AMERICAN UNIVERSITY OF BEIRUT

REVIEWING THE 1994, 1997, AND 2002 AGREEMENTS ON THE ORONTES RIVER: IS LEBANON'S SHARE FAIR AND EQUITABLE?

by
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ABSTRACT
OF THE PROJECT OF

Christopher Colby Peterson for Master of Arts
Major: Public Policy and International Affairs

Title: Reviewing the 1994, 1997, and 2002 Agreements on the Orontes River: Is Lebanon's Share Fair and Equitable?

In the age of the Anthropocene, humanity's access to and sustainable use of water resources have increasingly become objects of concern. One factor complicating this is when water resources flow across borders. Covering nearly half of Earth's surface, such transboundary river basins are shared by two or more states. Treaties on the use of these basins range from coercive to cooperative, reflecting various conceptualizations of sovereignty.

Lebanon is home to a major transboundary watercourse: the Orontes River. The Orontes originates in Lebanon, flowing in a northerly direction through Syria and Turkey before discharging into the Mediterranean. A series of treaties between Lebanon and Syria on the use of the river's flows emerged in the mid 1990s, being reformed twice to result in a finalized 2002 agreement allocating Lebanon 96 million cubic meters (MCM) out of 403 MCM measured at the Hermel Bridge gauge. This project seeks an answer to the question of whether these treaties allocate Lebanon a share of water that can be considered "fair and equitable." Focusing on the area south of Ar-Rastan, Syria, remote sensing is used alongside available data to estimate the riparians' consumptive use of the Orontes' flows. Potential water rights allocations (WRAs) are constructed for the distribution of the river's flows between the two riparians, each emphasizing different statistics as espoused by Dinar and Nigatu (2013), Dinar and Tsur (2017) and the 1997 UNWC. These WRAs emphasize practical and actionable solutions to the question of improving the final 2002 agreement.

Through a study on the Orontes Basin south of Ar-Rastan, this project aims to contribute to the growing literature on transboundary watercourse governance, providing a platform from which various principles related to the distribution of transboundary water in the age of the Anthropocene can be compared and contrasted.

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ABBREVIATIONS

m^3 : Cubic meters
MENA: Middle East-North Africa
MCM: Million cubic meters
UN: United Nations
UNWC: The 1997 United Nations Convention on the Law of the Non-navigational Uses of International Watercourses
WRA: Water rights allocation

DEDICATION

This project is dedicated to the people of the Arab nation, amongst whom I have had the pleasure of living for the past four years. You have taught me numerous things about myself and the world. May you all be blessed with the peace and well-being that you have long deserved.

CHAPTER 1

INTRODUCTION

The widespread availability of water is a hallmark of modern civilization. Many anxieties surrounding access to and use of water have been amplified in the current geological epoch of the Anthropocene. With some citing the detonation of the first atomic bomb as the event that heralded its arrival, the Anthropocene can be understood as the age in which humans have made a permanent mark on the Earth; we have effectively changed the "nature of nature."[1] Indeed, Earth's water resources that are so vital to humankind are increasingly being put under pressure by rising global temperatures; unless efforts are made to ensure that water is used efficiently and responsibly, this pressure will be compounded. In the countries of the MENA[2] region, water is amongst the most precious resources needed to sustain daily life. Many of the region's countries are ranked by multiple sources in the top-ten most water-stressed countries in the world.[3] As the phenomena of climate change continues, already scarce regional water resources will be put under increasing pressure. In addition, population growth is likely to be another factor that increases stress on water resources in the region.

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[1] Richard Monastersky, "First Atomic Blast Proposed as Start of Anthropocene," *Nature*, January 16, 2015, https://www.nature.com/news/first-atomic-blast-proposed-as-start-of-anthropocene-1.16739.

[2] Middle East-North Africa

[3] For examples of such country ranking systems, see "Aqueduct Country Ranking: Baseline Water Stress" (World Resources Institute, 2019), https://www.wri.org/applications/aqueduct/country-rankings/; "Goal 6 - Clean Water and Sanitation; Indicator 6.4.2 - Level of Water Stress: Freshwater Withdrawal as a Proportion of Available Freshwater Resources" (Food and Agriculture Organization of the United Nations, 2017), https://public.tableau.com/shared/GNSS5WC22?:display_count=y&:origin=viz_share_link&:embed=y.

One factor that adds another layer of complexity into the equation is when water resources flow across borders. Making up over 250 bodies of water and covering almost fifty percent of Earth's surface,[4] transboundary water resources are river basins, aquifers, and lakes shared by two or more countries.[5] Owing to one of the fundamental characteristics of water—it flows—it is a difficult resource for countries to manage in a way that ensures equitable access, while simultaneously respecting one of the key tenants of the international order: sovereignty. Groundwater resources are another factor that complicates this issue, as they are often unmeasured and ungoverned. The importance of groundwater ranges from minor to major depending on the geology of the watershed in question. The inclusion of groundwater in transboundary agreements is often neglected, with the focus being placed primarily on surface water.

The 1997 United Nations Convention on the Law of the Non-navigational Uses of International Watercourses[6] outlines a number of prescriptions for riparians of transboundary watercourses to follow in order to arrive at equitable agreements for the use of the watercourse in question. Examples of these guidelines include taking into account the social and economic needs of riparian states, and the geographic, hydrological, climatic, and ecological nature of the water basin in question.[7] Transboundary agreements exist on a spectrum ranging from cooperative to coercive. Cooperative agreements often exist when transboundary resources are plentiful; an agreement is more likely to be coercive when the water resource in question is under

[4] "Transboundary Waters," United Nations | International Decade for Action 'Water For Life' 2005-2015 (United Nations), https://www.un.org/waterforlifedecade/transboundary_waters.shtml.

[5] "Transboundary Waters," United Nations Water, accessed December 10, 2021, https://www.unwater.org/water-facts/transboundary-waters/

[6] Hereinafter, "the 1997 UNWC" or "the UNWC."

[7] 1997 UNWC, Article 6

heavy consumptive use by one or more riparians. Under these high demand situations, the framework provided by the 1997 UNWC may provide insufficient guidance, and the most powerful country in a given basin may coerce other riparians into signing an agreement that is not within their interests. Poor transboundary governance, combined with the effects of climate change and increasing demographic pressures, may result in tensions arising between a watercourse's riparian states. In addition, without proper governance, funding for water projects may be difficult to obtain.

Oftentimes, a frame of reference is lacking in the formulation of transboundary agreements, especially in those basins under high stress. As a result, there may be a lack of a "starting point," or range of possible, reasonable solutions that can be considered fair and equitable. Water rights allocations (WRAs) as described by Dinar and Nigatu are a useful method of determining a wide range of water allocations based upon the UNWC and other methodologies. These WRAs can be based around various characteristics of the riparian states, such as population distribution, arable land distribution, the source of the watercourse, and historical use of a river basin, amongst others.[8] Such a methodology can be seen as an attempt at defining a fair and equitable starting point for transboundary negotiations—an attempt to quantify the qualitative norms espoused in the 1997 UNWC. Thus, WRAs may help to prevent hegemony during transboundary negotiations.

Lebanon, despite its heavy winter precipitation, is no stranger to vulnerability of water resources. Pressure on Lebanon's water resources is due to myriad factors,

[8] Ariel Dinar and Getachew S. Nigatu, "Distributional Considerations of International Water Resources under Externality: The Case of Ethiopia, Sudan and Egypt on the Blue Nile," *Water Resources and Economics* 2–3 (October 2013): 14, https://doi.org/10.1016/j.wre.2013.07.001.

including population growth and urban expansion, the Syrian Refugee Crisis,[9] a lack of reliable electricity, system losses due to a lack of maintenance and theft,[10] as well as a lack of reasonable and comprehensive transboundary watercourse agreements with its neighbors. Lebanon is also home to a major transboundary watercourse: the Orontes River. Known in Arabic as *Nahr al-Assi*—the rebellious river—the Orontes springs from Lebanese territory and flows in a northerly direction through Syria and Turkey before discharging into the Mediterranean Sea. There are a number of successive treaties between Lebanon and Syria that deal with the allocation of the waters of the Orontes. In 1994, the two countries signed the Agreement on the Distribution of the Water of the Orontes River Originating from Lebanese Territory Between the Lebanese Republic and the Syrian Arab Republic,[11] which was amended in 1997,[12] and 2002.[13] It may be argued that the agreements started off as coercive (1994), with Syria establishing a hegemonic position. With time, the agreements evolved to become *slightly* more cooperative (1997 & 2002), though Syria has retained many aspects of its hegemonic status. Ultimately, there is a need for a better starting point in transboundary negotiations, especially under conditions of hegemony The Orontes River is no exception.

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[9] "Lebanon | Globalwaters.Org," Globalwaters.org, accessed December 5, 2021, https://www.globalwaters.org/wherewework/middleeast/lebanon.

[10] "Water Supply Systems on the Verge of Collapse in Lebanon: Over 71 per Cent of People Risk Losing Access to Water," July 23, 2021, https://www.unicef.org/press-releases/water-supply-systems-verge-collapse-lebanon-over-71-cent-people-risk-losing-access.

[11] The Lebanese Republic and the Syrian Arab Republic، "اتفاق يتعلق بتوزيع مياه نهر العاصي النابعة في الأراضي اللبنانية بين الجمهورية اللبنانية والجمهورية العربية السورية" (1994)، http://77.42.251.205/DownloadAgreementPage.aspx?Target=All&type=2&ID=3833&language=ar.

[12] Ibid، "ملحق لاتفاق توزيع مياه نهر العاصي النابعة في الأراضي اللبنانية" (1997)، http://77.42.251.205/Law.aspx?lawId=8864.

[13] Fadi G. Comair and Michael Scoulllos, "Orontes Hydro-Diplomacy: Historical Overview and Lebanon's Transboundary Water Treaties," in *Science Diplomacy and Transboundary Water Management: The Orontes River Case*, ed. Roberta Ballabio et al. (Paris; Venice: UNESCO, 2015), 34.

1.1 Statement of Problem & Research Question

This project seeks to determine if the 1994, 1997, and 2002 Agreements allocate to Lebanon a quantity of Orontes water that can be considered "fair and equitable." It also aims at providing a range of possible alternative allocations based around various statistics of the two riparian states. The project's analysis will be limited to the area above (i.e., south of) Ar-Rastan, Syria due to the fact that this portion of the basin is fed almost exclusively by water originating within Lebanon; the area below (i.e., north of) Ar-Rastan has significant contributions from Syrian groundwater recharge areas.[14] During this analysis, the following questions will be examined:

I. How and where is the water being consumed in the area of interest?

II. What is a range of reasonable allocations of water between Syria and Lebanon using the methodologies of the WRAs described in Dinar and Nigatu[15] and Dinar and Tsur?[16]

III. Given the results of *I* and *II*, what solutions can be examined to help facilitate fair and equitable distribution of water in the Orontes basin?

1.2 Literature Review

It has been noted by Dinar and Nigatu that "common pool resources, such as international river basins with multiple riparian states, are hard to manage efficiently

[14] Myriam Saadé-Sbeih et al., "Groundwater Balance Politics: Aquifer Overexploitation in the Orontes River Basin," *Water Alternatives* 11 (October 10, 2018): 677.

[15] Dinar and Nigatu, "Distributional Considerations of International Water Resources," 1–16.

[16] Ariel Dinar and Yacov Tsur, *Management of Transboundary Water Resources under Scarcity: A Multidisciplinary Approach* (WORLD SCIENTIFIC, 2017), https://doi.org/10.1142/9896.

and equitably."[17] Transboundary watercourses may be altered or impacted in ways that have harmful consequences for riparian states through pollution, overuse, introduction of harmful species, and the construction of dams, amongst other factors.[18] When combined with the effects of increasing demographic pressures and climate change in the Anthropocene, and in the absence of effective governance structures, these watercourses may arise as significant points of contention between riparian states. There are a variety of consequences that could be brought about in a country suffering from stressed water resources. While some may occur on a generational scale or be otherwise scarcely perceptible, it is possible for more acute and immediate consequences to occur, with wide-ranging implications for the country in question. One possible scenario could be a state failing to provide the most basic levels of sustenance to its citizens, by virtue of damaged or destroyed capacities to raise crops and/or livestock, or depletion of freshwater resources.[19] Because of this water scarcity-climate change-demographic pressure nexus, there is a need for more data, better understanding of regional watersheds, and a bolstering of governance. The Orontes River Basin is again no exception to this.

