise in a basin: indeed, the lack of a set procedure for the negotiation of a settlement to such disputes allows States to make use of whatever mean they mean they may consider appropriate, including force. By following the proceedings established by a treaty, the range of actions allowed to the States, is greatly reduced. Regarding enforcement mechanisms, they improve compliance by reducing States' incentives to cheat through compensation for the harmed party, together with the reputational loss for the free-rider that increases his costs for future cooperation. The exchange of hydrological data helps to build reciprocal trust between the riparians: the downstream country needs information over precipitations upstream in order to put in place the right policies to mitigate floods and droughts, as well as data on water discharge to operate hydroelectric dams. Moreover, when hydrological data are considered a State secret, as in the cases of Israel and China, it is very unlikely to observe cooperation. Regarding the establishment of an RBO, they serve as an institutionalized form of direct communication between the riparians to correctly manage the river and coordinate activities. Moreover, they

[36] Mitchell, S. M., and Zawahri, N. A. "The effectiveness of treaty design in addressing water disputes". *Journal of Peace Research*, Vol.52, No.2, 2015, 187-200.
[37] Breitmeier, H., Underdal, A., and Young, O. R. "The effectiveness of international environmental regimes: Comparing and contrasting findings from quantitative research". *International Studies Review*, Vol.13, No.4, 2011, 579-605.
[38] Mitchell, S. M., and Zawahri, N. A. "The effectiveness of treaty design in addressing water disputes". *Journal of Peace Research*, Vol.52, No.2, 2015, 187-200.

help the creation of epistemic communities of scientists, engineers and water professionals that provide the needed expertise for the river management. However, given the high variability in almost all their organizational and functional features, they need to be discussed more in detail. To be effective they shall include all the relevant riparians, although some short-term management efficiency can be achieved with a smaller number of members[39]. The same trade-off goes with the functional scope, as single issues are easier to manage, but in the long run RBOs should be able to tackle all the challenges that will present, so a loose integrated management is needed at least[40]. On their institutionalization, that is, their autonomy and legal power *vis-à-vis* the members, no research exists, although it is arguably that a high degree improves the overall effectiveness, making the RBO more able to carry its tasks and tackle eventual new challenges. Then, their organizational bodies shall be differentiated accordingly to the functional scope: overall, a threefold setup, composed by a decision making, an operationalizing and a secretariat body is considered to be adequate, with the possibility to add other bodies dealing with the specific needs of the basin, always considering the possibility of an overburdening bureaucracy or a lack of coordination[41]. Among these, the Secretariat plays a pivotal role in enhancing the RBO effectiveness «by fulfilling functions such as agenda-setting, organisation of decision-making processes, coordination of project development and implementation, data and information management, monitoring or the provision of knowledge.»[42] Regarding the decision-making process, there is a trade-of between majority rules and consensus: if the former grants more efficiency for problem-solving, the latter, the most common within RBOs, ensures long-term compliance for the members.

Thus, although there is a consensus among scholars over RBOs as the most effective provision to guarantee long-term cooperation, together with conflict resolution mechanisms and institutional capacity to absorb changes[43], they must be looked upon, as it does not hold true that the establishment of an RBO grants efficient cooperation by default. Moreover, a quantitative analysis of the discussed treaty provisions has showed that information exchange

[39] Schmeier, S. "Navigating cooperation beyond the absence of conflict: mapping determinants for the effectiveness of river basin organisations". *International Journal of Sustainable Society*, Vol.4, No.1-2, 2012, 11-27.
[40] *Ibidem.*
[41] *Ibidem.*
[42] *Ibidem.*
[43] De Stefano, L., Duncan, J., Dinar, S. *et al.* "Climate change and the institutional resilience of international river basins". *Journal of Peace Research*, Vol.49, No.1, 2012, 193-209.

is the most effective in ensuring long term cooperation: indeed, it is the fundamental step to be undertaken before any kind of coordinated or joint activity is initiated within the basin, without which cooperation is not possible. Even for the basic functioning of an RBO, the exchange of hydrological data is vital. Regarding the other features, enforcement mechanisms are also very effective in ensuring cooperation, although they are not common in water treaties[44]. Monitoring and conflict resolution mechanisms have, instead, little or no effect, while RBOs facilitate both peaceful negotiations and militarized disputes[45]: this can be explained by the above-mentioned differences in many aspects from RBO to RBO.

2.5 Other factors influencing cooperation

Although the drivers for cooperation discussed above are considered, in this study, the most important for cooperation, the complexity of the interactions around transboundary river basins makes mandatory to analyse several other secondary factors that influence the relations between co-riparians.

Besides structural water scarcity, the occurrence of droughts seems to confirm the Oregon School thesis that point to scarcity as a driver for cooperation: indeed, countries experiencing transboundary droughts within the basin are more likely to reach an agreement on water issues[46]. The reasons why States do cooperate in case of droughts are: first, the fact that this scarcity is occasional and not structural, therefore is treated as a natural disaster; second, populations and governments are more willing to accept second-best negotiations outcomes in time of crisis and third, countries are more interested in cooperation when they both face scarcity, making the drought mitigation a collective action problem[47].

Moving to non-water related factors, the Oregon School argues that «the higher the per capita GDP, or the lower the population density, the greater cooperation»[48], but the relation between these factors is rather weak. Nevertheless, basins with low population density are

[44] Tir, J., and Stinnett, D. M. "The institutional design of riparian treaties: the role of river issues". *Journal of Conflict Resolution*, Vol.55, No.), 2011, 606-631.
[45] Mitchell, S. M., and Zawahri, N. A. "The effectiveness of treaty design in addressing water disputes". *Journal of Peace Research*, Vol.52, No.2, 2015, 187-200.
[46] Hamner, J. "Drought and Hydro-Cooperation". *Paper presented at the 2009 Annual Meeting of International Studies Association*, 15-18 February 2009.
[47] *Ibidem.*
[48] Wolf, A. T., Yoffe, S. B., and Giordano, M. "International waters: identifying basins at risk". *Water policy*, Vol.5, No.1, 2003, 29-60.

more likely to experience cooperation since they do not really have an economically value for which disputes can occur. Regarding per capita GDP, this can be used as a proxy for economic integration, considering that highly politically and/or economically integrated region can overcome eventual obstacles towards cooperation and integrate reluctant States, not to mention the influence that they can have in neighbouring areas. Regarding integration, regional organizations deserve a special mention: this is the case of the EU and the SADC, which have developed their own regional water policy: the EU 2000 Water Framework Directive established binding requirements for the management of transboundary rivers for all EU members, and many non-EU members in the region comply as well with it, meaning that there has been a spill-over effect outside the organization. Similarly, the SADC Protocol on Shared Watercourses, adopted in 1995 and revised in 2000, provides binding rules for the management of shared waters and calls for the establishment of RBOs, bringing in reality to a rationalization of the already existing RBOs on a regional level, creating new ones to fill eventual gaps. More broadly, the existing relations between riparians facilitate cooperation, as «the success of the policy in the international arena may depend greatly on the conditions that exist among the basin countries.»[49]

Another factor that may influence cooperation in transboundary river basins in certain cases is the effect that cultural similarities and differences have on the relations between riparians: the more the countries' share the similar culture and values, the easier is to reach a satisfying outcome for all the parties and the more flexible are their negotiating strategies, being able to better strive for compromise[50]. Indeed, culture itself limits the option available for the parties both because of the negotiators' own ideas and the social acceptance of eventual compromises. However, «it appears that culture's effects on international negotiation are least prominent when structural factors are strong; and culture exerts its most powerful effects when structural factors are in remission.»[51] Then, the effect of culture in multilateral negotiations over water cooperation is not as strong as in bilateral ones: the explanation may come by the fact that different cultures tend to be "diluted" as their number at the negotiating table increases, while in the other case there is just a contraposition between two, which helps

[49] LeMarquand, D. G. *International rivers: The politics of cooperation*. Westwater Research Centre, University of British Columbia, 1977.
[50] Faure, G. O., and Rubin, J. Z. "Lessons for Theory and Research". In Faure, G. O., and Rubin, J. Z. (Eds.), *Culture and negotiation: the resolution of water disputes* (pp. 209-216). London: Sage, 1993.
[51] *Ibidem.*

to perceive the relation as antagonistic and better understand absolute and relative advantages. Moreover, the sacredness of water in many cultures (rivers venerated as gods or divinities presiding over water and precipitations) generated a high degree of attention from the public opinions towards water issues, as the fierce opposition to the process of water services privatization in many countries has showed: this has brought to the elaboration of the concept of "water nationalism": the idea is that water is treated like land in early State-building and nation-building processes, being thus "territorialized", meaning that is considered integral part of the territory defined by its physical characteristics and the transcendental attachment to it by people, which is indeed at the root of nationalism[52]. Like culture, this factor can be considered relevant only in certain basins: those where State-building and nation-building processes started recently.

Besides culture, the political system and domestic structure are also factors that influence the States' attitude to cooperate on water issues. According to the Kantian theories of democratic peace, countries with democratic governments generally avoid the use of force and look for peaceful solution of disputes, and thus it is assumed that they will also cooperate more successfully. However, the relation between democracy and cooperation is not linear, as one may expect, but it is positive until a certain threshold is reached[53]. Regarding domestic politics, disputes over water can occur within the States as well, intertwining themselves with other societal friction of economic, religious or ethnic nature aggravating them. These internal disputes within the States can be exploited by neighbours to advance their own foreign policy agenda: the clearest example is the support given by Syria to the Kurd PKK in Turkey, aimed at stopping the construction of dams on the Euphrates, which brought in the end to an agreement between Turkey and Syria[54]. Moreover, interest groups and stakeholders within the countries have different agendas on water management and thus cooperation with co-riparians, which means that conflicting claims shall be reconciled before entering in a regime of cooperation. Otherwise, the policies approved in the international arena will lack the

[52] Allouche, J. *Water nationalism: An explanation of the past and present conflicts in Central Asia, the Middle East and the Indian Subcontinent?* PhD Thesis, Institut universitaire de hautes études internationales, Université de Genève, 2004.
[53] Kalbhenn, A. "A river runs through it: democracy, international interlinkages and cooperation over shared resources". Zurich: National Center of Competence in Research (NCCR), *Working Paper No. 35*, 2009.
[54] Elhance, A. P. "Hydropolitics: Grounds for despair, reasons for hope". *International Negotiation*, Vol.5, No.2, 2000, 201-222.

popular support and thus their domestic implementation will be hampered, provoking a loss of credibility for the governing élite in front of both domestic and international public opinion.

Finally, external actors (countries outside the basin, international organizations, financial institutions) can have also an influence in promoting or hindering cooperation. International organizations are rather effective in making riparians reach an agreement even in a conflictive environment, but their mediation power is limited by their ability to provide financial aid and funds for projects in such countries. For examples, the Indus Waters Treaty can be considered a success for the World Bank, but it could not be accomplished without the promises for funds to both India and Pakistan and the mobilization of UNDP[55]. However, as already mentioned, the donors' agenda often differs from the necessities in the basin, so that institutions for cooperation are put in place, but the lack of benefits deriving from them undermines the base for cooperation itself. Moreover, financial aid is a double-edge sword, as the countries receiving it become often dependent from it in order to maintain the bodies for water management, thus creating a vicious circle.

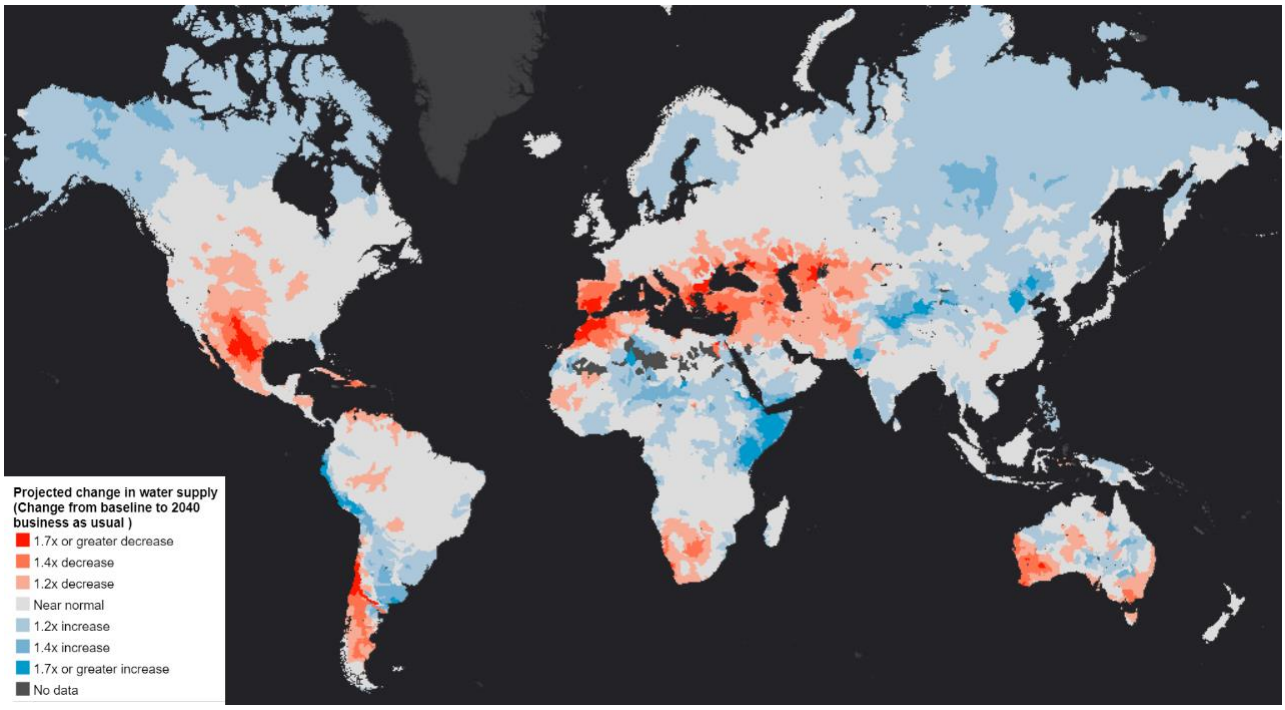
2.6 The impact of climate change in present and future cooperation

Global climate has always changed throughout history, modifying the way humans relate themselves with the environment: variations in the average temperatures and climatic events caused the end of civilizations, migrations and conflicts. The collapse of the Bronze Age the Eastern Mediterranean was caused by a drought followed by frosts that provoked several harvest failures; the centres of power of the three large Western African Empires, Ghana, Mali and Songhai, show a progressive move southward as the Sahara desert was expanding; the Great Migration of Germanic people into the former Western Roman Empire was caused, among other factors, by a sharp cooling of the climate; Greenland was colonized by the Vikings during the Medieval Warm Period, but then abandoned during the Little Ice Age, etc. However, since the Industrial Revolution, humans play an active role in climate change through the emission of carbon dioxide and other pollutants that act on the "natural" variation

[55] Nakayama, M. "Successes and failures of international organizations in dealing with international waters". *International Journal of Water Resources Development*, Vol.13, No.3, 1997, 367-382.

of climate[56]. Thus, the global temperature «has risen from near the coldest to the warmest levels of the Holocene within the past century, reversing the long-term cooling trend that began ca. 5000 years before present»[57], an unprecedented event in the known planetary history that has consecrated the last years as the warmest ever recorded, with a global temperature recently reaching1°C over the preindustrial level[58].

For river basins, climate change brings an important burden of uncertainties: while it is certain that the overall amount of freshwater will decrease in favour of the oceans and vapour steam in the atmosphere, the change in precipitation patterns and periodic events such as the monsoons or El Niño is highly unpredictable. Then, the meltdown of glaciers will increase the flow of rivers fed by them, but at the same put a strain on those countries that rely on snowpack for water storage and reduces drastically the flow during the dry season. A similar problem will be faced by countries that store water in reservoir, as the growing temperatures will increase the loss of water through evaporation.



Map 2.2: Projected change in global water supply by 2040[59].

[56] Qin, D., Chen, Z., Averyt, K. B. *et al*. IPCC, 2007: Summary for Policymakers. In Solomon, S., Qin, D., Manning, M. *et al*. (Eds.), *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press, 2007.
[57] Marcott, S. A., Shakun, J. D., Clark, P. U. *et al*. "A reconstruction of regional and global temperature for the past 11,300 years". *Science*, Vol.339, No.6124, 2013, 1198-1201.
[58] Source: http://climateanalytics.org/briefings/global-warming-reaches-1c-above-preindustrial-warmest-in-more-than-11000-years.html
[59] Source: http://www.wri.org/applications/maps/aqueduct-atlas/#x=9.41&y=2.44&s=bt!40!28!c&t=waterrisk&w=def&g=0&i=BWS-16!WSV-4!SV-2!HFO-4!DRO-4!STOR-8!GW-8!WRI-4!ECOS-2!MC-4!WCG-8!ECOV-2!&tr=ind-1!prj-1&l=2&b=national-geographic&m=projected

Thus, some regions will become more arid while others will become wetter, with an increase in frequency and severity of extreme events such as droughts and floods.