Under conditions where a given transboundary river basin is not under pressures from climate change and/or demographic pressures, reaching an agreeable arrangement between riparians can be fairly straightforward. A good example of such a case is the

[17] Dinar and Nigatu, "Distributional Considerations of International Water Resources," abstract.

[18] Sabine Brels et al., *Transboundary Water Resources Management: The Role of International Watercourse Agreements in Implementation of the CBD* (Montreal, Quebec: Secretariat of the Convention on Biological Diversity, 2008), http://www.cbd.int/ts/.

[19] David Michel et al., "Water Challenges and Cooperative Response in the Middle East and North Africa," 2012 U.S.-Islamic World Forum Papers (The Brookings Institution, November 2012).

Senegal River Basin, which has witnessed marked cooperation between its riparians.[20] However, under conditions where a basin is experiencing pressures from various sources—such as intensive consumptive use by crops—it may be more difficult to reach an agreement between a basin's riparians, and a hegemonic state, or hydro hegemon, may use this to its advantage to formulate a non-equitable agreement. Defined by Zeitoun and Warner, hydro hegemony is:

> …hegemony at the river basin level, achieved through water resource control strategies such as resource capture, integration and containment…that are enabled by the exploitation of existing power asymmetries within a weak international institutional context.[21]

Hegemonic configurations on river basins are not intrinsically "negative" or "damaging"—it is possible for a hegemonic country to play a leadership role, ultimately fostering greater stability and cooperation in a transboundary river basin. However, "[w]hat looks favourable from a hegemonic perspective…may not always be perceived in the same manner from the weaker state's vantage point." Indeed, hegemonic configurations may result in a situation in which one state makes all the decisions, resulting in inequitable usage conventions; such negative hegemonic configurations have been noted to be widespread in the MENA region.[22] The framework of hydro hegemony helps to analyze both covert and overt forms of power, and how hegemonic and non-hegemonic riparians alike can harness these powers to effect changes in transboundary basins. According to Cascão and Zeitoun, there are four pillars of power that can be tapped by riparians of a transboundary basin:

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[20] Margaret J. Vick, "The Senegal River Basin: A Retrospective and Prospective Look at the Legal Régime," *Natural Resources Journal* 46, no. 1 (2006): 211–43.

[21] Mark Zeitoun and Jeroen Warner, "Hydro-Hegemony – a Framework for Analysis of Trans-Boundary Water Conflicts," *Water Policy* 8, no. 5 (October 1, 2006): abstract, https://doi.org/10.2166/wp.2006.054.

[22] Ibid, 439.

- Geographic power: the upstream riparian of a transboundary watercourse can alter its flows in a way that affects or precludes the ability of downstream riparians to use its flows.
- Material power: perhaps the most "traditional" conceptualization of power in international affairs, this dimension of power includes a state's financial resources, technological "know-how," military power, and standing in the international community.
- Bargaining power: a riparian's ability to "control the rules of the game and set agendas." Notably, bargaining power might be available to weaker riparians, bestowing upon them an ability to maintain a degree of influence over stronger riparians.
- Ideational power: a state's ability to control perceptions and ideas about itself and its use of transboundary flows. For example, a hydro hegemon might take advantage of the lack of data on a transboundary watercourse in order to manipulate other riparians' decision-making abilities.[23]

In the context of the Orontes Basin, Syria is without doubt the hydro hegemon. It set the framework within which Lebanon agreed to the 1994, 1997, and 2002 Agreements, while simultaneously denying Turkey a spot at the negotiating table by rejecting all Turkish claims to sovereignty over the basin.[24] Most notably, all negotiations between Lebanon and Syria on the use of the Orontes took place while the former was under the

[23] Ana Elisa Cascão and Mark Zeitoun, "3: Power, Hegemony and Critical Hydropolitics," in *Transboundary Water Management: Principles and Practice.*, by Anton Earle (Hoboken: Taylor and Francis, 2013), 32, http://grail.eblib.com.au/patron/FullRecord.aspx?p=585455.

[24] The Turkish portion of the Orontes Basin lies in the territory known to Turkey as "Hatay." Syria considers this province to be occupied by Turkey, referring to it as "لواء الاسكندرون" (*liwa' aliskenderun*). For this reason, Syria does not consider the Orontes to flow through Turkey.

occupation of the latter.[25] This undoubtedly created a situation of power asymmetry. However, as will be shown, Lebanon was able to use certain powers identified above to improve its position vis-a-vis Syria on the basin.

Ultimately, factors relevant to arriving at an equitable agreement as espoused by the 1997 UNWC are somewhat subjective: they require riparians to negotiate in good faith, and choose from a wide range of negotiation possibilities. When good faith is lacking, or power asymmetry exists, the articles of the 1997 UNWC may be too open ended, and lack prioritization and quantification. For example, in managing the Orontes River Basin with Lebanon, Syria has focused on individual portions of the 1997 UNWC, such as Article 7 (the obligation to not cause significant harm), without taking a holistic approach to the document. Under these stressed and hegemonic conditions, the use of water rights allocations (WRAs) as described by Dinar and Nigatu might be methods conducive to reducing conflict and promoting equity between a basin's riparians. They give reasonable starting points for allocating each state a share that can be mutually agreed upon and may help to define a minimum allocation of water to the riparians of a transboundary watercourse. In attempting to create a model for the equitable distribution of the waters of the Nile between Ethiopia, Sudan, and Egypt, Dinar and Nigatu propose three WRAs.[26] WRA-I, adapted from Whittington et al. (1995) is based on a compromise between Egypt's position of prior use (Article 6 of the 1997 UN Watercourse Convention) and that Ethiopia's share should be minimal due to the fact it has other water sources, and Ethiopia's stance that it has a right to develop all

[25] This project uses the term "occupation" in a broad sense, acknowledging that various elements within Lebanon welcomed the Syrian presence. Furthermore, the 1991 "Treaty of Brotherhood, Cooperation, and Coordination" signed between the two countries legitimized Syria's presence in Lebanon. In spite of this, other elements of Lebanese society strongly decried Syria's activities.

[26] Dinar and Nigatu, "Distributional Considerations of International Water Resources," 14.

irrigable area within its territory in the basin. It allocates 12.2% of the Nile's waters to Ethiopia, and 22% and 65.8% to Sudan and Egypt, respectively. WRA-II is adapted from Article 5 (equitable and reasonable utilization and participation) of the 1997 UNWC, and allocates water resources based on 1960 census figures. Under this model, Ethiopia is allocated 38.4% of the Nile's waters, whereas Sudan and Egypt are allocated 14.1% and 47.5%, respectively. Finally, WRA-IV is adapted from Beaumont (2000), and allocates Ethiopia half of the Nile's waters, owing to its being the source of the Blue Nile, and then divides the remainder between Sudan (12.5%) and Egypt (37.5%) based on their historic use patterns of the river. These WRAs for the Nile were proposed to help reduce Egyptian hegemony on the Nile River. The relevance of WRAs can be found in their ability to define a minimum allocation of water to riparians, possibly negating some of the more negative, dominating aspects of hegemony.

Flowing from south to north, the Orontes River is primarily used for irrigation by the three riparian states. Depending on the source, the Orontes is either the second or third largest river in Lebanon in terms of annual flow.[27] Lebanon's Zarqa spring is the largest in the basin, contributing an average flow of between approximately 347–429 MCM/year.[28] In spite of this significant contribution, Lebanon has been allocated a relatively small share of the river's flows. As noted by Comair and Scoullos, the 1994

[27] The Litani is the largest river in Lebanon. According to the Lebanese Ministry of the Environment (2001), the Nahr Ibrahim's annual flow is 508 MCM, and the Orontes' is 480 MCM; Bakalowicz (2009) gives a figure for the annual flow of the Ibrahim of 319 MCM and 656 MCM for the Orontes. See "Lebanon's Second National Communication to the United Nations Framework Convention on Climate Change" (Republic of Lebanon - Ministry of Environment, February 2011), 9, https://unfccc.int/sites/default/files/resource/lebanon_snc.pdf.

[28] Economic and Social Commission for Western Asia (ESCWA) and Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), "Chapter 7 - Orontes River Basin," in *Inventory of Shared Water Resources in Western Asia*, E/ESCWA/SDPD/2013/Inventory (Beirut: United Nations, 2013), 232, http://waterinventory.org/sites/waterinventory.org/files/00-inventory-of-shared-water-resources-in-western-asia-web.pdf.

agreement between Syria and Lebanon on the use of the Orontes contains several weaknesses as it was signed when Lebanon was under Syrian occupation.[29] An annex was added to the agreement in 1997 in response to Lebanese claims that it was not equitable, allowing for the exclusion of several water sources in Lebanon from the agreement.[30] However, as noted by Makdisi, even after the 1997 Annex was put into force, the Syrian Army continued to patrol the Orontes Basin and harass Lebanese who desired to make use of the Orontes' waters.[31] A further amendment was made in 2002, resulting in Lebanon being allocated additional water, and Syria blessing the construction of two dams on the Lebanese portion of the watercourse. In spite of these adjustments, it is questionable if the agreements signed between Lebanon and Syria during this era can be considered equitable. Indeed, according to Makdisi, "Syria…essentially dictated the terms within which Lebanon agreed" to the 1994 and 1997 Agreements,[32] and the reality remains that the final amendment in 2002 was made when Lebanon was still under Syrian occupation. The contrast in the amounts allocated to the two riparians can quite literally be seen from space: Figure 1 on the following page shows a sharp increase in the number of irrigated areas immediately after the Orontes crosses the border from Lebanon into Syria. If both countries are to consider

[29] Fadi G. Comair and Michael Scoullos, "Orontes Hydro-Diplomacy: Historical Overview and Lebanon's Transboundary Water Treaties," in *Science Diplomacy and Transboundary Water Management: The Orontes River Case*, ed. Roberta Ballabio et al. (Paris; Venice: UNESCO, 2015).

[30] Nouar Shamout, "Syrian Perspective on Transboundary Water Management in the Orontes Basin," in *Science Diplomacy and Transboundary Water Management: The Orontes River Case*, ed. Roberta Ballabio et al. (Paris; Venice: UNESCO, 2015), 97.

[31] Karim S. Makdisi, "Trapped Between Sovereignty and Globalization: Implementing International Environmental and Natural Resources Treaties in Developing Countries: The Case of Lebanon" (Dissertation, Medford, Massachusetts, The Fletcher School of Law and Diplomacy (Tufts University), 2001), 304.

[32] Ibid, 305.

the flows of the Orontes to be of "mutual benefit,"[33] as stipulated by Article 1 of the 1994 Agreement, how might such a clear disparity in usage patterns be explained?

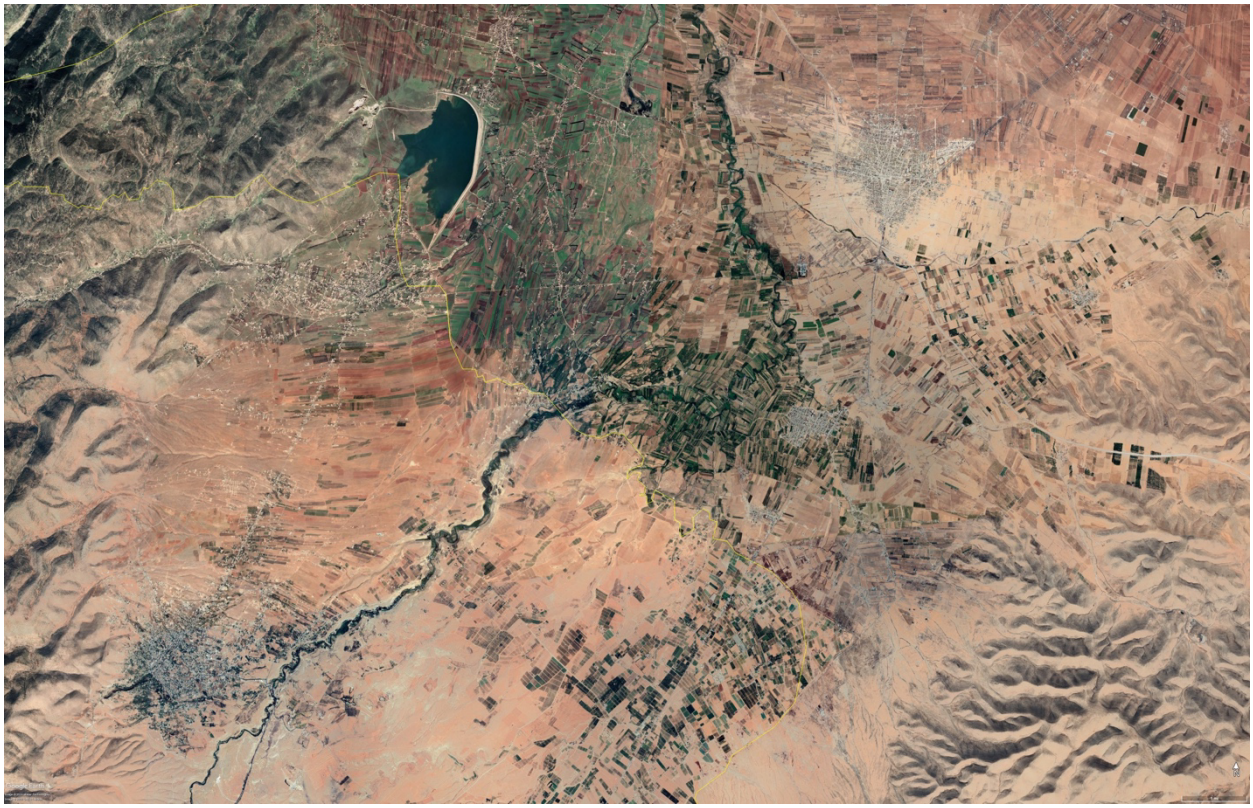

Figure 1. Google Earth Pro 7.3.4.8642. (October 2021). *Lebanon-Syria border detail*. 34°27'11.15" N, 36°29'28.09" E, Eye alt 16.5 mi. Maxar Technologies, CNES/Airbus 2022. <http://www.google.com/earth/index.html> (Accessed Jul 1 2022).

Despite the fact that nearly 6 million people inhabit the Orontes River Basin,[34] Conker and Hussein note that it is amongst the least researched transboundary basins in the MENA region.[35] UN-ESCWA and Bundesanstalt für Geowissenschaften und Rohstoffe note that there is an acute lack of data on the flow of the Orontes River in

[33] "يعتبر [لبنان وسوريا] ان مياه نهر العاصي...هي ذات منفعة مشتركة."

[34] ESCWA and BGR, "Orontes River Basin," 224.

[35] Ahmet Conker and Hussam Hussein, "Hydropolitics and Issue-Linkage along the Orontes River Basin: An Analysis of the Lebanon–Syria and Syria–Turkey Hydropolitical Relations," *International Environmental Agreements: Politics, Law and Economics* 20, no. 1 (March 2020): abstract, https://doi.org/10.1007/s10784-019-09462-7.

both Syria and Lebanon. For the years that data is available, many are not consecutive and rarely overlap.[36] In addition, groundwater data is almost non-existent. Finally, consistent measuring techniques may not have been used. The exchange of accurate and quality data is crucial for any transboundary agreement to function properly. As noted by Lins, "…what may be the most critical burgeoning challenge associated with water resources has received relatively minor attention, i.e., ensuring the adequacy, consistency and long-term maintenance of high-quality hydrological observations."[37] The lack of high-quality, consistent data makes the calculation of water use within the basin difficult. A simpler method of determining the two riparians' consumptive use of the Orontes' waters is required for this project. One straightforward method to estimate consumptive use is by comparing the irrigated acres in each country. Irrigation from both groundwater and surface water are accounted for in this technique; from the standpoint of usage, the origin of the water does not matter. Estimating current usage is crucial to determine the actual state of water use on the Orontes River. It serves as a starting point for future negotiations.

1.3 Methods

This project consists of three primary components: the creation of an accurate irrigation data set to calculate consumptive use and allocations; an evaluation of WRAs for the Orontes Basin; and then the use of this information to examine the 1994, 1997, and 2002 agreements to determine equity. Due to the absence of long term, consistent flow and precipitation data in the Orontes Basin, a simple technique will be used to

[36] ESCWA and BGR, "Orontes River Basin," 232.

[37] Harry F. Lins, "Challenges to Hydrological Observations" (World Meteorological Organization, 2008), https://public.wmo.int/en/bulletin/challenges-hydrological-observations.

determine water use within the two countries. The irrigated areas above Ar-Rastan, Syria will be calculated using land use data with GIS software. The ratios of consumptive use will then be calculated as follows:

$$P_L = I_L/(I_L+I_S)$$

$$P_S = I_S/(I_L+I_S)$$

Where:

- P_L is the percentage of irrigated acres in Lebanon that are included in the treaty with Syria
- P_S is the percentage of irrigated acres in Syria above Ar-Rastan
- I_L is the irrigated area in Lebanon that is included in the treaties with Syria
- I_S is the irrigated area in Syria above Ar-Rastan

Finally, water consumption estimates will be made using the following equation:

$$CU_L = I_L * D/E - R$$

$$CU_S = I_S * D/E - R$$

Where:

- CU_L is Lebanon's consumptive use
- CU_S is Syria's consumptive use
- D is demand; .655 mm[38]

[38] Hadi Jaafar et al., *Water Resources within the Upper Orontes and Litani Basins A Balance, Demand and Supply Analysis amid the Syrian Refugees Crisis* (International Institute for Environment and Development (IIED), 2016), 21, https://pubs.iied.org/10174iied.

- E is efficiency; 0.6[39]
- R is return; .2[40]

Following this analysis, a set of WRAs will be calculated for the distribution of the Orontes' flows between Lebanon and Syria, taking into account relevant demographic, physiographic, climatic, and other data in order to give a range of possibilities using different approaches and methodologies. These WRAs will then be compared with the percentage allotments of the 1994, 1997, and 2002 agreements between Lebanon and Syria on the Orontes River, as well as estimated use CU_L and CU_S. The project concludes with an exploration of possibilities available to Lebanon to bolster its position on the Orontes Basin vis-a-vis its co-riparians.

[39] Ibid.

[40] Ibid.

CHAPTER 2

OVERVIEW OF RELEVANT INTERNATIONAL WATER LAW AND BILATERAL LEBANESE-SYRIAN TREATIES

The following section will first give an overview of relevant international water law (IWL), exploring various international treaties and frameworks, as well as principles related to sovereignty and the use of transboundary watercourses. Subsequently, this section reviews the 1994, 1997, and 2002 treaties between Lebanon and Syria concerning the use of the Orontes' flows. It will look at how the treaties came into existence, their contents, as well as what factors led to their subsequent amendments being adopted.

2.1 Relevant Instruments and Principles of IWL

International water law encompasses a number of treaties and norms that have developed out of state practice and the work of various international organizations. The roots of much of the controversy surrounding the rights and responsibilities of the riparians of transboundary watercourses is centered heavily around the notion of state sovereignty. In the field of international relations, sovereignty can be understood as the right of a state to exercise exclusive authority over the territory it controls. In regard to transboundary watercourse governance, there are three primary doctrines concerning a state's sovereignty: absolute territorial sovereignty, absolute territorial integrity, and limited territorial sovereignty. The principle of absolute territorial sovereignty, primarily associated with the Harmon Doctrine,[41] professes that a state has the right to

[41] This doctrine takes its name from US Attorney-General (1895–1897) Judson Harmon, who argued in a dispute over the use of the Rio Grande with Mexico that "[t]he fundamental principle of international law

use an international watercourse passing through its territory however it likes, regardless of how its use might affect downstream riparians.[42] This principle has largely been rejected by the international community; as noted by McCaffrey, "[i]t is at best an anachronism that has no place in today's interdependent, water-scarce world."[43] The principle of absolute territorial integrity lies at the other end of the spectrum, declaring that an upstream riparian of a transboundary watercourse may not under any circumstance affect the flow of water to downstream riparians. This is a position frequently put forward by downstream riparians of a transboundary watercourse, such as Egypt and Sudan in the case of the Nile, or Syria in the case of the Orontes. McCaffrey states that the principle of absolute territorial integrity

> ...could have devastating effects upon upstream states that develop their water resources later than their downstream neighbors…[f]or it would effectively prohibit any development in an upstream state that adversely affected the flow of the water to a state or states downstream.[44]

The final principle—limited territorial sovereignty—holds that a state's sovereignty is limited by its compulsion to not use its territory in a way that could cause harm to other states. It has been noted as being the "prevailing theory of international watercourse rights."[45] According to this principle, the notion of sovereignty comes with both rights and responsibilities, and an emphasis is placed on "the mutual development of a river's

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is the absolute sovereignty of every nation…within its own territory. [Exceptions] to the full and complete power of a nation within its own territories must be traced up to the consent of the nation itself. They can flow from no other legitimate source." United States of America, XXI Official Opinions of the Attorneys General of the United States, 281–2 (Washington, D.C. 1898), quoted in Stephen C. McCaffrey, *The Law of International Watercourses*, Third edition, The Oxford International Law Library (Oxford, United Kingdom; New York, NY: Oxford University Press, 2019).

[42] McCaffrey, *The Law of International Watercourses*, 100–103

[43] Ibid, 100.

[44] Ibid, 116.

[45] Ibid, 125–126.

waters by the riparian states, and the promotion of the common interest of the international community over any one riparian's sovereignty."[46]

With the three core water allocation doctrines described, this section will now turn to an overview of relevant conventions of international water law. It has been noted by Baroud et al. that IWL proceeds chiefly from four main actors in the international arena: two scholarly NGOs—the Institute of International Law (IIL) and the International Law Association (ILA)—and two UN bodies—the International Law Commission (ILC) and the UN Economic Commission for Europe (UNECE).[47] In 1966 the ILA formulated the Helsinki Rules on the Uses of the Waters of International Rivers,[48] which was the first attempt to codify laws concerning transboundary watercourses.[49] Amongst other things, the Helsinki Rules state that riparians of a transboundary basin are entitled to "a reasonable and equitable share in the beneficial uses of the waters of [the basin],"[50] and that such countries ought to settle disputes over the water basin in question peacefully, "in such a manner that international peace and security and justice are not endangered."[51] As such, the Helsinki Rules can be seen as rejecting the rigid principles of absolute territorial sovereignty and absolute territorial integrity, encouraging states to work towards a usage framework built around equitable utilization of the water resources in question. The Helsinki Rules were never codified by the UN General Assembly, which instead in 1970 solicited the ILC to draft articles

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[46] Makdisi, "Trapped Between Sovereignty and Globalization," 224.

[47] Ziad Baroud et al., "Legal Analysis of Transboundary Waters in the Upper Jordan River Basin" (Beirut: Association of the Friends of Ibrahim Abd El Al, 2014), 16, https://doi.org/10.13140/RG.2.1.5181.5124.

[48] Hereinafter, "the Helsinki Rules."

[49] Joseph W. Dellapenna, "The Customary International Law of Transboundary Fresh Waters," *International Journal of Global Environmental Issues* 1, no. 3/4 (2001): 273.