The ability of river basins to adapt to such changes and avoid conflicts over water relies on the capacity to absorb them by the institutions dealing with water management. The most pressing issue in this respect is that the regions that are the most affected by climate change are also the least capable to tackle this challenge, without considering the fact that the institutions present there are heavily dependent on international funds. Then, river treaties are hard to negotiate and parties will not challenge them unless they consider them unfair, but with the change in flow seasonality and overall water availability this is more likely to happen. Thus, river treaties must allow flexibility in their provisions to face short-term and long-term water shortages: for examples, treaties allocating a percentage of the annual flow, rather than a precise quantity, will be more resilient by allocating proportionally the water available. Then, exchange of hydrological data will become even more important in the next decades, as it is impossible to correctly allocate water, both in terms of fairness between the riparians and to avoid overexploitation, without the exact amount of how much is available and how much is needed for ecosystem preservation. However, resistance to the inclusion of climate change related provisions in existing agreements may come from both the domestic and the international arenas. Regarding the former, redirecting water from one group of stakeholders to another after it was already allocated by another agreement has a very high political cost. Then, these concerns are reflected in the seat of negotiations, which in turn neglect the complexities deriving from climate change.

To solve this puzzle, more basin-level cooperation is needed: water uses and respective allocations should be jointly planned by basin States, reconciling at best the conflicting claims of different stakeholders. Water should be managed holistically, integrating all the economic sectors within the basin, with priorities given to universal access for everyday life needs and environmental services. Donors and international development agencies should remain in the picture in order to finance projects and provide the best available technology, but States, or an empowered authority dealing with water management, should be entitled to decide autonomously from external actors about basin development, with this autonomy being not detrimental for fundraising.

Steps for adaptation in river basin must be promptly taken: since life is unsustainable without water, the survival of these countries, and of the peoples living in there, is at stake. No war has been fought over water, but further degradation of its conditions will increase conflicting episodes over it, at least at the domestic and transnational level, migration and displacement due to floods and droughts: «if future populations respond similarly to past populations, then anthropogenic climate change has the potential to substantially increase conflict around the world, relative to a world without climate change.»[60]

2.7 Case selection

The selection of case studies is always a difficult exercise. The several criteria, according to which they have been chosen, are: transboundary river basin shared by more than two countries, similar number of relevant riparians and lack of a hydro-hegemon. By focusing on multilateral cooperation, all the basins shared by only two States (Indus, Columbia, Rio Bravo) have been excluded. However, in order to limit the influence of the number of riparians over cooperation and better observe their interactions, basins with five or four riparians have been selected. Then, considering the fact that power asymmetries have a prominent role over any other factor and their effect has already been studied, basins comprising a hydro-hegemon (Nile, Tigris-Euphrates, Mekong, etc.) have been excluded as well. Lake systems, such as the Great Lakes have not been considered for the scope of this study, as they present a different kind of collective action problem from rivers. Attention has been given also to data availability, which brought to the exclusion of some basins located in Africa such as the Senegal and Niger due to the absence of many indicators for them.

The four selected case studies conforming to these criteria are the Kura-Araks basin, the Aral Sea basin, the La Plata basin and the Sava basin. In order to avoid selecting on the dependent variable, the four case studies have been equally divided between positive (cooperation) and negative (lack of cooperation) outcomes, to have the largest possible variation in the dependent variable: the Kura-Araks and Aral Sea are those basins where cooperation did not take place, while the La Plata and Sava are those where it did. The

[60] Hsiang, S. M., Burke, M., and Miguel, E. "Quantifying the influence of climate on human conflict". *Science*, Vol.341, No.6151, 2013.

selection of case studies has also tried to balance geographical representation: the Kura-Araks is located in the South Caucasus, the Aral Sea in Central Asia, the La Plata in Latin America and the Sava in the Balkans. While North America has been excluded from this analysis by the fact that all basins are bilateral (Canada-USA or USA-Mexico), the few eligible African basins, such as Niger and Senegal, have been excluded because of the lack of available data on the basins and the countries.

The changes in the independent variables is resumed in the truth table below: the preliminary results suggest that cooperation depends firstly on the physical context, that is, the state of water resources, in terms of quantity and quality, and the organization of economic activities along the river, while lack of cooperation is observed even in a case (the Aral Sea) where an information exchange mechanism is present. Nevertheless, a more detailed analysis of the cases is necessary to understand the relative weight of the independent variable and the presence of eventual intervening variables in specific cases.

Table 2.1: Truth table with independent and dependent variables through cases

	Extreme water scarcity	**Incompatible water uses**	**Information exchange**	**Result**
Kura-Araks	Yes	Yes	No	Non-Cooperation
Aral Sea	Yes	Yes	Yes	Non-Cooperation
La Plata	No	No	Yes	Cooperation
Sava	No	No	Yes	Cooperation

The Kura-Araks is the major basin of the Southern Caucasus, shared by Turkey, Georgia, Armenia, Azerbaijan and Iran. After the breakup of the Soviet Union, the new independent States were not able to establish a cooperative regime. The main problem is the uneven distribution of land and water inputs among the riparians compared to their needs for economic activities. Moreover, the water is heavily polluted by municipal and industrial wastewater discharge from upstream, which affects the reliance of downstream Azerbaijan on the rivers' water for drinking and irrigation. Thus, chronic water scarcity is present within the basin, both in terms of quantity and quality (although it affects mostly the downstream riparians), economic activities along the stream are not compatible and there is no information exchange within the basin.

Similarly, the Aral Sea was also a mostly internal basin of the Soviet Union in Central Asia. Although it is a lake system, what is important are the two rivers that flow into the Aral, the Amu Darya and Syr Darya. The USSR heavily exploited them for cotton monoculture, which led to serious environmental degradation and the almost complete desiccation of the Aral Sea itself. After the collapse of the Soviet Union, the five new republics attempted to cooperate to share the basin's water and save what was left of the lake by entering in several agreements. Nevertheless, the overexploitation of the rivers and the heavy reliance of these countries on the cotton production has made water allocation a very conflictive issue. Moreover, upstream Tajikistan and Kyrgyzstan started to develop irrigation agriculture and hydropower production (not needed during Soviet times due to compensation in form of energy from downstream regions), disrupting the crops in Uzbekistan and Turkmenistan and aggravating the disputes over water allocations. Then, the signed agreements provided for information exchange, but they are falsified by the riparians to gain advantages in negotiations. Thus, chronic water scarcity, distributed in the whole basin both in terms of quality and quantity, incompatibility of water uses between upstream and downstream, and the ineffective information exchange block the potential cooperation between the countries.

The La Plata basin is a large river system located in Latin America, share by Bolivia, Brazil, Uruguay, Paraguay and Argentina. The 1969 La Plata Basin Treaty established the legal framework for the undertaking of bilateral and multilateral cooperation on several projects. Cooperation has taken place mostly in the form of joint hydropower infrastructure development, for example the construction of the Itaipu and Yacyretà dams by Paraguay, Brazil and Argentina. More recently, another important issue is the rivers' navigability, fundamental for landlocked Bolivia and Paraguay, which has to be improved with the Hidrovia project, but raises several concerns about its environmental impacts. Overall, there is no outstanding issue regarding water quantity and quality, economic activities, especially regarding coordination between hydroelectric dams, are rather balanced and an information exchange mechanism has been established.

The Sava river is a sub-basin of the Danube shared by Slovenia, Croatia, Bosnia and Serbia. It has been selected as a proxy for the Danube, having similar conditions but a heavily reduced number of riparians. Moreover, it is a recently internationalized river where cooperation is actually taking place. Soon after the end of the wars in the former Yugoslavia,

the four riparians agreed on the creation of a joint Commission for the river management, mostly focused on navigation and environmental issues. Then, EU legislation has had an important influence as well, as the 2000 Water Framework Directive affected water management in Slovenia and Croatia, thus influencing the practices in Bosnia and Serbia as well, also considering the possibility of a future EU membership. To date, is it the only case of an existent sub-basin Commission, coordinating with the several Danube Commissions.

2.8 Conclusion

The main drivers for cooperation selected as independent variables for this study are water scarcity, compatibility of water uses and exchange of hydrological data.

Regarding water scarcity, it has been defined in both terms of quantity available and quality level through the use of different indexes, namely the "Physical Risk Quantity" component of the World Resources Institute's Aqueduct Water Risk Atlas and the Water Quality Index (WATQI) from the Environmental Performance Index (EPI), plus separate components of the Water Poverty Index (WPI). Then, the relation between water scarcity and cooperation is not linear or inverse as it is believed, but has an inverted U-shaped curve, meaning that the probability for cooperation increases with scarcity until a point where is too scarce to gain any benefit by sharing it. Nevertheless, the various uses are impacted slightly differently by water scarcity, being some of them (e.g. environmental protection) less elastic.

Water uses can be divided in two categories, withdrawals and consumption: while the former return water to the flow, even if it is generally degraded, the latter removes it, embedding it in products or making it available for drinking. Thus, these different uses have to be rationally organized in a way that upstream activities do not harm the ones downstream. Otherwise, disputes may arise questioning the *status quo* in the basin, meaning that there is a linear relation between cooperation and how rationally the activities are distributed along the stream. Moreover, the relative importance of an economic sector for GDP and/or employment tends to exacerbate eventual disputes, as for the States becomes costlier to make concessions and cooperate. Although IWRM has attracted a very wide support from international organization with the belief that it is the optimal solution to balance water uses, it is not a one-

fits-all model, and thus every basin should have its own approach and focus on the problems that need to be resolved.

Regarding the third variable, the exchange of hydrological data is the first fundamental step to gear up cooperation, building trust between the riparians and allowing the correct planning of economic activities, projects and water allocations. On RBOs, the features that mostly impact positively their effectiveness are inclusion, a setup of bodies adequate for the confronted issues in the basin and the role of the Secretariat. Overall, RBOs should have enough flexibility to absorb the changes, both physical and institutional, that take place in basin.

Among secondary factors, droughts appear to have a positive effect on cooperation, being them episodic events, Then, economic and political integration allow riparians to better overcome some of the costs related to cooperation over water issues and even spill-over outside the integrated region, as it is showed by the legislation approved by the EU and the SADC regarding water management. Besides integration, democracies are expected to be more prone towards cooperation. However, interest groups or internal disputes for water may undermine a certain policy by opposing it, with the possibility of receiving support by neighbour countries that pursue their own agenda on water issues. Then, culture appears to play an important role when structural factors have a lower incidence, although its impact is still inversely related by the number of cultures negotiating, as they are diluted among themselves. Nevertheless, cultural similarities make the negotiations smoother thanks to shared values, which is especially helpful in a bilateral context when they tend to have an antagonistic perspective of the other. Similar to culture there is the concept of "water nationalism" that stresses the fact that in the early State-building process water is treated exactly like land, making States of recent formation less prone to cooperation. Finally, external actors have a positive impact on the establishment of cooperation, although it often becomes heavily dependent from international financing and follows the donors' agenda, which may not coincide with the specific needs of the basin.

Regarding climate change, the global temperature increase will reduce the overall amount freshwater available, but while some region will become more arid, other will become wetter. Water storage capacity, either through glaciers or reservoir, will be heavily affected by meltdown or evaporation, increasing seasonal variability and putting a strain on those

countries relying on those methods. Moreover, the frequency and intensities of droughts and floods will increase as well. However, the most affected countries are the least equipped to face these challenges. Thus, they shall be provided with funds and technology transfers, but should be given autonomy to them in order to better address the issues within the basin. Moreover, agreements and institutions must be equipped with enough flexibility to become resilient to changes in climate, water availability and natural disasters.

Finally, the criteria employed for case selection are: transboundary river basin shared by more than two countries, similar number of relevant riparians and lack of a hydro-hegemon. Moreover, the overall number of relevant riparians has been kept at the closest possible across the cases in order to avoid that cooperation is influenced by the amount of countries in the basin. Thus, the selected case studies, which will be analysed in the next chapters, are the Kura-Araks basin, the Aral Sea basin, the La Plata basin and the Sava basin.

CHAPTER THREE

THE KURA-ARAKS BASIN

3.1 Introduction

The Kura-Araks basin is a lesser known case of non-cooperation between riparians, located in the South Caucasus region and shared by Georgia, Armenia, Azerbaijan, Turkey and Iran. Although the last two countries occupy roughly 35% of the basin, the analysis will be focused on the three Caucasian republics, considering the relative weight, in terms of water resources and economic relevance, of the basin area compared to the territory of Turkey and Iran.

The basin presents a serious quantitative water scarcity concentrated mostly in downstream Azerbaijan, coupled with environmental degradation caused by wastewater discharge from both upstream riparians. Thus, it represents a classical externality problem in which however the downstream country is not "bribing" the others to receive more water and monitor its quality. Then, the economic activities are unevenly distributed along the stream, causing an unbalance between land and water factors and the overall organization of the basin.

Besides the overall relations between the riparians during the Soviet and post-Soviet period, there will be a focus on the influence of external actors, namely the EU and NATO, which were indeed providing the tools for water quality and hydrological data exchange that, especially the upstream riparians, did not have the incentives to establish, and indeed stopped soon after the end of the external funding.

In this chapter, a first description of the geography and hydrology of the basin is given, followed by an analysis of the collected empirical data regarding water scarcity and water uses, the first two independent variables related to the physical context in which countries

interact. Then, the analysis proceeds through the institutional developments within the basin in order to verify the presence of information exchange between the riparians, the third independent variable. Finally, a discussion of the empirical analysis in conducted and conclusions are drawn.

3.2 Basin overview

The Kura-Araks is the major river system in the region of South Caucasus and is composed mainly by two rivers and several tributaries fed by snowmelt from the mountains. The Kura river originates in the Kizil-Giadik mountain range in North-eastern Turkey and flows through Southern Georgia, including the capital Tblisi, before entering in Azerbaijan, where it fills into the Semkir, Yenikend and Mingechevir reservoirs and then discharges into the Caspian Sea. Its total length is 1.515 km with an average discharge of 575 million cubic meters per year (MCM/year)[1]. The river flows firstly through a mountainous terrain, cutting a valley between the Small and the Great Caucasus, and then on flat terrain once passed thorugh the Mingechevir reservoir. The Araks river originates in the Erzurum province in North-eastern Turkey and forms the border between Armenia and Turkey, Azerbaijan and Iran where it fills in the Aras Dam reservoir, Armenia and Iran for a short part and again Azerbaijan and Iran, where it passes through two other shared reservoirs, Khoda Afarin and Mil-Mughan, with a third under construction[2], before splitting in two branches, one flowing into the Kura and the other discharging directly into the Caspian Sea. Its total length is 1,072 km with an average discharge of 210 MCM/year[3]. Besides the two main rivers, 10.000 tributaries flow within the basin, of which over 40 are transboundary[4]. The total basin area is 188.000 Km^2, of which Armenia occupies 16%, Azerbaijan 31%, Iran 20%, Georgia 18% and

[1] Beruchashvili, N. L., Shotadze, M., Nikolaishvili, D. A. *et al. Caucasus Environmental Outlook*. Tbilisi: UNEP/GRID, 2002 available at https://wedocs.unep.org/bitstream/handle/20.500.11822/9598/Caucas_Environment_Outlook.pdf?sequence=3&isAllowed=y..

[2] Source: https://www.azernews.az/business/95625.html

[3] Vener, B. B., and Campana, M. E. Conflict and cooperation in the South Caucasus: the Kura-Araks Basin of Armenia, Azerbaijan, and Georgia. In M. Arsel and M. Spoor (Eds.) *Water, Environmental Security and Sustainable Rural Development: Conflict and Cooperation in Central Eurasia* (pp. 144–174). Oxford: Routledge, 2010.

[4] Vener, B.B. *The Kura-Araks Basin: Obstacles and Common Objectives for an Integrated Water Resources Management Model among Armenia, Azerbaijan, and Georgia*. Master of Water Resources Professional Project, Water Resources Program. Albuquerque: University of New Mexico, 2006.

Turkey 15%[5]. Outside the basin is it worth mentioning the Samur river, which originates in Russian territory and flows into the Caspian Sea, forming part of the border with Azerbaijan and providing water to the Apsheron peninsula where the capital Baku lies[6]

Regarding the distribution of water and land factors Table 3.1 and 3.2 show that it is heavily unbalanced, with Georgia having an excess of water compared to its needs and Azerbaijan suffering from a serious deficit. This is also reflected by the withdrawals per capita in the three countries: 635 m^3 for Georgia, 2.151 m^3 for Azerbaijan, and 784 m^3 for Armenia[7].

Table 3.1: Kura-Araks average annual water balance (km^3)[8].

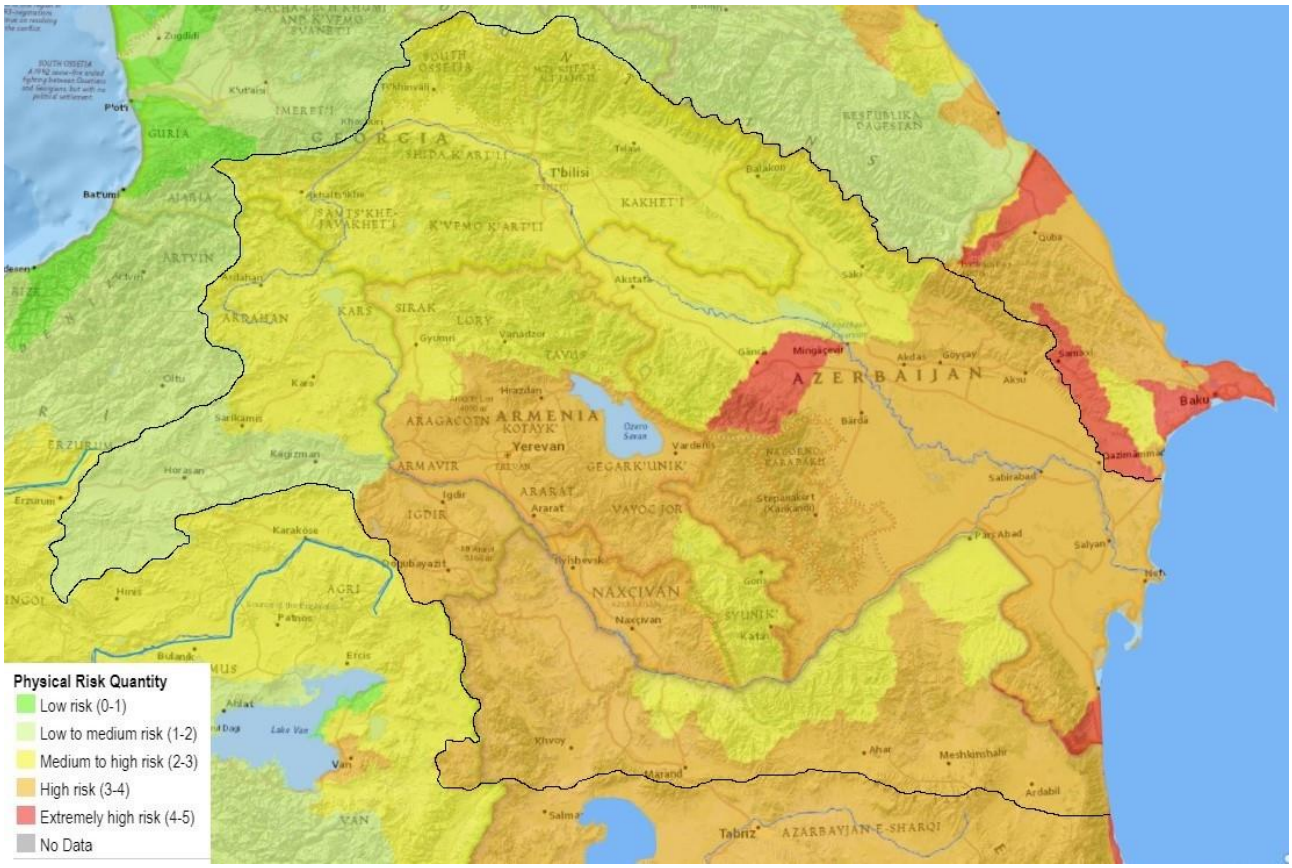
	AR	AZ	GE
Precipitation	18	31	26
Evaporation	(11)	(29)	(13)
River inflow	1	15	1
River outflow	(8)	(18)	(12)
Underground inflow	1	3	1
Underground outflow	(1)	(2)	(3)

Table 3.2: Land use in the Kura-Araks basin (km^2)[9].

	AR	AZ	GE
Land area	29.800	86.600	67.700
Disputed area	1.500	2.000	600
Forested area	4.250	7.590	10.900
Arable land	5.215	16.714	7.813
Pastured land	8.300	20.936	NA
Other	10.091	12.000	NA

[5] *Ibidem*.
[6] Vinogradov, S. "Transboundary water resources in the former Soviet Union: between conflict and cooperation". *Natural Resources Journal*, 1996, 393-415.
[7] Vener, B.B. *The Kura-Araks Basin: Obstacles and Common Objectives for an Integrated Water Resources Management Model among Armenia, Azerbaijan, and Georgia*. Master of Water Resources Professional Project, Water Resources Program. Albuquerque: University of New Mexico, 2006.
[8] *Ibidem,* parentheses indicate depletion.
[9] *Ibidem.*

The spatial distribution of water can be better understood with the map below, showing the map o the basin and its Physical Risk Quantity: while Georgia dwells in a rather fair situation, Armenia and Azerbaijan are under high, especially regarding some zones in the latter. By decomposing the index, it is possible to observe that the baseline water stress for Armenia and Azerbaijan is respectively 3,1 and 3,4, while floods represent the other important source of physical risk with an average score for the whole basin of 3,3[10].



Map 3.1: The Kura-Araks basin and its Physical Risk Quantity[11].

Moreover, the quality of water is heavily degraded: the hot-deck imputation for the WATQI assigns a value of 58,92 to all the three countries[12], although in the Environment component of the WPI Georgia scores 10,9 over 20, while Armenia 9,8[13]. Unfortunately, no computation has been made for Azerbaijan, but its downstream position and previous studies on the basin lead to the assumption that water quality there is lower than in its co-riparians. Moreover, it obtains 70% of its drinking water from the rivers, while Georgia and Armenia

[10] Source: WRI Aqueduct Country and River Basin Rankings, link: https://www.wri.org/applications/maps/aqueduct-country-river-basin-rankings/#x=0.00&y=0.00&l=2&v=home&d=bws&f=0&o=-9999&init=y
[11] Map elaborated with Esri ArcGIS Earth, Physical Risk Quantity layer elaborated by WRI.
[12] Srebotnjak, T., Carr, G., de Sherbinin, A. *et al.* "A global Water Quality Index and hot-deck imputation of missing data". *Ecological Indicators*, Vol.17, 2012, 108-119.
[13] Lawrence, P. R., Meigh, J., and Sullivan, C. "The water poverty index: an international comparison". *Keele Economics Research Papers*, No.19, 2002.

can rely on good quality groundwater stocks[14], meaning that the Kura and Araks are even more important for Azerbaijan.

Regarding the distribution of water uses, Table 3.3 shows the allocation of water for agricultural, industrial and domestic use, the employment and GDP share for the economic sectors and the share of hydropower over the total electricity production.

Table 3.3: Water withdrawals, employment and GDP share by sector and hydropower share over total electricity production, 2005[15].

	AR	AZ	GE
Agriculture water %	66,1	76,4	58,2
Agriculture empl. %	38,7	39,3	54,4
Agriculture GDP %	20,9	9,9	16,7
Industrial water %	4,4	19,3	22,1
Industrial empl. %	17,7	12,6	9.3
Industrial GDP %	41,4	58,5	23,8
Domestic water %	29,5	4,3	19,8
Hydropower %	28,1	13,2	85,8

The data show that, apart from agriculture, both Armenia and Georgia have a considerable share of withdrawals for domestic use, which wastewater is then discharged into the rivers (60% of Georgian and 100% of Armenian[16]). A similar share is withdrawn by Georgia for industrial purposes, while its co-riparians employ less water compared to employment and GDP share. Although agriculture has the lowest impact on Azeri value-added compared to the others, it is very important for the country because it employs almost 40% of the total workforce and it is the most productive due to its larger amount of arable land, that is more than twice as Georgia and more than thrice as Armenia. However, the water reaching these fields is of poor quality and generally not suitable for irrigation. Moreover, the terrain is

[14] Vener, B.B. *The Kura-Araks Basin: Obstacles and Common Objectives for an Integrated Water Resources Management Model among Armenia, Azerbaijan, and Georgia*. Master of Water Resources Professional Project, Water Resources Program. Albuquerque: University of New Mexico, 2006.
[15] Source: World Bank World Development Indicators, link: http://databank.worldbank.org/data/source/world-development-indicators. Data for Armenian shares of water withdrawals are form 2007 because of lack of data.
[16] Vener, B.B. *The Kura-Araks Basin: Obstacles and Common Objectives for an Integrated Water Resources Management Model among Armenia, Azerbaijan, and Georgia*. Master of Water Resources Professional Project, Water Resources Program. Albuquerque: University of New Mexico, 2006.

almost completely flat and an elevation below the sea level, meaning that it is more likely to experience floods that can damage crops and suffers from saltwater intrusion form the Caspian Sea at its estuary[17]. Then, the floods do not originate within the country, but on the many rivers flowing from the Caucasus mountains in Georgia, both by snowmelt and precipitation[18], so that coordination with the upstream riparian is needed for flood management through the numerous Georgian dams on the Kura and its tributaries for hydropower purposes that produce 85% of total electricity.

3.3 Water management during Soviet times and after independence

Before the dissolution of the Soviet Union, the Kura-Araks was a transboundary basin shared by Turkey, Iran and the USSR. By that time, the Kura river was almost completely within the Soviet territory, while the Araks marked most of the border with Iran. In its international relations over transboundary waters, the Soviet Union promoted «a policy of friendly, peaceful cooperation»[19], observing the principle of State sovereignty over water resources «so as not to project the implementation of sovereign rights into tyranny towards other States.»[20] Indeed, several agreements were signed for the joint management of the Kura-Araks and other basins with neighbouring countries. With Turkey, the USSR signed a first protocol in 1927, agreeing on an equal share of the river's water and the establishment of a joint commission to monitor the uses of frontier water[21]; then, successive treaties allowed the joint construction and maintenance of a hydroelectric dam on the Akhurian river[22], a tributary of the Araks forming part of the today Turkish-Armenian border. The last agreement was signed in 1990 on technical cooperation, river bed changes and joint hydropower facilities[23]. All these agreements remained in force after the independence of Armenia and Georgia. With

[17] Mammadov, R., and Verdiyev, R. "Integrated water resources management as basis for flood prevention in the Kura river basin". In *Workshop on Transboundary Flood Risk Management* (pp. 22-23), 2009.
[18] *Ibidem.*
[19] FAO. *Water Law in Selected European Countries, Volume II*. Rome: FAO, Agrarian and Water Legislation Section, 1983, p.118.
[20] *Ibidem.*
[21] Source: FAO AQUASTAT, http://www.fao.org/nr/water/aquastat/countries_regions/Profile_segments/TUR-IntIss_eng.stm
[22] Punsmann, G. and Gevorgyan, A. "Review of Legal Issues Between Armenia and Turkey". *Economic Policy Research Foundation of Turkey (TEPAV)*, 2012.
[23] Kibaroglu, A., Klaphake, A., Kramer *et al*. *Cooperation on Turkey's transboundary waters*. Status Report commissioned by the German Federal Ministry for Environment Nature Conservation and Nuclear Safety, F+ E. Project 903, No.19, 2005.

Iran, the USSR signed in 1957 a first agreement for the joint utilisation of the frontier parts of the rivers Aras and Atrak (a border river in today Turkmenistan) for irrigation and hydropower[24], following several treaties that established a *condominium* regime for the Caspian Sea[25]. Then, after the construction of the Mil-Mughan dam, cooperation was consolidated by added protocols in 1970[26] and 1973[27], which included provisions for frontier demarcation and settlement of eventual border conflicts or incident. Thus, water infrastructure development acted as a catalyser for the cooperation of the two countries beyond water itself.

Regarding water management within the Soviet Union, an overarching Water Code was established only in 1970 with the enactment of the Principles of Water Legislation of the USSR and Union Republics, although the Transcaucasian SFSR (dissolved in 1936 in the Georgian, Armenian and Azerbajan SSRs) had an advanced Water Code draft already by 1928[28]. According to the Principles, water resources, intended as water bodies such as rivers, lakes, etc., are an exclusive property of the Soviet People, and thus the State, but they can also «become a property of individuals and organizations as a result of lawful activities.»[29] Moreover, the water resources were considered as "integrated", thus transcending the borders between different administrative units and establishing basin-wide planning and holistic management. To this end, a State Eater Register was created to record water quantity, quality and current users to prepare plans and balances for its further use and conservation[30]. Moreover, the Principles established regulations for agricultural, industrial and domestic uses, hydropower production, waterworks construction, pollution and designation of protected areas, overall emphasizing water quality and prohibiting the discharge of harmful effluents from individuals and organizations[31]. Water management was then carried out by the Ministry of Land Reclamation and Water Resources, together with several agencies for other ministries

[24] Wolf, A. T. and Hamner, J. H. Trends in transboundary water disputes and dispute resolution. In Lowi, M.R. and Shaw, B.R. (Eds), *Environment and Security* (pp. 123-148). London: Palgrave Macmillan, 2000.
[25] Ghafouri, M. "The Caspian Sea: rivalry and cooperation". *Middle East Policy*, Vol.15, No.2, 2008 81-96.
[26] Ginsburgs, G., and Slusser, R. M. *A Calendar of Soviet Treaties: 1958-1973.* Alphen aan den Rijn: Sijthoff &Noordhoff, 1981, p.576.
[27] *Ivi*, p. 725.
[28] Feldbrugge, F. J. M., van den Berg, G. P, and Simons, W. G. (Eds.), *Encyclopedia of Soviet Law, Second Revised Edition.* Dordrecht: Martinus Nijhoff Publishers, 1985, p.819.
[29] FAO. *Water Law in Selected European Countries, Volume II*. Rome: FAO, Agrarian and Water Legislation Section, 1983, p.103.
[30] *Ivi*, p.117
[31] *Ivi*, pp.111-116

(Health, Science and Technology, etc.), ministries of the Union Republics and specialized district authorities when present, always observing the principle of basin planning[32].

The economic development during the Soviet time was concentrated on agriculture, with crops such as tea, and citrus that were not cultivated anywhere else in the USSR for climatic reasons, and industry, especially oil and gas, chemicals and machinery, ferrous and non-ferrous metals, cement, fertilizer, light manufacturing and food processing[33]. Electricity was produced internally through hydropower and hydrocarbons from the Caspian Sea, importing it form the other Republics in times of need.

After the dissolution of the Soviet Union, the three new independent States suffered a collapse of all the economic sectors: shortages of agricultural goods and electricity were registered, while industries reduced their operative capacity to only 20%-25%[34]. GDP fell by 50% and poverty rates increased to 60%-80%[35]. Moreover, the ethno-religious puzzle of the Caucasus, kept together by the USSR, conflagrated in a series of conflicts: Georgia experienced at the same time a civil war, minor tensions in the Javakheti region and the secession of Abkhazia and South Ossetia that brought to a Russian military intervention later in 2008, while Azerbaijan and Armenia fought for the Nagorno-Karabakh region. Thus, the relations between the three countries have been highly unstable since independence due to ethno-religious tensions and the autocratic nature of their domestic institutions, since the local communist leader took over establishing their own autocracies: Georgia started its transition towards democracy in 2004 with the Roses Revolution, while in Armenia the Prime Minister was forced to step down in 2018 after popular demonstrations that brought in the end to the election of an opposition member as Prime Minister. Nevertheless, all the three countries are still plagued by corruption and social unrest.

Regarding water management, no agreement has been signed between the new independent States, while cooperation with Turkey and Iran has proceeded under the treaties signed by the Soviet Union. These has been expanded through a 1997 agreement between

[32] *Ivi*, pp.116-118
[33] Beruchashvili, N. L., Shotadze, M., Nikolaishvili, D. A. *et al. Caucasus Environmental Outlook*. Tbilisi: UNEP/GRID, 2002 available at https://wedocs.unep.org/bitstream/handle/20.500.11822/9598/Caucas_Environment_Outlook.pdf?sequence=3&isAllowed=y.
[34] *Ibidem.*
[35] Vener, B.B. *The Kura-Araks Basin: Obstacles and Common Objectives for an Integrated Water Resources Management Model among Armenia, Azerbaijan, and Georgia*. Master of Water Resources Professional Project, Water Resources Program. Albuquerque: University of New Mexico, 2006.

Georgia and Turkey on environmental protection, a 2004 treaty between Armenia and Turkey for the joint operation of shared dams and further construction, and a 2016 treaty between Iran and Azerbaijan for the construction of hydropower facilities on the Araks river.

All the three countries have adopted a domestic water law: Armenia did it in 1992, while Georgia and Azerbaijan in 1997. The Armenian Water Code was replaced in 2002 by an updated law with more detailed regulations and provisions for the harmonization with the EU 2000 Water Framework Directive. It puts water management under the National Water Council, presided by the Prime Minister, and the Ministry for Nature Protection, together with several agencies from the Ministries of Agriculture and Health Protection, local and regional authorities. Water resources are State-owned, with detailed fees and regulations for any water use. Moreover, it recognizes the transboundary nature of many watercourses by instituting a Commission on Transboundary Water Resources, but no further action has been taken in this direction[36]. In Azerbaijan, the 1997 Water Code has put water under the responsibility of the Ministry of Ecology and Natural Resources and the State Committee for Amelioration and Water Economy, with an ownership scheme allowing both State and private sector to manage it. Moreover, it attempts to face the water scarcity on the country by regulating uses, wastewater management and energy production[37]. In Georgia, the responsibility for management of the water resources rests with the Ministry of Environment and Natural Resources, with marginal participation from the Ministry of Fuel and Energy and the Department of Amelioration within the Ministry of Agriculture. Moreover, water resources are completely State-owned, and licences are needed for any water use[38]. Thus, although there are some similarities in domestic legislation, further steps are needed to harmonize the water management within the basin and coordinate the government agencies dealing with water management. Then, no exchange of hydrological data between the riparians has been established and monitoring of water quality has stopped after the collapse of the Soviet Union[39]. It is also worthy to note that none of them signed the 1997 UN Water Convention.