[50] Helsinki Rules, Article IV

[51] Ibid, Article XXVII

on the non-navigational uses of international watercourses.[52] In 1974, the ILC began a study of state practice in order to codify customary international water law. This process took twenty years, with the ILC adopting in 1994 its Draft Articles on the Law of the Non-navigational Uses of International Watercourses, which formed the basis upon which the 1997 UNWC was built.[53] As previously noted, the 1997 UNWC gives guidelines by which states can work to arrive at a mutually agreeable use convention for a given watercourse. Part II (Articles 5–10) of the 1997 UNWC lays out the general principles of the convention. Article 5 discusses equitable and reasonable use, stipulating that riparians of a transboundary watercourse

> …shall participate in the use, development and protection of an international watercourse in an equitable and reasonable manner…[including] the right to utilize the watercourse and the duty to cooperate in the protection and development thereof, as provided in the present Convention.

Article 6 (Factors relevant to equitable and reasonable utilization) is amongst the most relevant to this project's guiding question. These factors are:

> *a)* Geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character;
> *b)* The social and economic needs of the watercourse States concerned;
> *c)* The population dependent on the watercourse in each watercourse State;
> *d)* The effects of the use or uses of the watercourses in one watercourse State on other watercourse States;
> *e)* Existing and potential uses of the watercourse;
> *f)* Conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect; and,
> *g)* The availability of alternatives, of comparable value, to a particular planned or existing use.

[52] Joseph W. Dellapenna, "The Berlin Rules on Water Resources: The New Paradigm for International Water Law," in *World Environmental and Water Resource Congress 2006* (World Environmental and Water Resources Congress 2006, Omaha, Nebraska, United States: American Society of Civil Engineers, 2006), 1-2.

[53] Baroud et al., "Legal Analysis of Transboundary Waters," 18.

Article 7 of the UNWC specifies that transboundary riparians shall take "all appropriate measures" to avoid causing significant harm to one another; in the case that significant harm is inflicted upon a riparian, the harming states shall consult the harmed state in order to "eliminate or mitigate such harm and, where appropriate, to discuss the question of compensation." Articles 8 and 9 specify an obligation amongst a transboundary basin's riparians to cooperate and regularly exchange data and information on the basin. Finally, Article 10 states that no use of a transboundary watercourse "enjoys inherent priority over another," and that Articles 5 and 7 ought to be used as a framework to resolve a conflict in uses. This project suggests that the two most important—and simultaneously controversial—points contained within the 1997 UNWC are Articles 5 and 6 (equitable and reasonable use and related factors), and 7 (obligation to not cause significant harm). These two articles can be seen as an attempt to strike a balance between the demands of upstream and downstream riparians, and in turn the principles of absolute territorial sovereignty and absolute territorial integrity.

With the relevant international treaties and principles of IWL laid out, the subsequent sections of this chapter will give an overview of the 1994, 1997, and 2002 treaties between Lebanon and Syria on the use of the Orontes' flows. Special attention will be paid to the treaties and principles discussed above, and how they interacted with the Orontes treaties' formation and subsequent revisions.

2.2 1994 Treaty

Though negotiations between Syria and Lebanon on the Orontes date back to 1940, it was not until 1994 that any concrete agreements crystallized.[54] The first article

[54] Comair and Scoullos, "Orontes Hydro-Diplomacy," 36.

of the 1994 Agreement on the Distribution of the Water of the Orontes River Originating from Lebanese Territory Between the Lebanese Republic and the Syrian Arab Republic[55] considers that both sides shall consider the Orontes River to be of mutual benefit. Article 2 of the 1994 Treaty determines that the distribution of the river's waters shall be based upon the following sources:

- discharge measured at the Hermel Bridge;
- springs, rainwater, tributary streams, and water extracted from wells within an area 500 meters from either side of the river and within the 1500-meter radius of the center of the circle formed by Ain ez-Zarqa, Hermel, and Ras El Mal springs;
- permanent tributaries of the Orontes, as well as any other sources deemed relevant by a proposed joint technical committee.

The 1994 Treaty establishes Lebanon's yearly share of Orontes' water to be 80 MCM if the flow measured at the Hermel Bridge reaches 403 MCM per year,[56] distributed according to the following schedule:

- September–October: 10 MCM
- November–February: 10 MCM
- March–April: 10 MCM
- May–August: 50 MCM[57]

In the case of a scarce year—i.e., one in which the flow at the Hermel Bridge is less than 400 MCM—Article 4 of the 1994 Treaty allocates to Lebanon a share of water

[55] Hereinafter "The 1994 Treaty."

[56] The 1994 Treaty considers an "average year" one in which the Orontes' flow reaches 400 MCM.

[57] 1994 Treaty, Article 3.

decreased "by a percentage equal to the percentage decrease in discharge relative to the average river discharge."[58] Articles 5 and 7 call for the creation of a joint technical committee and joint arbitral committee, respectively. Finally, Article 8 of the Treaty permits the exploitation of wells dug before September 20, 1994, and stipulates that any offending wells be closed down and filled in.

After the signature and ratification of the 1994 Treaty by Lebanon and Syria, Nasrallah Boutros Sfeir—then patriarch of Lebanon's Maronite Church—formed a committee (the Sfeir initiative) in order to determine whether the 1994 Treaty was truly in line with Lebanon's needs.[59] According to Sfeir, the terms and technical details of the 1994 Treaty were "anti-constitutional" and "not favorable to [Lebanon's] vital interest and formed an obstacle to its national sovereignty." The patriarch went as far as to describe some of the treaty's terms as "humiliating…for the Cedars country."[60] The committee determined that the treaty had a number of issues that made it unfavorable for Lebanon, such as the fact that one-third of Lebanon's allocation was outside of the irrigation season; that it was not formulated in concordance with any international norms concerning water resources; that it does not delineate the means by which the Lebanese may exploit the Orontes' waters; and that it may form a precedent that could be used by Israel in a future deal with Lebanon for use of the transboundary Hasbani and Wazzani Basins. Furthermore, by placing a cap on Lebanese withdrawals during normal years of 80 MCM, the 1994 Treaty guarantees that any additional flow from the Orontes will only benefit Syria, failing to take into account Lebanon's future water

[58] "…وفي [سنة شحيحة] تخفض حصة الجانب اللبناني بنسبة تعادل نسبة انخفاض التصريف بالقياس إلى متوسط تصريف النهر…"

[59] Tammam Kaissi, "Invalidating the Orontes River Treaty in the Context of Middle Eastern Politics," *Georgetown International Environmental Law Review* 26 (2014): 178.

[60] Quoted in Fadi Georges Comair, *Water Management and Hydrodiplomacy of River Basins: Litani, Hasbani-Wazzani, Orontes, Nahr El Kebir* (Louaize, 2009), 202.

needs. There was also further criticism emanating from the Baalbek-Hermel region that no provisions were made within the 1994 Treaty for the construction of a storage dam, which was seen as a much-needed tool to increase the area's development.[61] Ultimately, the 1994 Treaty enshrines the principle of absolute territorial integrity commonly favored by downstream riparians. As will be shown in subsequent chapters, the Orontes Basin constitutes an important agricultural area for Syria, especially before the country's ongoing civil war. This importance of the basin to Syria is reflected in the terms of the 1994 Treaty, which can be seen as being overly favorable to the Syrian position; as noted by Kaissi, the 1994 Treaty's "sole purpose was to limit Lebanon's upstream water use," and it "ensures that Syria's share varied in a manner always favorable to Syria."[62] In this sense, the 1994 Treaty is also a good example of a hydro hegemon reinforcing its position as such. Syria ensured that it received the lion's share of the Orontes' flows—which was facilitated by its overall hegemonic position over Lebanon at the time—in order to ensure access to a natural resource that is economically important to the country.

2.3 1997 Annex

In January of 1997 an annex[63] was added to the 1994 Treaty in order to exclude the basins of Yammoune, Marjhine, Joubab el Homor and Ouyoun Orgosh from being included in the agreement. With the passing and ratification of this annex, these four sub-basins of the Orontes were now treated as being Lebanese in their entirety and thus

[61] Greg Shapland, *Rivers of Discord: International Water Disputes in the Middle East* (New York: St. Martin's Press, 1997), 145.

[62] Kaissi, "Invalidating the Orontes River Treaty," 180.

[63] Hereinafter, "The 1997 Annex".

not subject to the provisions of the 1994 Treaty, though a stipulation is made that use of these basins is subject to their yearly renewal limit.[64] In addition, the second section of the 1997 Annex grants Lebanon further rights to use more water within the Orontes Basin—it permits Lebanon to use the proceeds of the Labweh springs in their entirety during the irrigation season from April until mid-October; it also allows for the Lebanese villages of Labweh, Amhaz, Toufiqiyeh, Al 'Ain, Nabi Osman, Sabbougha, Khraibeh, Hlatba, and Jabbouleh to use the Labweh springs for potable water, presumably year round.[65] Finally, the 1997 Annex requires Lebanon during the non-irrigation season to feed the incoming waters of the Orontes to the Hermel bridge with water from the Labweh springs and rainwater, and to commit itself to not undertake any operations limiting the flow of water into the Orontes River.[66]

While the 1997 Annex slightly elevated Lebanon's position vis-a-vis Syria on the Orontes Basin, it still contained weak points, and the dominating principle guiding the agreement was still that of absolute territorial integrity, ultimately favoring Syria as the downstream riparian. There were no provisions contained within the agreement for the dam needed to elevate the socio-economic conditions in the Baalbek-Hermel region, and Lebanon was not granted a larger share of water. Another issue with the 1997 Annex is that it does not specify how, or whether, the stipulations contained within it replace any of those within the 1994 Treaty. For example, it is not clear whether the clause that allows Lebanon to exploit the Labweh springs during the irrigation season period replaces that within the 1994 Treaty that limits withdrawals to 80 MCM

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[64] "...ويكون الاستثمار في [هذه الاحواض المغلقة] بحدود الموارد المائية المتجددة سنويا لكل حوض..."

[65] "...كما يستفيد [لبنان] من مياه الشرب للقرى التي تشرب من النبع حاليا ,وهي (اللبوة ـ أمهز ـ التوفيقية ـ العين ـ النبي عثمان ـ صبوغة ـ الخريبة ـ حلبتا ـ الجبولة)."

[66] "يتم رفد مياه العاصي الواردة إلى جسر الهرمل خلال ما تبقى من أشهر السنة من مياه ينابيع اللبوة ...ويتعهد [لبنان] بعدم القيام بأية إجراءات تحد من انسياب مياه الينابيع ومياه الأمطار إلى نهر العاصي."

annually.[67] According to Zwahlen et al., these new waters allocated to Lebanon are not counted in the total discharge amount of 403 MCM/year mentioned in the 1994 Treaty;[68] Kaissi, on the other hand, gives two possible interpretations of the 1997 Annex vis-à-vis the 1994 Treaty: (1) that the 1997 Annex is a supplement to the 1994 Treaty and not meant to replace it; or (2) that the 1997 Annex is a treaty that succeeds and effectively replaces its counterpart from 1994.[69]

2.4 2002 Amendment

In 1999, a Lebanese-Syrian High Council of Coordination was formed to review the 1994 Treaty and 1997 Annex with the goal of making the agreements more equitable and concordant with the 1997 UNWC, which had been signed and ratified by both the Lebanese and Syrian parliaments by this point.[70] The Lebanese side had a desire to transform what it considered to be a "lose-win" situation into a "win-win" situation. One of the motivations behind this desire was for Lebanon to strengthen its negotiating position vis-a-vis Israel should future bilateral relations be established between the two. The Lebanese delegation also desired the promotion of social stability in the Baalbek-Hermel region through the creation of jobs, as well as an improvement in the area's irrigation and hydroelectric infrastructure.[71] Syria was hesitant to accept the terms adopted by the Lebanese-Syrian Higher Council, asserting that "…the agreement would create an unstable economic situation," and that "…Syria's river

[67] Kaissi, "Invalidating the Orontes River Treaty," 180.

[68] Zwahlen et al., "Groundwater Flow in the Orontes River Basin," 59.

[69] Kaissi, "Invalidating the Orontes River Treaty," 180.

[70] Comair and Scoullos, "Orontes Hydro-Diplomacy," 39.