[36] Yu, W., Cestti, R. A. and Lee J. Y. *Toward Integrated Water Resources Management in Armenia*. Washington: World Bank, 2015.
[37] Vener, B.B. *The Kura-Araks Basin: Obstacles and Common Objectives for an Integrated Water Resources Management Model among Armenia, Azerbaijan, and Georgia*. Master of Water Resources Professional Project, Water Resources Program. Albuquerque: University of New Mexico, 2006.
[38] *Ibidem.*
[39] *Ibidem.*

3.4 The role of the EU and other external actors

Since the dissolution of the Soviet Union, the EU had a keen interest in the former communist countries in Eastern Europe, the Balkans and Caucasus. Besides security issues related to Russian containment (exemplified by the process for the Georgian entrance into the alliance) and ethnic conflicts, the Southern Caucasus has assumed strategic importance for what regards the supply of oil and gas to Europe in order to break the Russian monopoly on transport and diversify the import sources through the building of pipelines from the Caspian Sea to Southern Italy (the so-called "Southern Gas Corridor").

Thus, the EU long-term goal is to integrate these countries making them full members. In this regard, it signed treaties with the three republics in 1996 through the bilateral Partnership and Cooperation Agreements[40]. The major project launched with these agreements is the Technical Assistance to Commonwealth of Independent States (TACIS) Program, aimed at supporting with funding and know-how transfers the transition and recovery of the former Soviet countries. On water resources management, the EU, with the support of UNDP, launched the TACIS Joint River Management Project (JRMP), aimed at the integration of water resources, the enhancement of cooperation between the riparians, improvement of the water quality in the basin, preparation for management of large-scale infrastructural projects and development of capacity for monitoring and information exchange[41].

More interesting, NATO implemented from 2002 to 2009 the South Caucasus River Monitoring Project (SCRMP) within the framework of its Science for Peace Programme[42]. The Project was carried out with the collaboration of the Organization for Security and Cooperation in Europe (OSCE), with the goal of fostering collaboration between the three countries over the Kura-Araks basin, using water resources as a catalyser for further cooperation on other issues. The specific goals of the Project were: increase technical capabilities, establish standardized practices for data collection, establish database management system accessible to all the parties and a social framework for the region's water

[40] *Ibidem.*
[41] TACIS. *Joint River Management Programme Final Report.* Brussels: EuropeAid, October 2003.
[42] Campana, M. E., Vener, B. B., and Lee, B. S. "Hydrostrategy, Hydropolitics, and Security in the Kura-Araks Basin of the South Caucasus". *Journal of Contemporary Water Research & Education*, Vol.149, No.1, 2012, 22-32.

professionals[43]. The particularity of this project is that it was bottom-up, designed and managed by experts from the three countries, who received technical assistance and funding from NATO and OSCE. However, after the end of the Project in 2009, «only Azerbaijan is continuing to monitor because it has the funds, and the incentive – it is the downstream riparian.»[44] Thus, although the Project had very high probabilities to foster long-term cooperation over water by collecting and sharing hydrological data, its dependence on external funding and the lack of alternative means, both from domestic finances or other international donors, greatly hindered its potential. Moreover, this project completely lacked coordination with the EU TACIS-JRMP and USAID's South Caucasus Water Management Project, having most of the times overlapping activities resulting in a waste of resources[45].

3.5 Discussion of the empirical analysis and conclusion

The Kura-Araks is a transboundary river basin located in the Southern Caucasus, shared by Turkey, Georgia, Armenia, Azerbaijan and Iran. Land and water resources are unevenly distributed, with Georgia having a large surplus and Azerbaijan a wide deficit. Then, water quality is very low due to industrial and municipal wastewater discharges from upstream. Moreover, Azerbaijan heavily relies on the rivers' water for drinking and irrigation, suffering not only from water scarcity and environmental degradation, but also from frequent floods due to the flat terrain and lack of information from Georgia on precipitations and snowmelt.

The three republics were part of the Soviet Union during most of the 20th century and thus integrated into its economic system, developing specialized agriculture and industry related to food production and hydrocarbons. The USSR also cooperated with Turkey and Iran, signing agreements to equally share the basin's water and develop joint infrastructure for hydroelectricity production, which are still in place today. Indeed, these two countries preserved this cooperative regime with the new independent States, which however do not cooperate among themselves: Georgia has no incentive to reduce its effluents discharge or

[43] Campana, M. E., Vener, B. B., Kekelidze, N. P. *et al.* Science for Peace: Monitoring Water Quality and Quantity in the Kura-Araks Basin of the South Caucasus. In Moerlins, J. E., Khankhasayev, M. K., Leitman, S. F. *et al.* (Eds.), *Transboundary water resources: A foundation for regional stability in Central Asia* (pp. 153-170). Berlin: Springer Science & Business Media, 2008.
[44] Campana, M. E., Vener, B. B., and Lee, B. S. "Hydrostrategy, Hydropolitics, and Security in the Kura-Araks Basin of the South Caucasus". *Journal of Contemporary Water Research & Education*, Vol.149, No.1, 2012, 22-32.
[45] *Ibidem.*

prevent floods downstream and Azerbaijan has no power to enforce it on its upstream riparian, and the same goes for Armenia. Thus, what it showed by this case is that is sufficient to observe chronic scarcity in only some of the riparians to make it an obstacle for cooperation. However, the NATO SCRMP provided the three republics with an important tool that potentially could have enhanced cooperation among them, but the lack of external funding when the project ended left them with the choice to continue water quality monitoring or not, according to their financial resources and priorities: it is not a case that, at the moment, only Azerbaijan is carrying it.

By looking at the independent variables, it is possible to note that water scarcity is localized only downstream in quantitative terms, while it is a bit more distributed among the riparians in qualitative terms. Then, economic activities are not well distributed along the stream, as upstream uses hinder the ones downstream. Finally, the exchange of hydrological data is not regulated by any mean, and thus water quality monitoring is upon the countries' choice, resulting in its conduction only downstream. Thus, only the downstream riparian is willing to cooperate in order to ameliorate the situation (because it also lacks the force necessary to enforce it), while upstream countries have no incentive in monitoring water quality or clean up the river, that is, to bear higher costs without gaining any advantage. Political instability, ethno-religious conflicts and economic problems contribute to the lack of cooperation, although they play a secondary role regarding water issues. It is a classical Prisoner Dilemma in which upstream countries have a dominant strategy to not monitor water quality and/or clean-up, and subsequently the best strategy for the downstream country is not to pay them. However, the models suggest that adding water to other issues in which Azerbaijan has a comparative advantage, and thus can give concessions in exchange for better water quality, may be a solution to enhance cooperation. Otherwise, a third party shall step in and provide upstream countries with the incentives to cooperate, like the NATO SCRMP partially did. However, it has to be noted that such settlement would not comply with the provision of the UN Water Treaty, but is the best possible given the fact that none of them ratified it, although Azerbaijan voted for its approval.

CHAPTER FOUR

THE ARAL SEA BASIN

4.1 Introduction

The Aral Sea basin is probably one of the most studied by scholars, together with the Tigris-Euphrates, the Jordan and the Nile. It is located in Central Asia and is shared by the five former Soviet republics of the region: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Afghanistan also shares a part of the basin, but its civil war and continuous state of political instability and weakness of the formal economy did not allow it to play a role.

The basin presents a serious problem of water scarcity, both in quantitative and qualitative terms, due to the overexploitation of the two main rivers, the Amu Darya and Syr Darya, fro cotton production already during Soviet times, which brought in the long run to the almost complete desiccation of the Aral Sea and the environmental catastrophe that today affects the region. Thus, it is a rather complex problem, because almost all the economic activities (cotton production) are located downstream and consume an enormous amount of water, hindering development projects upstream.

In this chapter, a first description of the geography and hydrology of the basin is given, followed by an analysis of the collected empirical data regarding water scarcity and water uses, the first two independent variables related to the physical context in which countries interact. Then, the analysis proceeds through the institutional developments within the basin in order to verify the presence of information exchange between the riparians, the third independent variable. Finally, a discussion of the empirical analysis in conducted and conclusions are drawn.

4.2 Basin overview

The Aral Sea is the major basin of Central Asia and is composed by two rivers, the Amu Darya and the Syr Darya, and their tributaries, fed by snowmelt form the mountains. The Amu Darya originates form the confluence of the Piandj and Vakhsh rivers in the Pamir mountains, forming the Afghan border with Tajikistan and Uzbekistan. Then, it flows through Turkmenistan and Uzbekistan before discharging into the South Aral. Its most important tributaries are the Kunduz from Afghanistan, the Kafirnigan through the Tajik capital Dushanbe, and the Zeravshan flowing from Tajikistan through the fertile homonymous valley where two of the major cities of the Silk Route, Samarkand and Bukhara, lie. Its total length is 1.415 km with an average discharge of 69.000 MCM/year[1]. The river cuts a valley through the Pamir mountains between Tajikistan and Afghanistan, where several reservoirs have been built, before entering in a mostly flat and desertic terrain. The Syr Darya originates from the confluence of the Naryn and Karadar'ia rivers in the Tian Shan mountains in Kyrgyzstan and flows through the fertile Ferghana valley in Uzbekistan after filling the Kyrgyz Toktogul reservoir. Then, it flows through the Karakum reservoir in Tajikistan before re-entering in Uzbekistan. Finally, it enters Kazakhstan filling the Shardara and Koksaray reservoirs before discharging in the North Aral. Its total length is 2.212 km, the longest in Central Asia, with an average discharge of 34.500 MCM/year[2]. The river flows through a mountainous terrain in Kyrgyzstan before entering in the plains of the Ferghana valley and the steppes of the Turan depression. The whole basin comprises 92% of the total surface water of Central Asia (62% for Amu Darya and 30% for Syr Darya)[3]. The whole basin has an extended network of reservoirs, dams and irrigation canals: the largest is the Karakum canal, 1.100 km long, cutting through the Karakum desert in southern Turkmenistan and the capital Ashgabat, diverting around 15.000-20.000 MCM/year from the Amu Darya.

Despite the great amount of water per capita (around 2.500 m^3), the Aral Sea basin is one of the most stressed in the world: with a total runoff of 103.500 MCM/year[4], water withdrawals are 10.100 MCM/year for Kyrgyzstan, 11.700 MCM for Tajikistan, 24.900

[1] Vinogradov, S. "Transboundary water resources in the former Soviet Union: between conflict and cooperation". *Natural Resources Journal*, 1996, 393-415.
[22] *Ibidem.*
[3] *Ibidem.*
[4] Sum of the Amu Darya and Syr darya annual average runoff.

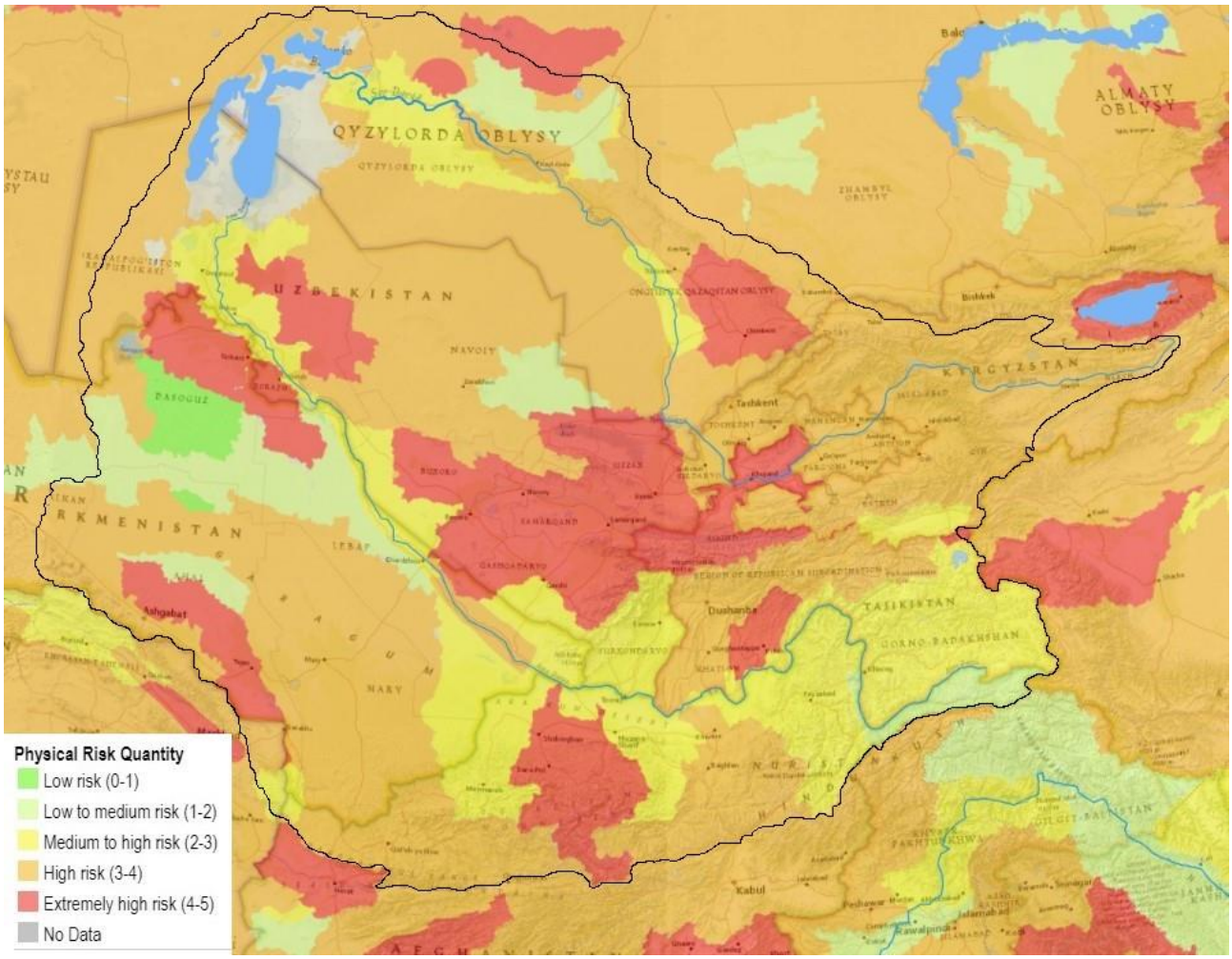
MCM/year for Turkmenistan and 53.700 MCM/year for Uzbekistan[5], leaving the remnants for Northern Afghanistan, Southern Kazakhstan and the environment. Thus, water withdrawals are very unevenly distributed, as Uzbekistan withdraws more water than Kyrgyzstan, Tajikistan and Turkmenistan put together, around half of the basin runoff. Moreover, it is possible to define it a "man-made scarcity" generated by the overexploitation of water resources, which is not sustainable in the long run. The reason for that is the extensive cotton monoculture and agricultural production in general: Table 4.1 shows that it accounts for around 90% of total water withdrawals in all the riparians apart from Kazakhstan. Moreover, it employs half of the workforce in Kyrgyzstan, Tajikistan and Uzbekistan, contributing also for a consistent share of the GDP: indeed, Turkmenistan and Uzbekistan are among the top ten world cotton producers[6]. Then, is it possible to note that hydropower in upstream Kyrgyzstan and Tajikistan is crucial for their energy supply: thus, the needs for electricity in these countries dictates the regime of water releases for its production. Since energy demand is higher in winter months, the result is that most of the water is released in that period, thus harming the crops downstream, first by flooding them in winter and then by leaving them with insufficient water during summer, when irrigation is mostly needed.

Table 4.1: Water withdrawals, employment and GDP share by sector and hydropower share over total electricity production, 2000[7].

	KAZ	KGZ	TJK	TKM	UZB
Agriculture water %	75,1	93,8	91,6	96,5	90,4
Agriculture empl. %	34	45,3	58,1	28,8	42,2
Agriculture GDP %	8,7	36,7	27,4	24,4	34,4
Industrial water %	20,7	3,1	4,7	1,1	3,9
Industrial empl. %	16,1	13,7	17	33,1	29,3
Industrial GDP %	37,8	29,2	35,3	41,1	20,2
Domestic water %	4,2	3,2	3,7	2,4	5,7
Hydropower %	14,7	85,9	98,4	0	12,5

[5] Source: World Bank World Development Indicators, link: http://databank.worldbank.org/data/source/world-development-indicators. Data on Uzbek water withdrawals are from 2001 because of lack of data.
[6] Source: https://www.worldatlas.com/articles/top-cotton-producing-countries-in-the-world.html
[7] *Ibidem.* Data on Uzbek shares of water withdrawals are from 2001 and data on Kazakh shares of water withdrawals are from 2002 because of lack of data.