[71] Ibid, 41–42.

infrastructure was already well established."[72] At this point, Lebanon used its position as the upstream riparian to its advantage, with the Lebanese delegation to the Higher Council warning their Syrian counterparts to heed the potential ramifications should Syria reject the adopted points, such as

> …negative effects on a major part of the Shiite population in the region, who lives beneath the threshold of poverty and may revolt against Syria, …[and] the position of Israel which might see this as an opportunity to impose the same negotiation terms on the Jordan river, [possibly resulting in] non-restitution of the Golan Heights and non-recovery of the water shares belonging to Syria.[73]

The framework of hydro hegemony provides interesting insights into the process of revising the treaties between Lebanon and Syria on the use of the Orontes. Despite being the weaker state, Lebanon succeeded in making use of two of the four pillars of hydro hegemonic power. By virtue of its geographic position as the upstream riparian, Lebanon has the theoretical ability to divert or stop flows, or at least threaten to do so. Bolstered by its geographic advantage, Lebanon was able to utilize bargaining power by citing two issues related to regional politics and safety. First, the overall dispossession of the basin's Shia population was invoked as a liability to Syria's stability. Perhaps intentionally, Lebanon did not specify which country these potential Shia agitators call home—there are significant Shiite populations found in both the Lebanese and Syrian portions of the Orontes Basin.[74] Second, Lebanon drew a parallel between its quest to obtain a better deal in the Orontes context with Syrian desires for the return of the Israeli-occupied Golan Heights and its related resources. By linking regional issues to

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[72] Ibid, 43.

[73] Ibid, 43-44.

[74] See *Syria Ethnic and Religious Map*, November 12, 2019, November 12, 2019, https://www.mepanews.com/d/other/suriyeetnikdiniyapi.jpg; Sergey Kondrashov, *Lebanon Religious Groups Distribution*, December 29, 2013, https://upload.wikimedia.org/wikipedia/commons/4/4f/Lebanon_religious_groups_distribution.jpg.

its allocation of Orontes water, Lebanon was able to begin setting certain items on the agenda, ultimately establishing a red line Syria was not to cross.

Syria and Lebanon did ultimately resolve their differences, with Presidents Émile Lahoud and Bashar al-Assad signing an amendment on March 3, 2002.[75] The 2002 Amendment allocates Lebanon an additional 16 MCM of groundwater, for a total allocation of 96 MCM. As noted by Comair and Scoullos, the 2002 Amendment and the minutes of the meetings that led to its formation and adoption contain a number of clauses and articles that fulfill the prescriptions of the 1997 UNWC. For example, the minutes showed that the delegations took into account the geographic, hydrographic, hydrological, climatic, ecological, social, and economic factors of the relevant basin areas, all prescriptions of Article 6 of the 1997 UNWC.[76] Perhaps the most significant outcome of the 2002 Amendment was Lebanon being authorized to construct two dams: a diversion dam located to the south of Hermel with a capacity of 27 MCM, intended to serve both countries, and a storage dam located to the north of Hermel, intended to provide Lebanon with 37 MCM of storage capacity.[77] To date, these projects have not been completed—the former was destroyed before its completion by Israel during its war against Lebanon in 2006, while construction on the latter has never started.

It must be noted that the 2002 Amendment was made before the end of the Syrian occupation of Lebanon. Beginning in 1976, the Syrian occupation lasted nearly three decades, ending on April 30, 2005, when the final Syrian troops and intelligence

[75] Comair and Scoullos, "Orontes Hydro-Diplomacy," 44; hereinafter, "the 2002 Amendment."

[76] Comair and Scoullos, "Orontes Hydro-Diplomacy," 45.

[77] Shamout, "Syrian Perspective on Transboundary Water Management," 97

officers left Lebanon.[78] Can an agreement signed with an occupying power truly be considered "fair and equitable?" It would be no stretch of the imagination to surmise that the stipulations of the 2002 Amendment—despite its greater compliance with the prescriptions of the 1997 UNWC—are still overly favorable to the Syrian position, again reaffirming the notion of Syria being the basin's hydro hegemon. As will be shown in subsequent chapters, there are two critical flaws contained within the final treaty—there is no explicit allocation to Syria, and while there is the stipulation that no new wells can be drilled after September 20, 1994, there was no obvious limit placed on the amount of groundwater that can be extracted from the wells, nor how many wells could be drilled. This will have important implications for the final answer to this project's guiding question.

[78] "انسحاب عسكري واستخباراتي سوري من لبنان نهاية الشهر الحالي," الشرق الأوسط, April 4, 2005, https://web.archive.org/web/20200618212313/https://archive.aawsat.com/details.asp?article=291751&issueno=9624.

CHAPTER 3

ESTIMATING WATER CONSUMPTION

As previously stated, data on the Lebanese and Syrian portions of the Orontes Basin is difficult to come by, and much of the data that is available can only be found for sporadic time ranges. This applies to two statistics which are indispensable to this project: irrigated hectares and water consumption. It is hoped that these statistics will give a clear picture of the *de facto* situation on the basin—are the stipulations laid out by the final 2002 Treaty being followed? This chapter attempts to give an up-to-date estimate of water consumption in the portions of the Orontes Basin relevant to this project. A 2016 study by Jaafar et al. surveyed cropland in Lebanon's Litani and Orontes River Basins. The most recent of its kind in the Lebanese portion of the Orontes Basin, the study surveyed approximately 1,500 fields within these two neighboring river basins. The authors of the study analyzed Landsat and Sentinel-2 scene files of the Bekaa Valley with GIS software, classifying them by type, ultimately concluding that the Lebanese portion of the Orontes Basin contains approximately 13,800 ha of irrigated cropland. The authors estimate Lebanon's consumption of water within the Orontes Basin to be approximately 118 MCM.[79] This number, however, includes the "excepted" areas mentioned in the 1997 Annex—Labweh, Yammoune, Marjhine, Joubab al Homr, and Oyoun Orghosh. This project will use GIS software to estimate the sizes of these areas in order to subtract them from the above-mentioned number and ultimately arrive at an estimate of water consumption that is covered by the agreement. As no similar study exists for the Syrian portion of the Orontes Basin south

[79] Jaafar et al., *Water Resources within the Upper Orontes*, 17–24.

of Ar-Rastan, this project will again use GIS to make an estimation of irrigated areas in this area, from which water consumption estimates will be made. An effort will be made to use consistent estimates in both areas. A geographic information system (GIS) is one tool that can be used to gather data referenced to a geographic area—such as irrigated areas and water consumption—when data sensed by more "traditional" methods—e.g., from field surveys or a stream gauge—cannot be used or relied upon. According to Dempsey, "GIS is a technological field that incorporates geographical features with tabular data in order to map, analyze, and assess real-world problems."[80] Another definition understands GIS as "…a system designed to capture, store, manipulate, analyze, manage, and present geographical data."[81] Such a system finds advantage in its ability to be used remotely, often with freely available and open source data.

3.1 Methodology and Results: Cropland and Irrigation

The free and open-source platform QGIS (version 3.16.16-Hannover)[82] was installed on a computer running macOS Monterey (12.4). A national-level administrative boundary shapefile of Lebanon was obtained from the United Nations Office for the Coordination of Humanitarian Affairs' (OCHA) Humanitarian Data Exchange platform.[83] The shapefile for the Orontes Basin was made by a contributor to the online community Kagle using data from the World Wildlife Fund's HydroSHEDS

[80] Caitlin Dempsey, "What Is GIS?," GIS Lounge, March 16, 2021, https://www.gislounge.com/what-is-gis/.

[81] "Mapping and Geographic Information Systems (GIS) : What Is GIS?," Research Guides - University of Wisconsin-Madison Libraries, accessed April 26, 2022, https://researchguides.library.wisc.edu/GIS.

[82] "QGIS - A Free and Open Source Geographic Information System," QGIS, accessed April 26, 2022, https://qgis.org/en/site/.

[83] "Lebanon - Subnational Administrative Boundaries," Humanitarian Data Exchange, accessed May 1, 2022, https://data.humdata.org/dataset/cod-ab-lbn.

database.[84] Finally, 2021 land use data from the European Space Agency's Sentinel-2 satellite constellation was obtained in the form of TIFF files in 10 meter resolution compiled by Impact Observatory, Microsoft, and Esri.[85] The scene files used in this project contain the following attributes:

- **Water**: in these areas, water is present year-round, e.g., lakes, ponds, rivers;
- **Trees**: areas with dense vegetation with a height of at least 15 meters, e.g., wooded vegetation, clusters of dense/tall vegetation within savannas, plantations;
- **Flooded Vegetation**: areas of vegetation "with obvious intermixing of water throughout a majority of the year," or seasonally flooded area containing grass, shrubs, trees, bare ground, e.g., emergent vegetation, heavily irrigated and inundated agriculture;
- **Crops**: cultivated cereals, grasses, and crops less than 15 meters tall;
- **Built Area**: Manmade structures, e.g., houses, dense villages, cities, towns, roads;
- **Bare Ground**: areas with rock and soil that are very sparse to entirely sparse year-round, e.g., exposed rock/soil, desert/sand dunes, dried lake beds; and
- **Rangeland**: area with small clusters of plants, or single plants in an area showing exposed soil or rock, e.g., moderate to sparse cover of bushes/shrubs, savannas with very sparse grasses.[86]

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[84] "Syria River Basins," Kaggle, accessed May 1, 2022, https://www.kaggle.com/datasets/bigironsphere/orontes-river-basin.

[85] "Sentinel-2 10m Land Use/Land Cover Timeseries Downloader," ArcGIS, accessed May 1, 2022, https://www.arcgis.com/home/item.html?id=fc92d38533d440078f17678ebc20e8e2. *(This dataset is available under a Creative Commons BY-4.0 license and any copy of or work based on this dataset requires the following attribution: This dataset is based on the dataset produced for the Dynamic World Project by National Geographic Society in partnership with Google and the World Resources Institute.)*

[86] Ibid.

Next, the land use TIFF file was loaded into a new project in QGIS. This raster graphic was then clipped using the Orontes Basin shapefile as a mask to create a new land use data raster graphic for the entire Orontes Basin (i.e., the Lebanese, Syrian, and Turkish portions in their entirety), shown below in Figure 2.

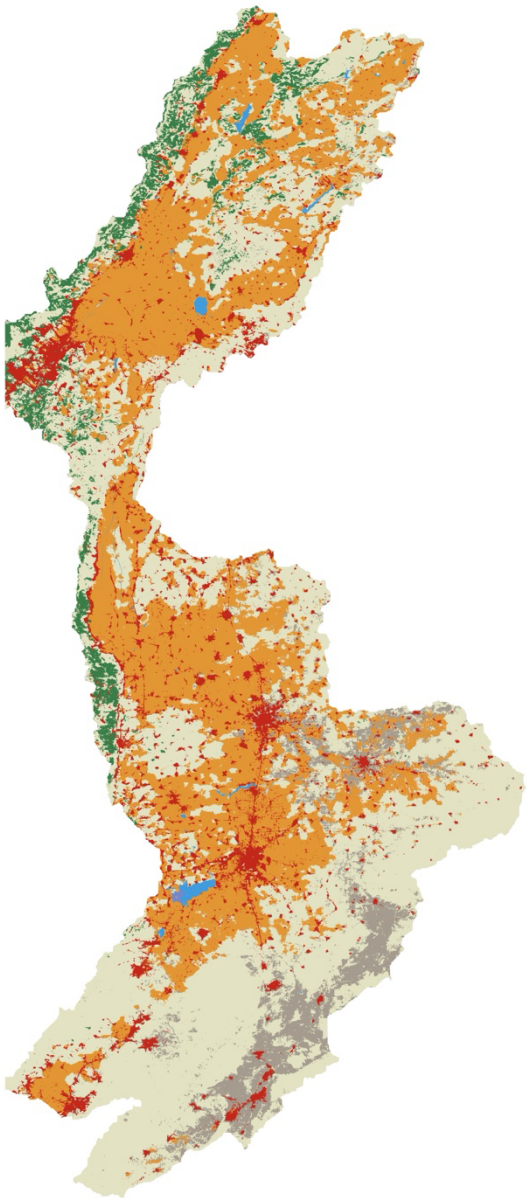

Figure 2. Orontes Basin land use [map]. Data layer: Esri, Microsoft, and Impact Observatory: Sentinel-2 10m Land Use [computer file]. American University of Beirut, Lebanon: Generated by Christopher Peterson, April 27, 2022. Using: QGIS - 64 Bit [GIS]. 3.16.16-Hannover

The national-level administrative boundary shapefile for Lebanon was then used as a mask to create two new land use data raster graphics—one showing the Lebanese portion of the basin, and one showing the Syrian and Turkish portions. Next, a new shapefile polygon was hand drawn for the Syrian portion of the basin south of the first major Syrian recharge area just north of Ar-Rastan. Finally, the color-coded values were reassigned the proper terminology (e.g., water, crops, built area) so a legend could be generated. This resulted in the creation of two distinct land use rasters for the relevant Syrian and Lebanese portions of the basin. These two rasters are shown on the next page in Figure 3, with the Lebanese-Syrian border being displayed as a dotted black line.

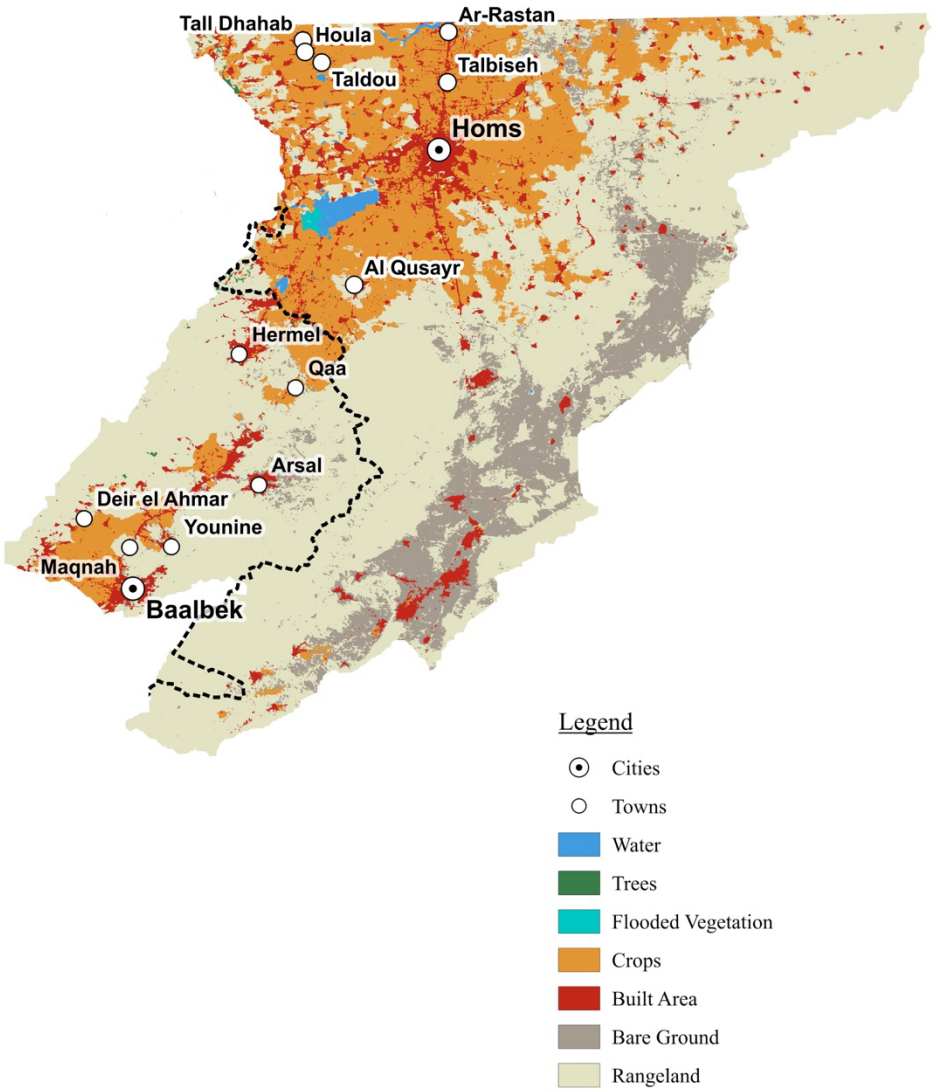

Figure 3. Orontes Basin land use detail - Lebanon and Syria south of Ar-Rastan [map]. Data layers: Esri, Microsoft, and Impact Observatory: Sentinel-2 10m Land Use; OpenStreetMap QuickOSM [computer files]. American University of Beirut, Lebanon: Generated by Christopher Peterson, July 1, 2022. Using: QGIS – 64 Bit [GIS]. 3.16.16-Hannover

One limitation of the original land use TIFF files used in this project is that they do not distinguish between rainfed and irrigated crops. Significant portions of the Orontes Basin utilize rainfed agriculture; the effects of the Syrian Civil War have

increased the prevalence of this practice within Syria.[87] As a result, the land use maps alone are not sufficient to calculate the size of the relevant irrigated areas and estimate their water consumption. In order to rectify this issue, the Syrian land use file was trimmed to only show the areas under irrigation, utilizing a land use map based on 2010 data from Jaubert.[88] Next, a raster layer unique value report was run on the resulting land use raster, showing that this area has approximately 84,460.5 hectares of irrigated areas. An overlay of the irrigated areas south of Ar-Rastan in the Syrian portion of the basin are shown on the following page in Figure 4.

[87] Ahmed Haj Asaad and Ronald Jaubert, "Geostrategic Stakes and the Impact of the Conflict in the Orontes River Basin," *Confluences Méditerranée* N° 89, no. 2 (June 1, 2014): 183, https://doi.org/10.3917/come.089.0173.

[88] Ronald Jaubert, "Syria: The Impact of Conflict on Population Displacement, Water and Agriculture in the Orontes River Basin," Water Security in the Middle East (Geneva: Swiss Agency for Development and Cooperation, 2014), 19, https://reliefweb.int/attachments/4726b45e-77fc-3c35-8e4d-f6ef806d7dad/Syria%20Feb%202014-2.pdf.

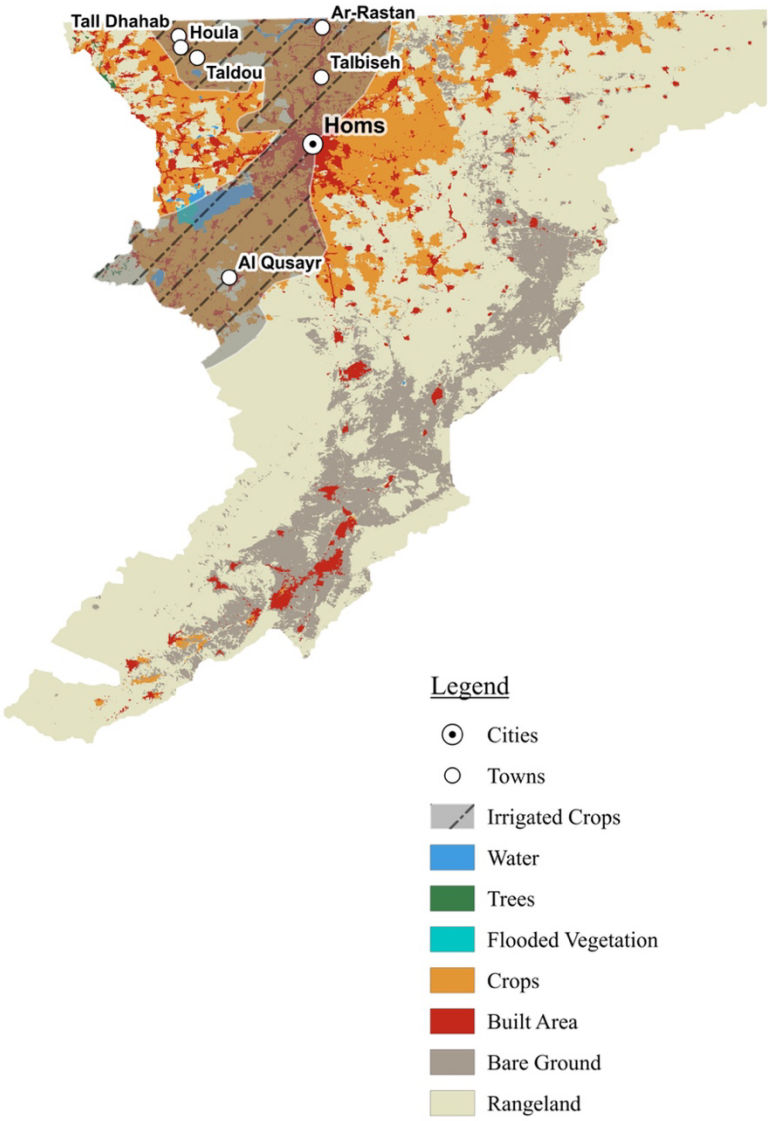

Figure 4. Orontes Basin land use detail - Syrian irrigated areas south of Ar-Rastan [map]. Data layers: Esri, Microsoft, and Impact Observatory: Sentinel-2 10m Land Use; OpenStreetMap Quick OSM [computer files]. American University of Beirut, Lebanon: Generated by Christopher Peterson, July 1, 2022. Using: QGIS – 64 Bit [GIS]. 3.16.16-Hannover. Using data from Jaubert (2014).

As previously stated, the 13,800-hectare figure for Lebanon's irrigated areas includes the areas that are exempt from counting towards Lebanon's allotment as per the terms of the 1997 Annex, namely: Labweh, Yammoune, Orgosh, Joubab al Homr, and Marjhine. In order to ensure that these areas do not count towards the estimate of

Lebanon's consumption of the Orontes' flows, this project first used GIS to estimate the size of their respective irrigated areas. The sizes of the four areas' respective irrigated areas are displayed below in hectares:

- Labweh: 2,847
- Yammoune: 296
- Orgosh: n/a[89]
- Joubab al Homr: 95
- Marjhine: 475
- **Total: 3,713**

The largest of these four areas, Labweh, is shown on the following page in Figure 5 as an overlay on the Lebanese Orontes land use graphic.

[89] Oyoun Orgosh appears to have no irrigated areas for the 2021 land use TIFF file used in this project.

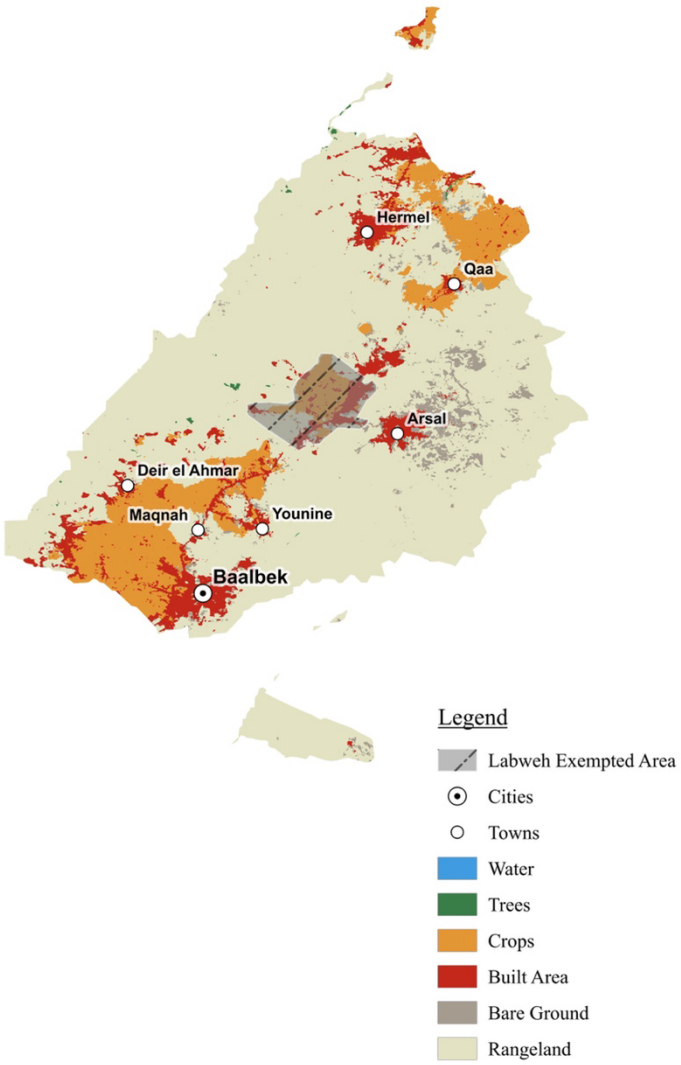

Figure 5. Orontes Basin land use detail - Labweh exempted area (Lebanon) [map]. Data layers: Esri, Microsoft, and Impact Observatory: Sentinel-2 10m Land Use; OpenStreetMap QuickOSM [computer files]. American University of Beirut, Lebanon: Generated by Christopher Peterson, July 2, 2022. Using: QGIS – 64 Bit [GIS]. 3.16.16-Hannover.