Regarding the spatial distribution of scarcity, the map shows an overall critical risk in the area most interested by extensive agriculture: the Ferghana and Zeravshan valleys, the Karakum area around Ashgabat and the delta region of the Amu Darya. However, almost all the other parts of the basin are under high stress. Overall, the basin scores a Physical Risk Quantity of 3,4, but an analysis of the decomposed index shows a very high value for Baseline Water Stress compensate by rather low values for variability, droughts and floods[8].



Map 4.1 The Aral Sea basin and its Physical Risk Quantity[9].

For what regards water quality, it has to be considered very low, given the levels of pollution observed in the rivers, high mortality rates and the poisonous salt deserts left by the desiccation of the Aral Sea[10]. The WATQI for the basin countries is 65,6, although also in

[8] Source: WRI Aqueduct Country and River Basin Rankings, link: https://www.wri.org/applications/maps/aqueduct-country-river-basin-rankings/#x=0.00&y=0.00&l=2&v=home&d=bws&f=0&o=-9999&init=y

[9] Map elaborated with Esri ArcGIS Earth, Physical Risk Quantity layer elaborated by WRI.

[10] Vinogradov, S., and Langford, V. P. "Managing transboundary water resources in the Aral Sea Basin: in search of a solution". *International Journal of Global Environmental Issues*, Vol.1, No.3-4, 2001, 345-362.

this case is a hot-deck imputation[11]. By looking at the Environment component for the WPI instead, the scores go as it follows, evidencing serious environmental problems in all the basin countries: Kazakhstan 9,4, Kyrgyzstan 8,8, Tajikistan 10,9, Turkmenistan 10,9 and Uzbekistan 8,2[12].

4.3 Water management during Soviet times and the environmental catastrophe

Like in the Southern Caucasus, the USSR promoted cooperation with its co-riparian Afghanistan, signing agreements in 1946 and 1958 on the uses and quality of the Amu Darya, founding a commission tasked to cope with these issues, and several others on assistance for agricultural development, hydroelectric generation and construction of irrigation infrastructure[13].

Although the general principles of Soviet domestic water management have already been described in the previous chapter, the Aral Sea Basin had a unique development. The Soviet Central Asia was designated as the USSR "cotton belt", in order to reduce the cotton imports from the US and develop its own heavy and light industry[14]: «between 1940 and 1986, cotton production on irrigated land was increased by over 300% in Turkmenistan, by 196% in Tajikistan and by 122% in Uzbekistan.»[15] Thus, «by 1986, over 3 million hectares of land in Turkmenistan, Tajikistan and Uzbekistan were under cotton production, accounting for more than 50% of total Soviet agricultural production.»[16] The challenge that Soviet planners faced is that cotton cultivation requires a very large amount of water: therefore great works for the improvement of irrigation system and the construction of diversion schemes were undertaken. However, many of them were cancelled or substituted after Stalin's death: for example, de-Stalinization brought to an end the plantation of shelterbelts and windbreaks to cool off the

[11] Srebotnjak, T., Carr, G., de Sherbinin, A. *et al*. "A global Water Quality Index and hot-deck imputation of missing data". *Ecological Indicators*, Vol.17, 2012, 108-119.
[12] Lawrence, P. R., Meigh, J., and Sullivan, C. "The water poverty index: an international comparison". *Keele Economics Research Papers*, No.19, 2002.
[13] Source: FAO AQUASTAT, http://www.fao.org/nr/water/aquastat/countries_regions/Profile_segments/AFG-IntIss_eng.stm
[14] Micklin, P. P. "The water management crisis in Soviet Central Asia". *The Carl Beck Papers in Russian and East European Studies*, No.905, 1991.
[15] Vinogradov, S., and Langford, V. P. "Managing transboundary water resources in the Aral Sea Basin: in search of a solution". *International Journal of Global Environmental Issues*, Vol.1, No.3-4, 2001, 345-362.
[16] *Ibidem.*

climate in Central Asia[17], and the Main Turkmen canal, projected to irrigate the northern part of the Karakum desert and connect the Amu Darya to the Volga river, was abandoned in favour of the actual Karakum canal. Moreover, a major water diversion of the 'Ob and Irtysh rivers in Siberia through a canal 2544 km long, known as the "Sibaral", was planned during the '70s and early '80s, but was finally rejected due to its enormous costs and environmental concerns[18]. Nevertheless, the agricultural development projects proceeded, also aiming at the desiccation of the Aral Sea: «the Syr Darya provided no flow to the Aral from 1974–1986 and the Amu Darya minimal or no flow for 1982–1983, 1985–1986, and in 1989.»[19] Dams were constructed upstream, although they were considered just as water regulators and thus were not equipped with hydropower turbines: indeed energy was provided by downstream countries, which were, and still are, rich of oil and gas, thus envisaging a compensation scheme between the Soviet republics. Then, an RBO (Basseynoe Vodnoe Ob'edinenie, BVO) for each river was also created to determine and enforce water allocation[20].

However, these development plans had several negative consequences, due to the design of the plans themselves and their poor implementation. Canals were not lined with concrete, increasing the waste of water due to bed infiltration and evaporation, meaning that in the early 1980s « at least 40% of the water withdrawn was lost before it reached the fields, primarily due to filtration from earthen canals.»[21] This construction flaw brought also to the transport and concentration of silt in reservoirs, thus reducing their capacity. Then, irrigation return flows greatly reduced water quality because of the accumulation of salts, fertilizers, pesticides and cotton defoliants of widespread use in the region, reducing its suitability for further irrigation downstream. The heavy pollution, coupled with the failed implementation of crop rotation resulting in extensive cotton monoculture, had negative effects on the soil as well, reducing crop yields and often causing desertification. Moreover, the pollutants transported by the rivers ended up accumulating into the Aral Sea, whose shrinking was deemed by Soviet

[17] Brain, S. "The great Stalin plan for the transformation of nature". *Environmental History*, Vol.15, No.4, 2010, 670-700.
[18] Micklin, P. P. "The fate of "Sibaral": Soviet water politics in the Gorbachev Era". *Central Asian Survey*, Vol.6, No.2, 1987, 67-88.
[19] Micklin, P. "The Aral Sea crisis and its future: An assessment in 2006". *Eurasian Geography and Economics*, Vol.47, No.5, 2006, 546-567.
[20] Wegerich, K. "Hydro-hegemony in the Amu Darya basin". *Water Policy*, Vol.10, No.S2, 2008, 71-88.
[21] Micklin, P. P. "The water management crisis in Soviet Central Asia". *The Carl Beck Papers in Russian and East European Studies*, No.905, 1991.

scientists to be of little harm to neighbouring zones[22]. Instead, it had a disastrous impact on the economy and population at the local and regional level: the friable salt crust at the bottom is easily transported southwards by the winds, generating salt and dust storms with plenty of pollutants in the delta of the Amu Darya[23]. Then climate changed as well, with the region becoming more arid due to the loss of humidity from the lake. Finally, the thriving fishing industry of the Aral were almost completely destroyed, together with the rich ecosystem, by the massive pollution and shrinking of the lake.

A very interesting story is that of the Vozrozhdeniya Island in the Aral Sea: this was used by the Soviet as a military base for the testing of secret biological weapons and was abandoned when Soviet Union collapsed in 1991. When the island joined with the mainland in 2001, concerns were raised on the possibility that the pathogen agents could contaminate the neighbouring region or fall in the hands of terrorist organization, and were thus destroyed in the following years by the Uzbek government with US technical support[24].

4.4 Water management after independence and attempts for transboundary governance

Soon after independence, the five new republics formulated claims for an equitable share of water, but for the time being agreed on the conservation of the *status quo*: indeed in 1992 they already signed the Agreement on Cooperation in the Management, Utilization, and Protection of Water Resources in Interstate Sources, in which they laid down provisions for a joint management of common water resources, avoidance of pollution and harm to co-riparians, but at the same time maintained the former Soviet allocation quotas[25]. Nevertheless, the agreement established the Interstate Commission for Water Coordination (ICWC), tasked with the determination of the water management policy, its monitoring and implementation, and empowered with binding decisions for all water users[26]. The former Soviet BVOs for the Amu Darya and Syr Darya were also maintained as branches of ICWC for each river.

[22] *Ibidem.*
[23] *Ibidem.*
[24] Micklin, P. "The Aral Sea crisis and its future: An assessment in 2006". *Eurasian Geography and Economics*, Vol.47, No.5, 2006, 546-567.
[25] De Chazournes, L. B. The Aral Sea basin: legal and institutional aspects of governance. In Finger, M., Tamiotti, L. and Allouche, J. (Eds), The multi-governance of water: four cause studies (pp.147-171). New York: State University of New York Press, 2006.
[26] Agreement on Cooperation in the Management, Utilization, and Protection of Water Resources in Interstate Sources, 1992.

Then, in 1993, under promises of funds by the World Bank and the EU, the five republics signed the Agreement On Joint Activities In Addressing The Aral Sea And The Zone Around The Sea Crisis, Improving The Environment, And Ensuring The Social And Economic Development Of The Aral Sea Region, adding four new intergovernmental institutions: the Interstate Council of the Aral Sea (ICAS), the Executive Committee of ICAS (EC-ICAS), the International Fund for Saving the Aral Sea (IFAS) and the Sustainable Development Commission (SDC). The first two set policy goals and provided coordination and implementation of the different projects in the basin, including the World Bank sponsored Aral Sea Basin Programme (ASBP), aimed at the environmental restoration of the Aral and the disaster zone, improvement of transboundary water management and capacity-building in the affected countries[27]. IFAS was instead created to gather funds from member States and international donors, while the SDC was intended to balance economic, environmental and social issues in planning decisions[28]. The reformulation of the ASBP by the World Bank, coupled with an evident overlap between the ICWC and ICAS, brought to a reorganization of the institutional structures in 1997: ICAS, EC-ICAS and IFAS were merged into the new International Fund for the Aral Sea (IFAS) composed by the ministers of the five States concerned with agriculture, water, and the environment, deciding on the policies proposed by the Executive Committee and collecting contributions to finance its activities[29]. Then, its relation with the ICWC was clarified in 1999: IFAS became the political authority, guiding the work within the basin through policies and principles, while ICWC became the technical branch, dealing with the regulation and supervision of water allocation[30].

However, cooperation did not take place as expected for several reasons. First, all the countries were affected by internal unrest and interethnic tensions, both domestically and internationally. The Ferghana valley has been the most important bone of contention: the presence of numerous Uzbek, Tajik and Kyrgyz exclaves, its position at the crossroads between the different national communication networks and its rich cotton fields made it a very valuable strategic objective for three countries. Moreover, Tajikistan suffered from a

[27] De Chazournes, L. B. The Aral Sea basin: legal and institutional aspects of governance. In Finger, M., Tamiotti, L. and Allouche, J. (Eds), The multi-governance of water: four cause studies (pp.147-171). New York: State University of New York Press, 2006.
[28] *Ibidem.*
[29] *Ibidem.*
[30] Allouche, J. "The governance of Central Asian waters: national interests versus regional cooperation". In *Disarmament Forum*, Vol.4, 2007, pp. 45-56.

civil war that lasted from 1992 to 1997 and Islamic fundamentalism spilled over from neighbouring Afghanistan due to the conflict between the mujahidin faction and the Taliban rule. Nevertheless, disputes over water resources were the most relevant, also leading to military intervention in some cases: in 1999 Uzbekistan deployed 130.000 troops on the Kyrgyz border to guard off transboundary reservoirs, and also threatened to seize the Toktogul dam[31]. Uzbekistan had also contingency plans to seize reservoirs in North-eastern Turkmenistan, determined to preserve its favourable position in water allocation[32]. Then, several minor fights took place around dikes and irrigation canals around the exclaves in the Ferghana valley and between Kazakhstan and Uzbekistan[33].

Hostilities did not fall short to the use of force, but took also the form of economic retaliation. The compensation system implemented during Soviet times, exchanging upstream water with downstream energy, stopped to function by the end of the USSR. Thus, Kazakhstan, Uzbekistan and Turkmenistan started to sell their oil and gas at market prices, while pretending water releases from upstream according to their needs. Therefore, Kyrgyzstan and Tajikistan, in need of energy and agricultural products, started to develop their own hydropower capacity and irrigation schemes, asking payments for water releases. At the same time, cuts of water from upstream and of energy from downstream have been often employed to force the other party to honour debts and commitments. Moreover, the winter water releases for electricity production have been used as a weapon as well, causing devastating floods in 1993, 1998 and 2001[34]. Because of this harmful potential for downstream countries, Uzbekistan has opposed the Kyrgyz Toktogul II project and the Tajik Rogun dam, while these two countries, notwithstanding several ethnic tensions, have started to work together to bypass the former Soviet electric grid centred on Tashkent in order to sell power directly to Kazakhstan. All the retaliatory acts had the effect of disrupting national economies, raising tensions between the countries and creating a climate of suspicion and distrust.

Moreover, the IFAS-ICWC institutional setup has not been able to address these disputes and favour peaceful negotiations. Indeed, these organizations were created mostly by

[31] Source: Pacific Institute Water Conflict Chronology, http://www.worldwater.org/conflict/map/
[32] Allouche, J. "The governance of Central Asian waters: national interests versus regional cooperation". In *Disarmament Forum*, Vol.4, 2007, pp. 45-56.
[33] *Ibidem.*
[34] *Ibidem.*

pressures of external actors and donors such as the World Bank, but the countries lack the actual will to cooperate. The focal point is on data collection, because information represents the factual basis on which negotiations over water allocations can be undertaken, as countries withdrawing more than their fair share will see their quotas reduced. Thus, countries have the monopoly on data collection within their territory, so it is not possible to control if water intakes for the Karakum canal or other diversions are correct or not. Moreover, Uzbekistan has a great influence over ICWC and the two BVOs, as they are both based within the country, having the possibility to manipulate information on water withdrawals: indeed, according to unofficial data, it was withdrawing two times the amount reported in the official ones[35].

Three actors should then be briefly mentioned for their impact on present and future interactions between the basin countries: Afghanistan, Russia and China. Afghanistan is the elephant in the room of the Aral Sea basin, having the upstream section of the Amu Darya in common with Tajikistan and one of its tributaries, the Kunduz: the civil war prevented the country to participate in the creation of IFAS, but the economic recovery will mean an increase of water withdrawals from the river, considering that the northern regions are safer and more suitable for agriculture. Thus, Afghanistan shall be entitled with its own share of the Amu Darya water, or it will proceed unilaterally with its projects. Then, Russia has as its main objective to restore its influence in Central Asia by combining water and energy and through a *divide et impera* strategy towards the five republics. Indeed, Russia is collaborating with Tajikistan and Kyrgyzstan on the construction of dam for hydropower and the development of electric grids, and at the same time is reconsidering the Soviet diversion scheme for the 'Ob and Irtysh in order to make Kazakhstan and Uzbekistan heavily reliant on Russian water[36]. Finally, China has become increasingly important for Central Asia, especially in terms of economic influence. The region is fundamental for the provision of oil and gas via land routes, thus increasing competition for Russian hydrocarbon exports. However, water has gain a central position in the Chinese policy towards the region: the massive migration to Xinjiang, to neutralize the Uighur minority and grant stability on the western borders of the People's Republic, has increased water needs for urban and agricultural uses. Moreover, the development of cotton culture, occupying almost half of Xinjiang arable

[35] Wegerich, K. "Hydro-hegemony in the Amu Darya basin". *Water Policy*, Vol.10, No.S2, 2008, 71-88.
[36] Allouche, J. "The governance of Central Asian waters: national interests versus regional cooperation". In *Disarmament Forum*, Vol.4, 2007, pp. 45-56.

land[37], is a very important stake for the Chinese textile production and export. However, the region is already under very high water stress, with the Lake Balkhash in danger to follow the same fate of the Aral, and China is willing to import more water from both Kazakhstan and Kyrgyzstan, thus competing with Uzbekistan for the Syr Darya waters.

4.5 Discussion of the empirical analysis and conclusion

The Aral Sea is one of the most stressed basins of the world, located in Central Asia and share by Northern Afghanistan, Southern Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. The great water scarcity and degradation in the basin has been caused by the extensive cotton monoculture, mostly concentrated in the Ferghana and Zeravshan valleys and the Amu Darya delta. However, is a fundamental source of income for the countries due to high level of exports and value of the commodity, and for population as the most important form of employment. Moreover, the high water demand downstream conflicts with the upstream necessity to develop hydric infrastructure for irrigation and hydropower production purposes.