Table 1 on the following page displays the finalized quantities of irrigated areas in the portions of the Orontes Basin relevant to this project, with Lebanon's exempted areas subtracted from its consumption estimate.

Table 1. Quantities of cropland, displayed in hectares.

	Lebanon	Syria south of Ar-Rastan
Flooded Vegetation[90]	n/a	907.1
Irrigated	10,087	84,460.53

In order to calculate Syria and Lebanon's percentage share of irrigated acres, we return to the equations that were introduced at the beginning of this project in Chapter 1. First, the irrigated acres in Syria ($I_S=85367.5$) and Lebanon ($I_L=10087$) are summed to get the result of 95,454.5, the total amount of irrigated hectares in this project's area of study. This total area is used to divide each country's individual share, resulting in percentages of irrigated acres for each country. Using the first equation from Chapter 1:

$P_L=10087/(10087+85367.5)$

$\boldsymbol{P_L=0.106}$

$P_S=85367.5/(10087+85367.5)$

$\boldsymbol{P_S=0.894}$

These results show that in 2021, Lebanon's share of irrigated hectares in the Orontes Basin was approximately 10.6%, whereas the Syrian share south of Ar-Rastan was approximately 89.4%. Finally, an estimate of water usage is made using the second equation from Chapter 1:

$CU_S=.8(846{,}000{,}000\ m^2*.655m/.60)$

$\boldsymbol{CU_S=739\ MCM}$

[90] Areas classified as "flooded vegetation" appear to only be found in the Syrian portion of the Orontes Basin. In the area relevant to this project, "flooded vegetation" is found on the western shores of Qattinah Lake, approximately 6 kilometers form the Lebanese salient containing the villages of Qarha, Kaniset Akkar, and Hnaider. For the purposes of this project, "flooded vegetation" was counted with crops as part of Syria's irrigated area.

CU_L=.8(100870000*.655/.60)

CU_L=88 MCM

3.2 Interpretation

The use ratios and consumption estimates obtained using GIS constitute an interesting primary source conducive to much discussion. Perhaps the most striking observation is that more water is being consumed than is accounted for in any of the relevant treaties—827 MCM versus the 403 MCM noted in the treaties. This number can be accounted for if we consider the possibility that Syria is making significant groundwater abstractions from the basin's many aquifers. The vast difference between the Lebanese and Syrian consumption estimates might be explained by the extremely high density of wells in the latter's territory, as shown by Saadé-Sbeih et al.[91] In turn, the intensive abstractions on the Syrian side could very well be explained by one key stipulation (or lack thereof) in the 1994, 1997, and 2002 Agreements—none make any mention of an explicit allocation to Syria. And while Article 8 of the 1994 Agreement does specify that both sides may not drill new wells after September 20, 1994, it contains the stipulation that both riparians are allowed to make abstractions from wells drilled prior to this date. Indeed, previous research has shown that groundwater levels in the Syrian portion of the Orontes Basin have declined significantly in the period between 2003–2014.[92] What could very well be at play here is a classic case of a

[91] See Saadé-Sbeih et al., "Groundwater Balance Politics," 666.

[92]Khalil Abdallah Lezzaik, "An Integrated Assesment of Groundwater Scarcity and Risk Conditions in the Arab Middle East and North Africa Region" (Athens, The University of Georgia, 2016), 49, https://getd.libs.uga.edu/pdfs/lezzaik_khalil_a_201608_phd.pdf.

hegemonic riparian with established prior using the principle of absolute territorial integrity to its advantage.

CHAPTER 4

WATER RIGHTS ALLOCATIONS (WRAS)

What does it mean for international waters to be distributed "fairly" and "equitably"? What evidence might be submitted by a riparian state of a given transboundary watercourse in order to support its case for a greater allocation—or different use of—the water resource in question? The position of a riparian on the watercourse will undoubtedly affect this. An upstream state of a transboundary watercourse might argue that as the contributor to the source of the river's flows, it ought to be permitted to use a larger share of these flows; it may even view this river as a domestic resource rather than a transboundary one. On the other hand, a downstream or midstream riparian with long-established historical use of a river might put forth the view that upstream riparians ought to not do anything that would put the quality or quantity of water it is used to receiving in jeopardy. Countries facing heavy pressures on their water resources could advance the position that they should be allocated a greater share of another transboundary river in a case where other riparians have alternative sources of water that would offset the difference. Indeed, answering this question in a practical, "real-world" way isn't clear cut—there are a multitude of statistics that a riparian may submit as evidence that it needs a greater allocation of a transboundary watercourse's resources.

It is worth briefly considering some examples of criteria put forward by riparians in other transboundary basins of the MENA region in order to justify their calls for a greater share of water. In the case of the Nile River Basin, Ethiopia has invoked the fact that less than half of its population has access to electricity as

justification for building the Grand Ethiopian Renaissance Dam, which is hoped to provide up to 6 gigawatts of electricity for the country.[93] Although this is a non-consumptive use, Egypt has cited its millennia-old dependence river as grounds for preserving its lion's share of the resources, with Egyptian President Abdel Fatah al-Sisi threatening that should anyone take "even a drop" of Egypt's water, the region would fall into a case of "unbelievable instability."[94] Turkey's Southeastern Anatolia Project (Güneydoğu Anadolu Projesi, GAP) was launched in 1977 with the goal of harnessing the flows of the Euphrates and Tigris rivers for hydroelectric and agricultural purposes in order to boost the socioeconomic conditions of southeastern Anatolia. The downstream riparians of these two basins—Iraq and Syria in the former, and Iraq in the later—have voiced concern that GAP will result in a decrease in the respective flows' quality and quantity. Though the project is due for completion in 2047, the flow regime of the Euphrates has already been "changed entirely." Some estimates predict that if completed as planned, the project will consume 50% of the Euphrates' resources and 14% of those of the Tigris.[95]

Article 6 (factors relevant to equitable and reasonable utilization) of the 1997 UNWC is a good starting point for considering statistics to take into account when formulating possible usage arrangements for a transboundary watercourse; its qualitative and open-ended nature, however, make its application more difficult. In a

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[93] "Grand Ethiopian Renaissance Dam Project, Benishangul-Gumuz," Water Technology, accessed May 1, 2021, https://www.water-technology.net/projects/grand-ethiopian-renaissance-dam-africa/.

[94] Abdel Fattah el-Sisi, March, 2021, Ismailia, Egypt (video). 02:18. https://youtu.be/S8zOOtPnSNc?t=66.

[95] Economic and Social Commission for Western Asia (ESCWA) and Bundesanstalt für Geowissenschaften und Rohstoffe, "Chapter 1 - Euphrates River Basin," in *Inventory of Shared Water Resources in Western Asia*, E/ESCWA/SDPD/2013/Inventory (Beirut: United Nations, 2013), http://waterinventory.org/sites/waterinventory.org/files/00-inventory-of-shared-water-resources-in-western-asia-web.pdf.

case where all of a basin's riparians are vying for what each considers its "fair share" of water, a more appropriate question may be how we can ensure that a transboundary river's waters are distributed in the *most* fair and equitable way possible. As previously stated, water rights allocations (WRAs) as described by Dinar and Nigatu[96] and Dinar and Tsur[97] may be one possible way to reduce conflict between a transboundary basin's riparians. In order to quantify a fair and equitable schedule for the distribution of a transboundary watercourse's flows, such WRAs take into account various statistics of the riparian countries in question, including:

- Physical factors of the watercourse in question;
- Population;
- Historical use;
- Location of a watercourse's headwaters;
- Social and economic needs of riparians;
- The effect(s) of the use(s) of the watercourse in question by one riparian on other riparians;
- Existing and potential uses of the watercourse in question;
- Conservation, protection, development, and economy of use of the water resources of the watercourse and the costs of measures taken to that effect; and,
- The availability of alternative sources of water.[98]

Another approach to determine potential equitable distributions of transboundary watercourses is the relevant factors matrix (RFM) developed by Wouters et al. This

[96] Dinar and Nigatu, "Distributional Considerations of International Water Resources."
[97] Dinar and Tsur, *Management of Transboundary Water Resources*.
[98] Dinar and Nigatu, "Distributional Considerations of International Water Resources," 7; Dinar and Tsur, *Management of Transboundary Water Resources*, 80–81

methodology "details the range of factors relevant to assessing a [riparian's] entitlement to the uses of the waters of a [transboundary river], and specifies the information required with respect to each factor."[99] The relevant factors are broken down into six categories:

- The physical context of the transboundary watercourse ("what?");
- The population of the transboundary watercourse ("who?");
- The uses of the transboundary watercourse and related benefits of the uses ("what uses?");
- The domestic and international outcomes of the uses of the transboundary watercourse ("what impacts?"); and,
- Consideration of efficiency of the uses and their alternatives ("what options?").[100]

Such methodologies can be seen as attempts to quantify some of the more qualitative prescriptions found in the 1997 UNWC. By virtue of their ability to guarantee an absolute minimum allocation for weaker riparians, such methodologies are also conducive to reducing negative aspects of hegemony—i.e., hegemony as domination, rather than leadership.

As an exhaustive exploration of all the above-listed factors in the context of the Orontes Basin is outside of the scope of this project, this project's analysis will be limited to the following statistics:

- Demographics and socio-economic conditions;

[99] Patricia K. Wouters et al., *Sharing Transboundary Waters: An Integrated Assessment of Equitable Entitlement - The Legal Assessment Model*, IHP-VI Technical Document in Hydrology 74 (International Hydrological Programme (IHP) of the United Nations, Educational, Scientific and Cultural Organization (UNESCO), 2005), 77.
[100] Ibid.

- Physical context, including climatic projections and pressure on water resources at a national level; and,
- Dependence upon the water resource in question.

The following sections will justify the selection of these statistics for this project, then relay the statistics from the Lebanese and relevant Syrian portions of the Orontes Basin. For all statistics, every effort was made to find sub-national data, but when it was not available, national level data was used instead. A series of WRAs based on said statistics will follow, in which a wide range of possibilities for the distribution of the Orontes' waters between the two countries will be explored.