The basin was almost completely within the Soviet Union, except for an upstream section of the Amu Darya share with Afghanistan, that managed it according to its plans, although maintaining its policy of cooperation towards its riparians. The region was shaped by important waterworks aimed at the increase of agricultural production, especially cotton. Aral itself was planned to be desiccated, without expecting relevant environmental changes. The region was also managed as a single unit, with upstream countries releasing water according to downstream agricultural needs and receiving energy in exchange. However, the poor execution of the plans brought to the inefficiency of irrigation infrastructure and critical levels of pollution, including the contamination of all the area surrounding the Aral Sea, which was drastically reduced in its size. Thus, the situation inherited by the new independent countries was affected by an environmental catastrophe and uneven water allocation quotas favouring downstream riparians. While these were maintained after independence, the same did not follow regarding the compensation system: therefore, upstream countries started to retain water for the development of irrigated agriculture and hydroelectricity production, thus

[37] *Ibidem.*

damaging the downstream cotton monoculture that is a major source of exports and employment.

Thanks to the mediation of the World Bank and the EU, the five republics signed several agreements, creating a comprehensive institutional framework for the basin management and the rehabilitation of the Aral Sea. However, the countries kept rather conflictive relations among themselves, with sporadic use of force and economic retaliation, caused mostly by disputes over water resources, although ethno-religious conflicts sometimes raised the tensions, as disputes over land were generally intertwined with issues regarding water rights.

By looking at the independent variables, it is possible to note that water scarcity is high in almost all the basin in quantitative terms, with quality especially low in downstream regions due to pollution from agriculture. Then, the distribution of economic activities along the stream generates conflicts and disputes, especially between upstream winter hydropower production and downstream summer irrigation. However, what is most interesting is the third variable: information exchange was already included in the first 1992 treaty, but it has not become a driver for cooperation or building trust among the riparians. Instead, it still is an issue on which the five republics are quarrelling, often presenting data diverging from reality: a plausible explanation is that water allocation quotas depend from them, and thus they are manipulated to instrumentally gain a better negotiating position. Thus, it is possible to affirm that in this case water scarcity got the lion's share, followed by incompatible water uses, while information exchange had a negative impact as well, although this is probably caused by water scarcity itself. Finally, political instability and ethno-religious conflicts aggravated the crisis because of unclear borders and numerous exclaves, while the neighbouring countries often work as a divisive factor in the basin, exploiting water and natural resources to put riparians in competition among each other for financial support for development programmes.

A restoration of the Soviet compensation system, although more economically and politically stable than the actual regime, would not be sustainable for the environment: therefore, a rethinking of the economic activities and water uses in the basin is needed by employing the capitals gain from cotton and natural resources export to finance a transition to less water-intensive activities, granting a better economic welfare and a safer environment, fighting desertification and partially rehabilitating the Aral Sea.

CHAPTER FIVE

THE LA PLATA BASIN

5.1 Introduction

The La Plata is one of the largest river basins in the world, located in Latin America. It is a *sui generis* case of cooperation between the riparians, as they affirm at the same time the joint ownership of the water resources and the States' sovereignty. More interestingly, the basin is managed through a comprehensive agreement that allows the creation of bilateral and multilateral treaties for the implementation of different projects and the management of specific sections in the basin. Overall, there is no issue on water scarcity, and cooperation has been focused mostly on joint hydropower production, navigation and, more recently, environmental protection.

In this chapter, a first description of the geography and hydrology of the basin is given, followed by an analysis of the collected empirical data regarding water scarcity and water uses, the first two independent variables related to the physical context in which countries interact. Then, the analysis proceeds through the institutional developments within the basin in order to verify the presence of information exchange between the riparians, the third independent variable. Finally, a discussion of the empirical analysis in conducted and conclusions are drawn.

5.2 Basin overview

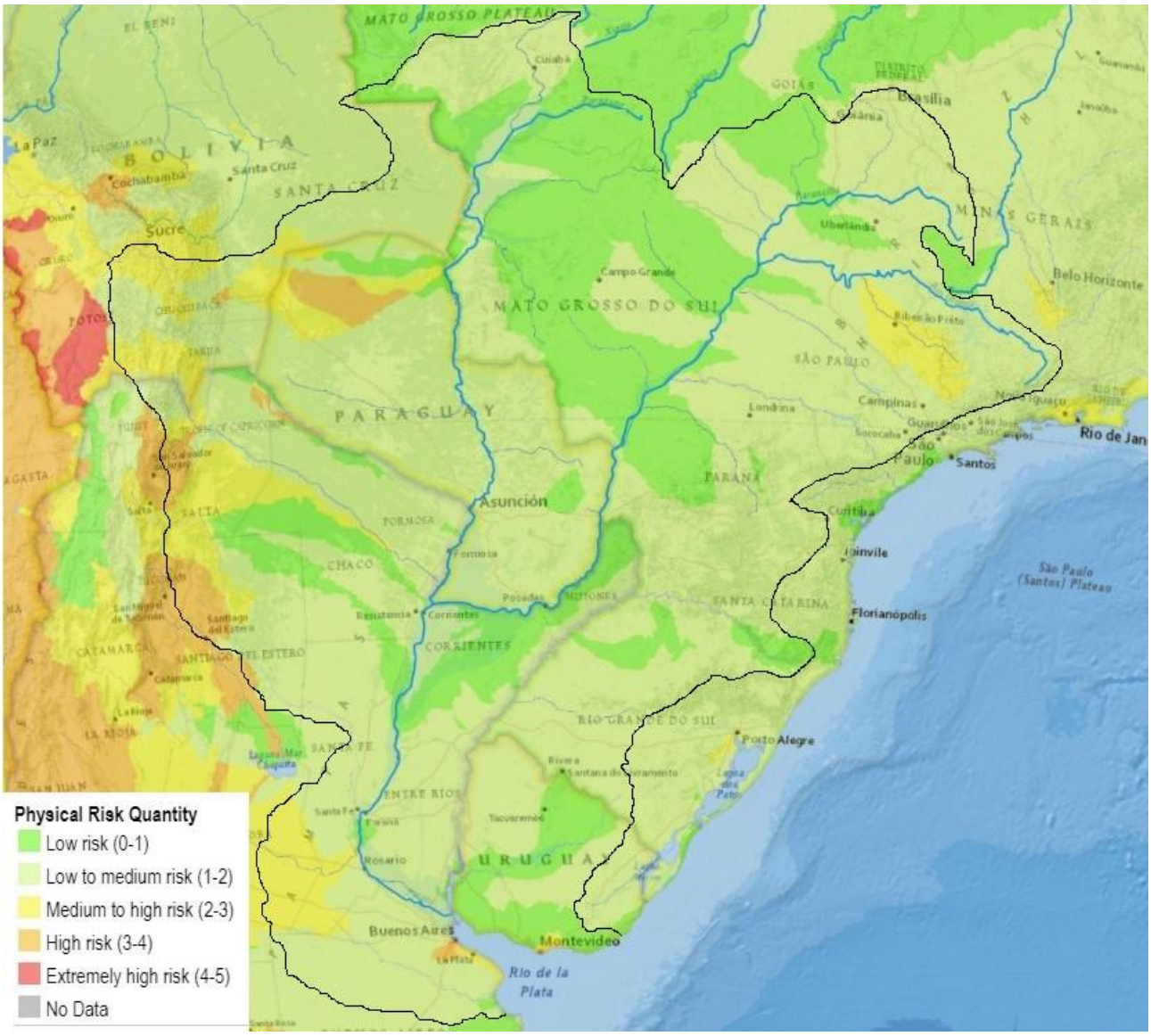
The La Plata is a basin located in Latin America and is a complex river system composed by the Paranà and its tributaries, among which large rivers such as the Paraguay and Uruguay

are also present. It is shared by Southern Brazil (states of Mato Grosso, Goiás, Minas Gerais, São Paulo, Mato Grosso do Sul, Paraná, Santa Catarina and Rio Grande do Sul), Southern Bolivia (departments of Santa Cruz, Chuquisaca and Tarija), Paraguay, Uruguay, and Northern Argentina (provinces of Jujuy, Salta, Formosa, Chaco, Misiones, Tucumán, Santiago del Estero, Santa Fe, Corrientes, Córdoba, Entre Ríos, Buenos Aires and La Pampa).

The Paranà river originates in Southern Brazil at the confluence between the Panaraiba and Rio Grande and flows southwards forming the border between the states of Goiás and Minas Gerais and then the states of Mato Grosso do Sul, São Paulo and Paranà. While entering the Itaipu artificial lake it forms the border between Brazil and Paraguay and then between Paraguay and Argentina, flowing through the Yacyretà artificial lake. Finally, it enters in the Corrientes department in Argentina and flows through the major cities or Rosario and Santa Fe before discharging in the Rio de la Plata, the gulf in front of the South Atlantic were Buenos Aires and Montevideo lie. Its total length is 4.880 km with an average runoff of 536.112 MCM/year[1]. The Paraguay river originates in the Mato Grosso and flows through Southern Brazil and El Pantanàl wetlands, the largest in the world. Then, it forms part of the border between Brazil and Paraguay and flows across the former and its capital Asunción, before forming the border with Argentina and joining the Paranà. On its route is receives the waters of the Pilcomayo, a navigable tributary that forms part of the border between Paraguay and Argentina. Its total length is 2.621 km with an average runoff of 85.147 MCM/year[2]. The Uruguay river originates between the states of Santa Catarina and Rio Grande do Sul in Southern Brazil, forming the border of the country with Argentina and then between Uruguay and Argentina, before joining the Paranà in its delta, discharging in the Rio de la Plata. Its total length is 1.838 km with an average runoff of 173.448 MCM/year[3]. The terrain is composed by the vast plateaus between Brazil, Paraguay and Argentina, forming the numerous waterfalls that characterize the basin, while large plains are present in Western Paraguay, Uruguay and Northern Argentina. Worth to be mentioned is also the Guaranì aquifer, the second largest in the world, which stretches below most of the basin and is a large source of freshwater[4].

[1] Source: FAO AQUASTAT, http://www.fao.org/nr/water/aquastat/basins/la-plata/index.stm.
[2] *Ibidem.*
[3] *Ibidem.*
[4] *Ibidem.*

By looking at the water resources present in the basin, is it possible to affirm that the region does not suffer from water availability issues: indeed, by looking at the spatial distribution of water risk, apart from a zone in Western Paraguay, were the agricultural production of the country is concentrated, and the shores of the Pilcomayo, the basin is at low or very low risk. The overall Physical Quantity Risk of the basin is 1,3, consistent with the spatial distribution: by decomposing the index, it is possible to note that the Baseline Water Stress is even lower, 0,8, while the greatest concern comes from the flood occurrence in the basin, scoring 3,2[5].



Map 5.1: The La Plata basin and its Physical Risk Quantity[6].

[5] Source: WRI Aqueduct Country and River Basin Rankings, link: https://www.wri.org/applications/maps/aqueduct-country-river-basin-rankings/#x=0.00&y=0.00&l=2&v=home&d=bws&f=0&o=-9999&init=y

[6] Map elaborated with Esri ArcGIS Earth, Physical Risk Quantity layer elaborated by WRI.

Although water is not scarce, the access to it is problematic in some parts of the basin: by the turn of the century, the share of population receiving safe drinking water ranged from 86% in Brazil to 73% in Argentina, with rural areas covered only from 5% to 17%[7]. By looking at the WPI Access component, is it possible to obtain a similar picture: the scores of the basin countries range from 7,7 of Paraguay to 14,9 of Bolivia, similar to countries in the MENA region, but below the post-Soviet republics in the Caucasus and Central Asia[8]. An explanation may come from the lack of water infrastructures and, in recent years, the privatization of the water sector in many Latin American countries, as they affect negatively the access to water for the poorer households[9]

Water quality is instead an increasing relevant issue in the basin, although it is still not degraded to a critical level: the WATQI scores record 85,80 for Argentina, 66.31 for Bolivia, 84,31 for Brazil, 69,74 for Paraguay and 88,31 for Uruguay[10]. Most interesting, upstream countries have far more degraded water than downstream Argentina, while it has been assumed that water quality decreases as it flows downstream. The WPI Environment component has some discrepancies with the WATQI: the scores are 12,5 for Argentina, 11,4 for Bolivia, 11 for Brazil, 10,5 for Paraguay and 10,8 for Uruguay[11], meaning that they have similar levels of environmental degradation.

Regarding the economic activities, Table 5.1 shows that agriculture is a relevant sector for Bolivia, Brazil and Paraguay, mostly concentrated on cattle rearing and cash crops such as coffee, sugar cane and soya[12]. However, it has to be noted that the tropical and sub-tropical climate in the basin, with high levels of precipitations and humidity, renders irrigation less important for agricultural production, making it less reliant on the rivers' water. Then, industrial production contributes for a consistent share of employment and production, with the most important agglomerates concentrated around São Paulo, the Southern Brazilian

[7] Elhance, A. P. *Hydropolitics in the Third World: Conflict and cooperation in international river basins*. Washington: US Institute of Peace Press, 2000, p.32.
[8] Lawrence, P. R., Meigh, J., and Sullivan, C. "The water poverty index: an international comparison". *Keele Economics Research Papers*, No.19, 2002.
[9] Labonte, R. N., Schrecker, T., Sanders, D. *et al. Fatal indifference: the G8, Africa and global health*. Lansdowne: University of Cape Town Press, 2004, pp.157-158.
[10] Srebotnjak, T., Carr, G., de Sherbinin, A. *et al.* "A global Water Quality Index and hot-deck imputation of missing data". *Ecological Indicators*, Vol.17, 2012, 108-119.
[11] Lawrence, P. R., Meigh, J., and Sullivan, C. "The water poverty index: an international comparison". *Keele Economics Research Papers*, No.19, 2002.
[12] Elhance, A. P. *Hydropolitics in the Third World: Conflict and cooperation in international river basins*. Washington: US Institute of Peace Press, 2000, p.30.

states on the banks of the Paranà and between Rosario and Buenos Aires in Argentina[13]. Domestic water withdrawals have gained a more consistent share sue to urbanization process, especially in Argentina, Brazil and Paraguay, while the basin is the most populated region in South America[14]. Moreover, hydroelectric power production has a fundamental role in the region's development, as the La Plata basin «contains one of the largest pools of hydroelectric power potential in the world»[15], and indeed around 75 dams have been built by far[16]. Interestingly, the exploitation of the rivers, due to the geography and historical development of the region, is distributed in a manner that avoids the concentration of activities over a single watercourse: while Paraguay and Uruguay mostly rely on their homonymous rivers, Brazil and Argentina employ the Paranà for their industrial, agricultural and domestic uses[17].

Table 5.1: Water withdrawals, employment and GDP share by sector and hydropower share over total electricity production, 2014[18].

	ARG	BOL	BRA	PAR	URU
Agriculture water %	73.9	92	60	78,6	86,6
Agriculture empl. %	2,1	31	14,6	22,8	9,2
Agriculture GDP %	8	5	13	20,5	7,7
Industrial water %	10,6	1,5	17	6,4	2,2
Industrial empl. %	24,2	20,6	22,9	19,1	21
Industrial GDP %	24,3	27,6	20,5	26	24,7
Domestic water %	15,5	6,5	23	15	11,2
Hydropower %	29	63,2	25,7	100	74,2

Navigation also has a fundamental role in the regional economy: since Paraguay is landlocked and Bolivia lost its access to the Pacific Ocean after the War of the Pacific against Chile in 1884, the Paraguay and Paranà are their only access point to the global market, as

[13] *Ibidem.*
[14] Source: FAO AQUASTAT, http://www.fao.org/nr/water/aquastat/basins/la-plata/index.stm.
[15] Da Rosa, J. E. "Economics, politics, and hydroelectric power: the Parana River Basin". *Latin American Research Review,* Vol.18, No.3, 1983, 77-107.
[16] Source: FAO AQUASTAT, http://www.fao.org/nr/water/aquastat/basins/la-plata/index.stm.
[17] *Ibidem.*
[18] Source: World Bank World Development Indicators, link: http://databank.worldbank.org/data/source/world-development-indicators.

most of the rivers is navigable. Brazil also exploits the waterways to improve its export capacity towards its neighbours and outside the region.

5.3 The La Plata Basin Treaty

Conflicts in the region were mostly related to border demarcation and economic issues between the former Spanish and Portuguese colonial empires and their successor States, while water resources have never been the source of tensions, besides the dispute between Paraguay and Brazil over the Guaira Falls in the 1960s, whose successful resolution will be described in the next section. Instead, several bilateral treaties had been signed between the riparians since 1910 on border, water quantity and quality, navigation and hydropower development issues[19]. Then, the basin countries signed in 1969 the La Plata Basin Treaty, laying down the first legal framework for multilateral cooperation. The treaty established an RBO, consisting in the Meeting of the Chancellors, the Intergovernmental Co-ordinating Committee (CIC)[20] and a Secretariat. The Meeting of the Chancellors defines by unanimity vote the basic policy guidelines of the basin[21], providing the political guide for the basin management and stressing the intergovernmental nature of the RBO. The CIC is instead a permanent body that «promotes, coordinates and conducts multinational actions aimed at promoting the better use of the resources of the La Plata River Basin and harmonious and balanced regional development»[22], composed by two representatives per Member State, one technical and one political[23]. The Secretariat is instead presided by every country on a rotation basis. It is interesting to note that the treaty was signed at time when all the basin States were under military dictatorship, which underlines the low conflict environment in which this broader regime of cooperation was initiated[24].

The most important provision of the La Plata Basin Treaty is Article VI, encouraging the formation of «specific or partial bilateral or multilateral agreements, directed at the fulfilment

[19] Source: International Freshwater Treaties Database, http://gis.nacse.org/tfdd/treaties.php.
[20] See the CIC website, http://cicplata.org/es/inicio/.
[21] La Plata Basin Treaty, 1969.
[22] *Ibidem.*
[23] Alcañiz, I., and Berardo, R. "A network analysis of transboundary water cooperation in La Plata Basin". *Water Policy*, Vol.18, No.5, 2016, 1120-1138.
[24] *Ibidem.*

of the general development goals for the basin»[25], which brought in the to the creation of a complex institutional architecture in the basin. This position was reinforced by the 1971 Declaration of Asunción on the Use of International Rivers, establishing the principle of joint sovereignty over the contiguous sections of the transboundary rivers and calling for the establishment of bilateral agreements between the riparians[26]. The CIC was complemented in 1974 by the creation of the Financial Fund for the Development of the Countries of the Plata Basin (FONPLATA), adding to the RBO the necessary financial capacity to undertake studies and support construction works and environmental projects[27]. Then, a large number of treaties was signed between the riparians on almost all the issues related to the basin's water management, from hydropower projects to water quality and navigation. Worth to be mentioned are the 1973 and 1975 treaties between Argentina and Uruguay, respectively on the joint management of the Rio de la Plata and the Uruguay river, the 1979 Agreement on Paraná River projects between Argentina, Brazil and Paraguay, the 1989 Resolutions No.238 and 239, establishing the Program for the Hidrovía Paraguay-Paraná and its relative committee (Intergovernmental Committee for the Hidrovía Paraguay-Paranà, CIH), and the 1995 Agreement constituting the trilateral commission for the development of the Pilcomayo river basin between Argentina, Bolivia and Paraguay[28]. The overall organizational structure can be resumed through a classification of the different bodies according to their functional scope[29]:

a) *organizations competent for the whole basin management and development*: this is the case of the CIC and the FONPLATA, tasked with the management of the basin and all its aspects;
b) *organizations addressing specific sub-basins*: they are tasked with the management of single river units within the La Plata basin and are, the JTECPR for the Paraguay river, the CARU for the Uruguay river, the CRA for the Apa river basin, the COBINABE for the Upper Bermejo and Grand Tarija rivers, the TCDPRB for the Pilcomayo river, the CRQ for the Quaraí river and the CARP for the Rio de la Plata;

[25] La Plata Basin Treaty, 1969.
[26] CIC Plata *Resolución No.25 de la IV Reunión de Cancilleres de los países de la Cuenca del Plata, Declaración de Asunción sobre aprovechamiento de ríos internacionales*. Asunción: CIC Plata, 3 June, 1971.
[27] See the FONPLATA website, http://www.fonplata.org.
[28] Source: International Freshwater Treaties Database, http://gis.nacse.org/tfdd/treaties.php.
[29] The list of the cited organizations can be found in CIC Plata, *Marco institucional y legal para la gestión integrada de los recursos hídricos en la Cuenca del Plata*. Washington: Organization of American States, 2017.

c) *organizations addressing single stretches of the rivers*: dedicated to the management of single parts of the basin not referable to a sub-basin, created for localized necessities, they are the COMIP and the CCDFR for the section of the Paranà river shared by Argentina and Paraguay (the first is for water management, the second for fisheries conservation), the BACLRPB for the Lower Pilcomayo river and the JTC for stretches of the Uruguay river;
d) *technical commissions for navigation*: tasked with the construction and maintenance works for the navigable waterways, the only present is the CIH for the Hidrovía Project, encompassing most of the basin;
e) *binational commissions for energy projects*: tasked with the management of joint projects for hydropower developments, they are the Itaipu Binational Entity, the Yacyretá Binational Entity, the Salto Grande Joint Technical Commission and the CC for the Garabi Pananmbi Project;
f) *organizations managing single aquifers*: is a new type not yet functional, the only present to date is the GAC for the Guarani aquifer[30].

This overview of the detailed institutional structure for the La Plata basin management shows that cooperation between the riparians is quite well developed: the La Plata Basin Treaty has worked as an "umbrella agreement", laying the principal guidelines for binational and trinational treaties related to specific sub-basin, river sections, technical issues and single projects were they are needed. It is thus based on a "problem-shed" concept, aiming at solving the challenges arising in the basin, instead of creating standardized institutions for water management as prescribed by IWRM. However, it is not flawless, as many cases of competences overlapping can be observed: the Paraguay river is influenced by eight organizations and the Paranà by six, as well as Paraguay, including the CIC, the FONPLATA and the CIH, which encompass all the five countries. All these overlapping organizations also have a difference in inclusion: on the Pilcomayo there is a clear overlap between the trinational commission TCDPRB and the binational one for the lower part of the river BACLRPB, the Paranà section shared by Argentina and Paraguay is governed by both COMIP and Yacyretá Binational Entity, without considering the CIC, the CIH and the other

[30] Villar, P. C. "International cooperation on transboundary aquifers in South America and the Guarani Aquifer case". *Revista Brasileira de Política Internacional*, Vol.59, No.1, 2016.

organizations working on that river, etc. Thus, the major issue that has to be addressed is the coordination between all these entities, in order to reduce overlaps and improve the efficiency in the basin management. Few frameworks for the coordination between the different organizations are in place, although they have been established mostly for the conduction of specific projects funded by international organizations, and thus risk to end together with the projects[31]. The CIC is the only body that can enhance the establishment of an institutionalized and stable regime of coordination between the different organizations, but it attempts have been rather weak in this direction[32].

5.4 The Itaipu and Yacyretà dams' case

The construction of the Itaipu and Yacyretà dams is an interesting case that exemplifies the cooperation among the riparians during the second half of the 20th century. The regional politics has always revolved around the competition between Spain and Portugal in regard of their respective colonial empires, and their major successor States, Argentina and Brazil. Indeed, the republics of Uruguay and, in particular, Paraguay served as a buffer zone between the two major neighbours, which were not able to agree on a partition of the border region[33]. By then, the country employed the so called "pendular diplomacy", balancing the claims of both neighbours, although Argentina had a major economic influence thanks to the Paraguay-Paranà link. However, with the resort of Brazilian expansionism in the 1950s and the need of new energy sources, the issue of the delimitation of the border at the Guaira Falls, unsettled during the previous decades, rose again[34]. However, when the tensions escalated in 1965 with the Brazilian military occupation of the area, the two countries went to the negotiating table for the construction of a joint hydroelectric dam, agreeing on an equal share of the energy produced. Interestingly, they jointly stated the common ownership of the hydroelectric potential of the Guaira Falls with the 1966 Acta de Foz de Iguazu, but did not renounce their

[31] Villar, P. C., Ribeiro, W. C., and Sant'Anna, F. M. "Transboundary governance in the La Plata River basin: status and prospects". *Water International*, Vol.1-18, 2018.
[32] *Ibidem.*
[33] Elhance, A. P. *Hydropolitics in the Third World: Conflict and cooperation in international river basins*. Washington: US Institute of Peace Press, 2000, p.34.
[34] Da Rosa, J. E. "Economics, politics, and hydroelectric power: the Parana River Basin". *Latin American Research Review*, Vol.18, No.3, 1983, 77-107.

territorial claims on them[35]. Nevertheless, the area was planned to be submerged by the artificial lake resulting from the construction of the Itaipu dam, thus eliminating the object of the dispute. However, the treaty was signed only in 1973: the parties agreed on the construction of the largest dam in the world at the time, surpassed only in 2012 by the Chinese Three Gorges plant in terms of installed capacity[36], Moreover, the parties decide to contribute to the project and share the benefits on an equal level, but the huge disparity in economic and financial resources between the two countries resulted in Brazil providing most of the funding and the equipment to Paraguay in the form of loans[37]. The ownership of the site was conceded to a binational corporation equally composed by the representatives of the two national electricity companies, ANDE for Paraguay and ELECTROBRAS for Brazil[38]. Another issue is related with the equal sharing of the electricity production: since Paraguay could not absorb all of its production, it supposedly had to sell it abroad. The Itaipu Accord however guaranteed to one partner the exclusive right to buy all of the surplus energy for a fixed price established, meaning that Brazil had at its disposal a relevant amount of cheap energy for its development goals[39].

By the time the Itaipu dam was at its first stages of negotiation between Brazil and Paraguay, Argentina took actions on a multilateral and bilateral level: its major concern was that the project of the dam had been undertaken without its prior consensus or consultation and its impact on the downstream activities, included navigation and development of hydropower capacity. Thus, it brokered the international meetings that led to the signature of the La Plata Basin treaty and the creation of the CIC, while at the same time entered in negotiations with Paraguay for the joint construction of a hydroelectric dam, copying exactly the Itaipu Accord. Indeed, the Yacyretà Accord and the dam project was nothing but the blueprint from the Itaipu dam[40]. The differences between the two treaties rely on the modality by which Paraguay can sell its electricity surplus: indeed, it can sell to Argentina at a fixed

[35] *Ibidem.*
[36] Siegel, K. M. Regional Environmental Cooperation in the La Plata River Basin. In Siegel, K. M., Regional Environmental Cooperation in South America (pp. 91-121). London: Palgrave Macmillan, 2017.
[37] Elhance, A. P. *Hydropolitics in the Third World: Conflict and cooperation in international river basins*. Washington: US Institute of Peace Press, 2000, p.42.
[38] Da Rosa, J. E. "Economics, politics, and hydroelectric power: the Parana River Basin". *Latin American Research Review,* Vol.18, No.3, 1983, 77-107.
[39] *Ibidem.*
[40] Elhance, A. P. *Hydropolitics in the Third World: Conflict and cooperation in international river basins*. Washington: US Institute of Peace Press, 2000, p.45.

preferential price (higher than the one agreed in the Itaipu Accord[41]) established in the treaty, but it could also sell to its other countries[42].

The debate on whether Paraguay is receiving a fair compensation for its share of electricity production is rather controversial: while the small country claims to being remunerated unfairly by its neighbours, Brazil and Argentina affirm that it is benefitting from infrastructural projects that could have never been able to build by itself. Nevertheless, the Itaipu and Yacyretà dams' case shows how the principle of formal equality in the riparians' relations have been established and how these joint infrastructural projects create interdependencies between the countries, thus enhancing cooperation.

5.5 Discussion of the empirical analysis and conclusion

The La Plata basin, shared by Argentina, Bolivia, Brazil, Paraguay and Uruguay, is a *sui generis* case of cooperation on transboundary waters, stemming from the competition between the two major countries, Argentina and Brazil, for regional hegemony. Given the large amount of water in the basin in the form of river runoff, aquifers and precipitation, physical scarcity is not an issue. However, parts of the population do not have access to safe drinking water and environmental concerns are increasing due to economic development causing pollution and large infrastructural works affecting the ecosystems and the regular flow of the river. Nevertheless, economic activities are fairly distributed between the Paranà river and its major tributaries.

The five countries signed in 1969 the La Plata Basin Treaty, a framework agreement establishing the guidelines for bilateral and multilateral cooperation in the basin, as well as an RBO for the whole basin management, the CIC. In the following decades the basin countries engaged in several agreements, including the management of sub-basin and single sections of the river, the development of projects related to hydropower production and the improvements for the rivers' navigability as a tool of economic development. Although all these developments are remarkable, more coordination is needed between the different

[41] *Ivi,* p.46.
[42] Da Rosa, J. E. "Economics, politics, and hydroelectric power: the Parana River Basin". *Latin American Research Review*, Vol.18, No.3, 1983, 77-107.

organizations, as a flaw of this problem-based approach for institutional development is that the created bodies often have overlapping competences.

The case of the Itaipu and Yacyretà dams show how the countries, although because of competition for regional hegemony, transformed an externality issue in a common-pool resource by declaring joint ownership of the hydroelectric potential while respecting the States' sovereignty. Moreover, they opted for sharing the benefits of hydropower production, making it a plus-sum game: whether Paraguay is entitled of a higher price for its electricity exports, the development of the hydropower potential on the Paranà river provided the country with cheap electricity and a stable rent deriving from its export.

By looking at the independent variables, it is possible to note that water scarcity is almost completely absent from the basin in both terms of quantity and quality, while the access issues, affecting urban peripheries and rural areas, are not within the scope of this study, although they do not appear to influence interstate cooperation. Then, the distribution of economic activities is not conflictual, given their balancing among the major rivers. Finally, information exchange is effectively taking place in the basin at the CIC level and between States, sub-basin entities and technical committees: thus, data are collected and dispersed by and among different organization, allowing accountability and coordination. While the absence of water scarcity explains the lack of conflict over water and the focus on issues unrelated to water allocation in the basin, information exchange can be considered a major driver for cooperation as the riparians build trust among each other and infrastructures can be effectively managed.

CHAPTER SIX

THE SAVA BASIN

6.1 Introduction

The Sava basin has acquired its transboundary nature after the dissolution of Yugolsavia in the early 1990s, and it today shared by Slovenia, Croatia, Bosnia, Serbia and, to a marginal extent, Montenegro and Albania. It is a rather lesser known case of cooperation between riparians, notwithstanding the security issues caused by the ethno-religious tensions in the countries of the Western Balkans.

The basin presents no serious issues regarding water quantity and quality, although some improvements are needed in regard to the environmental management of urban areas. Moreover, floods are a major problem of the region, requiring cooperation between the riparians in order to prevent and avoid damages.

The countries started cooperation after the end of the wars int the former Yugoslavia to achieve economic development and environmental protection supported by the EU, establishing the International Sava River Basin Commission (ISRBC). This resulted in the creation of a comprehensive cooperation framework for navigation and sustainable development, together with harmonization of national legislations with international conventions and the EU *acquis communitaire*. In particular, cooperation has been established between the ISRBC and the International Commission for the Protection of the Danube River, a peculiar relation between basin and sub-basin authorities.

In this chapter, a first description of the geography and hydrology of the basin is given, followed by an analysis of the collected empirical data regarding water scarcity and water uses, the first two independent variables related to the physical context in which countries

interact. Then, the analysis proceeds through the institutional developments within the basin in order to verify the presence of information exchange between the riparians, the third independent variable. Finally, a discussion of the empirical analysis in conducted and conclusions are drawn.

6.2 Basin overview

The Sava is a sub-basin of the Danube river, located in the region of the Western Balkans and is shared by Slovenia, Croatia, Bosnia, Serbia and, marginally, Montenegro and Albania. It originates at the confluence between the Sava Dolinka and the Sava Bohinjka, in the Eastern Alps in Slovenia, and flows trough the capital Ljubljana, before entering the fertile region of the Pannonian Plain in Croatia, cutting through fertile land and the capital Zagreb. Then, it forms the border between Bosnia and Croatia, receiving water from several rivers originating in the Dinaric Mountains in the west, among which the most important in the Drina. Finally, it enters Serbia, where it flows through the capital Belgrade before discharging in the Danube. Its total length is 945 km with an average runoff of 53.611 MCM/year, making it the largest tributary of the Danube in terms of discharge[1]. The terrain in the basin is mostly mountainous, while fertile plains are present between Croatian Slavonia and Serbian Vojvodina.

By looking at the basin's water resources, is it possible to observe that no criticality arises regarding water availability: indeed, the spatial distribution of water risk, there are no zones in which water resources are under particular stress, apart from the area around Belgrade which has a medium risk level. Indeed, the overall Physical Risk Quantity in the basin is 1,3, consistent with the spatial distribution: by decomposing the index, it is possible to note that the Baseline Water Stress is even lower, 0,8, while the greatest concern comes from the flood occurrence in the basin caused by the high levels of precipitation in the upstream mountainous regions, scoring 3,6[2].

[1] ISRBC. *2nd Sava River Basin Analysis Report*. Zagreb: International Sava River Basin Commission, 2016, available at: http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/2nd_sava_river_basin_analysis_report.pdf

[2] Source: WRI Aqueduct Country and River Basin Rankings, link: https://www.wri.org/applications/maps/aqueduct-country-river-basin-rankings/#x=0.00&y=0.00&l=2&v=home&d=bws&f=0&o=-9999&init=y

Map 6.1: Map 6.1: The Sava basin and its Physical Risk Quantity[3].

Regarding water quality, pollution has been kept at a rather low level, excluding the areas around Zagreb and Belgrade[4]: indeed, the WATQI scores for the basin countries are 90,88 for Bosnia, 90,44 for Croatia and 97,62 for Slovenia[5], while it has not been calculated for Serbia and thus it is assumed is lower than the other riparians, but not too far from them. However, the WATQI is not consistent with the WPI Environment component, with upstream Slovenia and Croatia scoring respectively 10,6 and 11,2, while no computation has been made for

[3] Map elaborated with Esri ArcGIS Earth, Physical Risk Quantity layer elaborated by WRI.
[4] ISRBC. *2nd Sava River Basin Analysis Report*. Zagreb: International Sava River Basin Commission, 2016, available at: http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/2nd_sava_river_basin_analysis_report.pdf
[5] Srebotnjak, T., Carr, G., de Sherbinin, A. *et al*. "A global Water Quality Index and hot-deck imputation of missing data". *Ecological Indicators*, Vol.17, 2012, 108-119.

Bosnia and Serbia[6]. Major sources of pollution are agriculture in Croatia, urban wastewater discharges from Bosnia, Croatia and Serbia[7], and lead and zinc mining activities in Bosnia along the homonymous river[8].

Table 6.1 shows that industry plays a very important role in the basin's economy, both in terms of employment and value added, while agriculture is still relevant in terms of employment for Bosnia and Serbia. Although data for the domestic share of water withdrawals are incomplete, is it possible to observe, comparing with the information available, that an important share of water is employed for domestic use, consistent with the pollution generated by urban areas. Then, hydropower occupies a consistent of the basin countries' electricity production, due to the prevalence of a mountainous terrain which is very suitable for the construction of dams, accounting for around 1/3 for Bosnia, Serbia and Slovenia and 2/3 for Croatia.

Table 6.1: Water withdrawals, employment and GDP share by sector and hydropower share over total electricity production, 2014[9].

	BIH	HRV	SRB	SVN
Agriculture water %	NA	2,3	2,8	0,3
Agriculture empl. %	17,1	9,6	21,1	3,5
Agriculture GDP %	7,2	4,1	9,3	2,3
Industrial water %	14,8	22,1	NA	85,5
Industrial empl. %	30	27	24,7	30,9
Industrial GDP %	22,1	22,5	25,2	28,4
Domestic water %	NA	76,7	NA	14,2
Hydropower %	36,7	67	32,9	35,5

[6] Lawrence, P. R., Meigh, J., and Sullivan, C. "The water poverty index: an international comparison". *Keele Economics Research Papers*, No.19, 2002.
[7] ISRBC. *2nd Sava River Basin Analysis Report*. Zagreb: International Sava River Basin Commission, 2016, available at: http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/2nd_sava_river_basin_analysis_report.pdf
[8] Rucevska, I. (Ed.) *Balkan Vital Graphics: Environment Without Borders*. UNEP/Earthprint, 2007.
[9] Source: World Bank World Development Indicators, link: http://databank.worldbank.org/data/source/world-development-indicators.

Finally, navigation has gained an increasing importance for the basin economy: since Bosnia lacks a trading port, although owning a total 25 km of coastline, and Serbia lost its access to the sea after the Montenegrin independence in 2006, the navigability in the lower course of the Sava would allow the two countries to trade with the other riparians along the Lower Danube and reach the Mediterranean through the Black Sea.

4.3 Yugoslavian water management and the International Sava River Basin Commission (ISRBC)

Before the dissolution of Yugoslavia, the Sava river was the largest internal basin of the country, which was managed through a mixed system of integrated water management and high autonomy for the constituent republics, given the more free-market economic approach established by Tito, compared to the Soviet Union. Indeed, «only the regulation of the basic characteristics of water regimes of concern to two or more republics remains at the federal government.»[10] Thus, the federal government was mostly responsible for transboundary watercourses with neighbouring countries and the design of plans for flood protection. Instead, the republics managed the emission of authorizations for water uses, infrastructure construction and pollution prevention. Moreover, they entered in inter-republic agreement when those issues became transboundary among them. Then, ownership rights were conceded even to privates without authorization in certain cases, but in general water uses were generally managed through organizations of associated labour, the basic economic units running factories, hydropower plants, mines and farms[11]. Finally, internal waterways navigation was also developed, and since the Sava was connected to the Danube, it was put under the federal competence.

The large development of heavy industry and the poor management of the Yugoslavian economy in the ‘80s and ‘90s caused serious pollution on the river, but the authorities could not put their clean-up plans in action because of the eruption of the civil conflict in the country, which generated further environmental degradation due to the water and soil

[10] FAO. *Water Law in Selected European Countries, Volume II*. Rome: FAO, Agrarian and Water Legislation Section, 1983, p.124.
[11] *Ivi*, pp.126-133.

contamination from depleted uranium, cadmium, lead and other heavy metals[12]. Moreover, the oil embargo and the NATO bombing campaign caused serious infrastructure disruption, hindering navigation on the river[13]. Moreover, with the dissolution of Yugoslavia the Sava river, together with several other water bodies, became transboundary, making the rehabilitation work more complex.

In the post-conflict environment following the wars in the former Yugoslavia, the new independent States joined in 1999 the EU-sponsored Stability Pact for South-Eastern Europe, which served as a forum to discuss cooperation on several issues, including the Sava river basin[14]. Moreover, the riparians committed to the adoption of the 2000 EU WFD and the Convention on Cooperation for the Protection and Sustainable Use of the River Danube, in light of a future admission in the EU.

In 2002, the four republics signed the International Framework Agreement on the Sava River Basin (FASRB) and an accompanying Protocol on the Navigation Regime, the first voluntary agreement between them[15]. Its main goals are the establishment of an international regime of navigation, sustainable water management, prevention of pollution and extreme events such as floods and droughts and the harmonization of the countries' legislation with the *acquis communitaire*[16]. Cooperation should be conducted under both equitable use and no harm principles, but no hierarchy has been established among them in the agreement, which may lead to several problems in case disputes arise in the future. Then, sovereign equality and territorial integrity shall be respected, while the EU WFD serves as a paradigm for cooperation[17]. Moreover, the agreement envisages the creation of the International Sava River Basin Commission (ISRBC) for the implementation of its goals: a permanent Secretariat is established as the executive body, based in Zagreb and composed by one representant for each member, all having one vote. Then, it has a binding decision-making power regarding navigation issues, while on the other fields it can only make recommendations[18]. Article IV

[12] Stec, S., Kovandžić, J., Filipović, M. *et al*. "A river ran through it: post-conflict peacebuilding on the Sava River in former Yugoslavia". *Water international*, Vol.36, No.2, 2011, 186-196.
[13] *Ibidem.*
[14] *Ibidem.*
[15] *Ibidem.*
[16] International Framework Agreement on the Sava River Basin (FASRB), available at: http://www.savacommission.org/dms/docs/dokumenti/documents_publications/basic_documents/fasrb.pdf
[17] *Ibidem,*
[18] ISRBC. *2nd Sava River Basin Analysis Report*. Zagreb: International Sava River Basin Commission, 2016, available at:

specifically addresses information exchange among the riparians, as they are obliged to «exchange information on the water regime of the Sava River Basin, the regime of navigation, legislation, organizational structures, and administrative and technical practices.»[19] This task has been carried out at both national and ISRBC levels, although the latter has to often relied on data collected by the formers. Nevertheless, cooperation on the issue went down smoothly, with the elaboration of the 2007 Development and Upgrading of the Hydrometeorological Information and Flood Forecasting/Warning System in the Sava River Basin (HMIFFWS), nicknamed as the "Sava Project"[20], and the 2014 Policy on the Exchange of Hydrological and Meteorological Data and Information in the Sava River Basin[21], signed by the national hydrometeorological agencies of the four riparians. These initiatives resulted in the creation, in the following year, of the Sava Hydrologic Information System (HIS)[22], a tool for collecting storing, analysing and reporting real-time hydrological and meteorological data.

6.4 The role of the EU legislation and the Danube Commissions

The EU has been an important actor in the post-conflict environment in former Yugoslavia, providing humanitarian assistance and technical support in many fields, including water. Indeed, the EU supported the initiatives in the Sava basin through funding and know-how transfer, helping the countries in their implementation of the WFD. The Sava basin was in fact designated in 2001 as one of the 13 pilot projects for the implementation of the WFD[23]: the process started in 2006, under the ISBRC Permanent Expert Group for River Basin Management (PEG RBM), with the development of the Sava River Basin Analysis

http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/2nd_sava_river_basin_analysis_report.pdf

[19] *Ibidem.*

[20] ISRBC. *Sava River Basin Analysis Report*. Zagreb: International Sava River Basin Commission, 2009, available at: http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/sava_river_basin_analysis_report_high_res.pdf

[21] ISRBC. *Policy on the Exchange of Hydrological and Meteorological Data and Information in the Sava River Basin*. Geneva: World Meteorological Organization (WMO), 2014, available at: http://www.savacommission.org/dms/docs/dokumenti/documents_publications/basic_documents/data_policy/dataexchangepolicy_en.pdf

[22] See the HIS website, http://savahis.org/his;jsessionid=F0299DCE0EC883F536016D12520762A3

[23] Stec, S., Kovandžić, J., Filipović, M. *et al*. "A river ran through it: post-conflict peacebuilding on the Sava River in former Yugoslavia". *Water international*, Vol.36, No.2, 2011, 186-196.

(SRBA) according to Article V of the WFD[24], which became in 2009 the first comprehensive report for the Sava river basin. Then, development of the Sava River Basin Management Plan (RBMP) started at the end of 2009, with EU support provided through technical assistance managed directly by the DG Environment and by a direct grant to ISRBC for the plan preparation, resulting in its approval in 2014[25]. The WFD laid also comprehensive frameworks for the conduct of the analysis, from classification of water body types to data required for the basin assessment, and for the surface and groundwater monitoring[26].

The Sava riparians also cooperated on flood protection under the 2007 EU Floods Directive, providing the process for effective flood risk analysis and the elaboration of prevention and contingency plans: the result has been the development of the Flood Risk Management Plan in the Sava River Basin (Sava FRMP), which is still under elaboration, and the already mentioned HIS[27]. Moreover, ISRBC has to coordinate the application of the Floods Directive with the WFD, «focusing on opportunities for improving efficiency, information exchange and for achieving common synergies and benefits having regard to the environmental objectives laid down in Article 4 of Directive 2000/60/EC.»[28]

Cooperation in the Sava river basin has been also influenced by the implementation of the Convention on Cooperation for the Protection and Sustainable Use of the Danube River included in the FASRB[29]: the provisions brought the ISRBC to collaborate with the Danube Navigation Commission and the International Commission for the Protection of the Danube River (ICPDR). Indeed, since the Sava river is part of the larger Danube basin, all the three organizations have jurisdiction over the Sava watershed. Thus, the ISRBC signed with the

[24] European Parliament and Council Directive 2000/60/EC of 23 October 2000 establishing a framework for Community action in the field of water policy, available at https://eur-lex.europa.eu/resource.html?uri=cellar:5c835afb-2ec6-4577-bdf8-756d3d694eeb.0004.02/DOC_1&format=PDF

[25] ISRBC. *2nd Sava River Basin Analysis Report*. Zagreb: International Sava River Basin Commission, 2016, available at: http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/2nd_sava_river_basin_analysis_report.pdf

[26] European Parliament and Council Directive 2000/60/EC of 23 October 2000 establishing a framework for Community action in the field of water policy, available at https://eur-lex.europa.eu/resource.html?uri=cellar:5c835afb-2ec6-4577-bdf8-756d3d694eeb.0004.02/DOC_1&format=PDF

[27] ISRBC. *2nd Sava River Basin Analysis Report*. Zagreb: International Sava River Basin Commission, 2016, available at: http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/2nd_sava_river_basin_analysis_report.pdf

[28] European Parliament and Council Directive 2007/60/EC of 23 October 2007 on the assessment and management of flood risk, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32007L0060&from=EN

[29] International Framework Agreement on the Sava River Basin (FASRB), available at: http://www.savacommission.org/dms/docs/dokumenti/documents_publications/basic_documents/fasrb.pdf

Danube Navigation Commission the Joint Statement on Guiding Principles on the Development of Inland Navigation and Environmental in the Danube River Basin, summarizing the principles for the sustainable navigation of the Danube and its tributaries. On the other hand, it has engaged in a cross-cutting cooperation with the ICPDR over hydropower, flood management and environmental issues, exchanging data and harmonizing their practices. Moreover, the ISRBC has been granted the observer status in the works of the ICPDR, participating regularly at the Ordinary and the Working Group Meetings[30].

6.5 Discussion of empirical analysis and conclusion

The Sava is a transboundary sub-basin of the Danube shared by Slovenia, Croatia, Bosnia and Serbia. The basin did not develop outstanding water scarcity issues due to the water available and the low population density. However, some environmental problems arose in the basin, especially after the wars in the former Yugoslavia. Moreover, the region suffers from frequent floods, causing relevant damages to urban settlements and economic activities.

The new independent States established a comprehensive framework for cooperation with EU support by signing the FASRB, which established the ISRBC to carry out the task of managing the river's navigation, sustainable development and pollution prevention. The Commission successfully completed its assessment on the basin and development plans for the general management and flood risk prevention. Moreover, it has brought together the national hydrometeorological agencies in order to improve data collection and diffusion, and enhance transparency by making all the information accessible to the public.

The EU legislation and international law played an important role in shaping the basin's water management, with the implementation of the WFD and the Convention on Cooperation for the Protection and Sustainable Use of the Danube River already prescribed in the FASRB. Indeed, these provisions brought to a tremendous improvement in water quality data collection practices and the harmonization of the national legislation regarding navigation, water infrastructural development and environmental protection.

By looking at the independent variables, it is possible to note that water scarcity is almost completely absent from the basin in both terms of quantity and quality, although floods are a

[30] Source: http://www.savacommission.org/news_detail/28

relevant issue. Then, the distribution of economic activities is not conflictual, given their sequencing along the stream and their relative contribution to the river's pollution. Finally, information exchange is effectively taking place in the basin, both at the Commission and at the national level, with harmonized practices for data collection, an institutional framework for their sharing between the countries, the ISRBC and the ICPDR and the transparency of the published data.

Although the region has been plagued by ethno-religious conflicts, some of them still not completely resolved today, water has been conductive for cooperation between the riparians, since its abundance, coupled with the shared interest on the environmental protection and navigation potential of the Sava river, has not only prevented conflicts, but also promoted collaboration between the countries. Moreover, the EU support has speeded up this process, paving the way for a more sustainable peace in the region.

CONCLUSION

This work tried to answer the research question: *why and in which modalities do States cooperate on international river basins in which three or more riparians are present?* To this end, a qualitative study has been conducted through the analysis of three different independent variables in four selected cases.

The outcome of the analysis is consistent with the preliminary results exposed in Chapter two: moderate water scarcity and compatible water uses positively influence cooperation, while the presence of information exchange in treaty provisions does not appear to have an effective influence.

Regarding extreme water scarcity, the Kura-Araks case has showed that it is sufficient for it to be concentrated only in one area of the basin (in this case downstream) to negatively affect cooperation. More interestingly, the issues around which conflict and cooperation revolve in the basin vary with the level of scarcity: while in the Kura-Araks, and especially in the Aral Sea cases, water allocation was the most discussed issue, in the La Plata and Sava basin the most relevant problems generally regarded hydropower development and environmental protection. Thus, the results were consistent with the scarcity-cooperation nexus exposed in Chapter two, although further research is needed to elaborate specific models for each of the different fields of cooperation.

Regarding the compatibility of water uses, its influence has been remarkable: in the Kura-Araks and Aral Sea cases disputes over water releases and effluent discharges severely hindered cooperation, adding tensions to the already controversial issue of water allocation, while especially in the La Plata basin the coordination of water releases for hydroelectricity production and the rivers' navigation has promoted economic development and trust-building among the riparians.

Instead, information exchange did not act as expected: the Aral Sea has indeed represented an anomalous case in this regard: although several agreements, institutions and provisions establishing exchange of hydrological data between the riparians, the basin countries refused to cooperate and information became another controversial issue further hindering cooperation. A possible explanation is that geographical factors, such as water scarcity, have a major influence in determining a more or less cooperative outcome when compared to

institutional ones. Thus, it has to be concluded that the institutional resources within the basin are not sufficient to overcome the problems deriving from extreme water scarcity: in that case even the heavy influence of external actors in the establishment of basin management institutions has proven to be not sufficient to overcome the scarcity problem. Nevertheless, in the Kura-Araks case support from international organizations was relevant to start cooperation between the riparians, although it came to an end together with the external funding. Thus, it is possible to argue that international organizations and external actors can have an impact if they provide proportional support and capacity-building in the basin. Otherwise, the outcome will be dependence of the recipients and return to the *status quo ante* when the programs are terminated. Nevertheless, this does not fall within the scope of this study, and further research is needed in this direction.

The results obtained in this study integrate the present literature and provide new suggestions on the scarcity-cooperation nexus, as well as new directions for further research on the subject. Moreover, creative solutions for scarcity-related issues should be elaborated, including the trade on virtual water and the transition to more water-efficient technologies, by analysing the basins on a case-to-case basis, as river basins are mostly unique units for their geographical, climatic, cultural and historical characteristics.

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