4.1 Demographics and Socio-economic Conditions

Demographics and socio-economic conditions of the relevant parts of the Orontes Basin may be some of the most pertinent statistics included in this analysis. A rational line of thought is that an area with more people will have higher water requirements; the socio-economic conditions of the populations in question will, however, change these water requirements. Those suffering from poverty can be heavily affected by water as a direct input into production, such as livestock rearing, agriculture, manufacturing, and fishing, and for health, food security, and welfare in general.[101] The former point is particularly relevant to the Orontes Basin, the flows of which, as noted in Chapter 3, are under heavy use by all riparians. In its General Comment on the Right to Water, the United Nations Committee on Economic, Social and Cultural Rights (CESCR) states that "[t]he human right to water is indispensable for leading a life in

[101] "Water and Poverty" (Asian Development Bank, March 2006), https://www.adb.org/sites/default/files/publication/28859/water-brief-water-and-poverty.pdf.

human dignity. It is a prerequisite for the realization of other human rights."[102] Ensuring that the inhabitants of the Orontes Basin are receiving sufficient water—an indispensable part of maintaining, if not hopefully improving their overall status—will therefore necessitate an overview of their socio-economic conditions. For the purposes of this project, population sizes and poverty rates will be examined. Ideally, per capita income statistics specific to the relevant areas would be taken into consideration; however, this data is unavailable. Instead, this project will rely upon poverty rates, considering them to be a related statistic from which similar assumptions may be gleaned. Furthermore, migration rates will not be taken into consideration due to a lack of data and the complex nature on the ground in the relevant parts of the Orontes Basin as a result of the Syrian Civil War and economic crisis in Lebanon. As with many other of the statistics this project is concerned with, accurate population figures for the relevant areas it is concerned with are difficult to come by. This project relies on data from two main sources in order to estimate population figures. First, available material, such as the 2004 Syrian Census, newspaper articles, and data from Lebanon's Council for Development and Reconstruction will be used to give population estimates for significant basin cities and towns. Second, data obtained through population density maps with QGIS will be used.

4.1.1 Demographics

The Lebanese portion of the Orontes Basin is located almost entirely within the Baalbek-Hermel Governorate, though a small part falls within the Akkar Governorate.

[102] Committee on Economic, Social and Cultural Rights (CESCR), "General Comment No. 15 (2002) - The Right to Water (Arts. 11 and 12 of the International Covenant on Economic, Social and Cultural Rights)," E/C.12/2002/11 (2013), https://documents-dds-ny.un.org/doc/UNDOC/GEN/G03/402/29/PDF/G0340229.pdf?OpenElement.

Major towns in the Lebanese portion of the basin include Baalbek, Arsal, Qaa, and Hermel. Population figures for these towns are estimated by various sources as ~93,000,[103] ~75,000,[104] ~13,000,[105] and ~22,000,[106] respectively. The area of the Syrian portion of the basin that this project is concerned with is located within the governorates of Rif Dimashq and Homs. Major towns and cities in Rif Dimashq include Yabroud and An-Nabk, with the 2004 census placing their figures at ~26,000[107] and ~33,000,[108] respectively. As for the Homs Governorate, the major towns are Al-Qusayr, Talbiseh, and Ar-Rastan, with 2004 population figures cited as being ~30,000,[109] ~31,000,[110] and ~40,000,[111] respectively. The eponymous city of Homs was recorded as having a population of approximately 750,000 in the 2004 census.[112] As can be seen, Syria has the largest cities, but these figures alone are not sufficient for the purposes of this project. In order to give more precise population figures, remote sensing was again used in order to estimate the population of the areas relevant to this project. The methodology used can be found in this project's appendix. The results indicated that in

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[103] The Council for Development and Reconstruction, "Stakeholder Analysis and Social Assessment for the Proposed Cultural Heritage and Tourism Development Project" (Beirut, November 2001), http://www.charbelnahas.org/textes/Amenagement_et_urbanisme/Cultural_Heritage_Report/G-Baalbek_141-173.pdf, 158.

[104] United Nations High Commissioner for Refugees, "LEBANON: Arsal Influx Inter-Agency Update," November 29, 2013, https://data2.unhcr.org/en/documents/download/38844.

[105] Muhammad Abi Samra, "العونيون والقواتيون في القاع: ثارات قديمة متجددة،" *Al Modon*, October 5, 2019, https://bit.ly/389hozo.

[106] "Hermel," localiban, June 10, 2015, http://www.localiban.org/hermel-3698.

[107] Syria Central Bureau of Statistics, "General Census of Population and Housing 2004" (Damascus, 2004), https://web.archive.org/web/20200122013312/http://cbssyr.sy/new website/General_census/census_2004/NH/TAB03-22-2004.htm.

[108] Ibid, https://archive.ph/reFUv.

[109] Ibid, https://archive.ph/20121204165131/http://www.cbssyr.org/new website/General_census/census_2004/NH/TAB04-13-2004.htm.

[110] Ibid, https://archive.ph/20130112201713/http://www.cbssyr.org/new website/General_census/census_2004/NH/TAB04-19-2004.htm.

[111] Ibid, https://archive.ph/20130112185055/http://www.cbssyr.org/new website/General_census/census_2004/NH/TAB04-18-2004.htm.

[112] Ibid, https://archive.ph/20120731052244/http://www.cbssyr.org/new website/General_census/census_2004/NH/TAB04-1-2004.htm.

2020, approximately 372,614 people lived in the Lebanese portion of the basin, while around 1,675,203 people lived in the Syrian portion of the basin south of Ar-Rastan, for a total population of 2,047,817. As for their total populations at the national level, the World Bank estimates Syria's to be 17.5 million,[113] whereas Lebanon's is estimated to be approximately 6.8 million.[114]

4.1.2 Socio-economic conditions

Once a middle-income country, Lebanon's overall socio-economic status has been rapidly deteriorating due to the severe economic crisis which has been ongoing in the country since late 2019. With the exchange rate between the Lebanese Lira and United States Dollar collapsing from the official rate of ~1,515 LL/USD to an all-time low as of late May 2022 of ~34,100 LL/USD,[115] as many as three quarters of Lebanese are estimated to be living in poverty.[116] The governorate of Baalbek-Hermel has been noted to be one of the most impoverished areas of the country. A report by ESCWA states that 57,000 (92%) of the households in the governorate are classified as being poor.[117] According to the report's definitions, "poor" means that the households lack access to one or more of six dimensions (education, health, public utilities, housing, assets and property, and employment and income).[118]

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[113] "Population, Total - Syrian Arab Republic," The World Bank, accessed June 1, 2022, https://data.worldbank.org/indicator/SP.POP.TOTL?locations=SY.

[114] "Population, Total - Lebanon," The World Bank, accessed June 1, 2022, https://data.worldbank.org/indicator/SP.POP.TOTL?locations=LB.

[115] "Lebanon Market Rates Today," lirarate.org, accessed May 24, 2022, https://lirarate.org/.

[116] Ainhoa Goyeneche and Dana Khraiche, "Lebanon's Inflation Rate Is Worse than Zimbabwe's and Venezuela's," *Al Jazeera*, September 21, 2021, https://www.aljazeera.com/economy/2021/9/21/lebanons-inflation-rate-is-worse-than-zimbabwes-and-venezuelas.

[117] Economic and Social Commission for Western Asia (ESCWA), "Multidimensional Poverty in Lebanon (2019-2021) - Painful Reality and Uncertain Prospects," 2021, https://www.unescwa.org/sites/default/files/news/docs/21-00634-_multidimentional_poverty_in_lebanon_-policy_brief_-_en.pdf.

[118] Ibid.

For the better part of a decade, Syria has been gripped by a civil war. Though at the time of this paper's writing much of the higher-intensity fighting has ceased with the Syrian Government regaining control over much of the country, the effects of the conflict have left the country largely devastated. As in any war, there have been uncountable consequences suffered by the country of Syria and its people. Syria is in a precarious economic situation due to the effects of the war, as well as the country's being cut off from much of the world in terms of international trade and funding due to the myriad sanctions imposed upon it by various Western countries. The exchange rate between the Syrian Lira to the United States Dollar has fallen from a rate of approximately 47 LS/USD in late 2011[119] to an all-time low of 4,730 LS/USD in early 2021.[120] The overall poverty rate in Syria has increased from 34% in 2007 to 83% in 2015.[121] According to Hamati, urban poverty rate estimations from 2015 reveal that the Homs Governorate had an overall poverty rate of 90%.[122] As for Rif Dimashq, urban poverty figures from the same year show that 87% of the governorate's population was living in overall poverty. According to the report, "overall poverty" is defined as "the share of the population whose expenditure lies under the upper poverty line."[123]

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[119] Central Bank of Syria, "أرشيف أسعار العملات الأجنبية عام 2011،" 2011, https://web.archive.org/web/20110527094035/http://www.banquecentrale.gov.sy/forex/forex-ar/FX-2011.xls.

[120] "دولار/ ليرة سورية - سعر الدولار اليوم في دمشق،" الليرة اليوم، accessed May 24, 2022, https://sp-today.com/currency/us_dollar/city/damascus.

[121] ESCWA, "الإطار الاستراتيجي لبدائل السياسات - سوريا بعد النزاع,"الاجندة الوطنية لمستقبل سوريا, 2017, https://archive.unescwa.org/sites/www.unescwa.org/files/page_attachments/spaf-final24-1-2017.pdf, 88.

[122] Samer Hamati, "A Consequence of a Tragedy: Nowcasting Poverty Rate in Syria," *Journal of Poverty and Social Justice* 28, no. 3 (October 1, 2020): 299–336, https://doi.org/10.1332/175982720X15977681182347.

[123] Ibid.

4.2 Physical Context

The physical and hydrological context of any transboundary basin will be relevant to an arrangement for the distribution of its flows. A country's relative contribution to the basin is undoubtedly important—one simple line of logic may be that the more water a country contributes to a transboundary watercourse, the more it ought to be allocated. Along similar lines, the location of a river's headwaters is also an important factor to take into consideration, as it relates heavily to the notions of sovereignty as discussed in the previous chapter. In addition, there may also be significant quantities of subsurface water flowing from an upstream riparian of a transboundary watercourse to a downstream riparian—it is important that this water is accounted for. Climate change projections are undoubtedly an important physical statistic to take into consideration when formulating a use convention on a transboundary watercourse. For the purposes of this project, data for predicted temperature increases will be gathered and compared for the relevant parts of the Orontes Basin. Is there a particular area of the basin that is predicted to suffer disproportionately in comparison with other areas? If the predicted increases in temperature were to occur, crops grown in the Orontes Basin would require more water to attain similar crop yields, resulting in further pressures on both countries' national water resources. This will undoubtedly affect the allocation of water if we desire to arrive at the most "fair and equitable" distribution of the river's flows.

4.2.1 Hydrologic context

Estimates show that Lebanon contributes approximately 412–500 MCM to the Orontes Basin yearly—between 347–429 MCM from Ain ez-Zarqa,[124] and 65 MCM from other groundwater flows.[125] The water that Lebanon contributes through recharge areas within its territory constitutes the vast majority of flows—both underground and surface—upstream of Ar-Rastan in Syria, as shown by Saadé-Sbeih et al.[126] Downstream of Ar-Rastan, there are significant recharge areas within Syria.

4.2.2 Climatic context

According to a 2019 report by the World Resources Institute, Lebanon is already the third most water-stressed country in the world, being placed into the category of countries considered to be experiencing "extremely high baseline water stress."[127] Possible future threats from climate change pose a significant threat to the Lebanese portion of the Orontes Basin, with an expected average temperature increase in Lebanon's interior of 2–5°C (36–41°F) in the next 20 to 50 years.[128]

Syria has long been known to suffer from acute water shortages. According to the World Resources Institute, Syria ranks as the 31st most water-stressed country in the

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[124] ESCWA and BGR, "Orontes River Basin," 232.

[125] François Zwahlen et al., "Groundwater Flow in the Orontes River Basin and the Syria–Lebanon Water Sharing Agreement," in *Karst without Boundaries*, Selected Papers on Hydrogeology 23 (Boca Raton, FL: CRC Press/Balkema, 2016), 60, https://doi.org/10.1201/b21380-6.

[126] Saadé-Sbeih et al., "Groundwater Balance Politics," 677.

[127] Rutger Willem Hofste, Paul Reig, and Leah Schleifer, "17 Countries, Home to One-Quarter of the World's Population, Face Extremely High Water Stress," World Resources Institute, August 6, 2019, https://www.wri.org/insights/17-countries-home-one-quarter-worlds-population-face-extremely-high-water-stress.

[128] Nadim Farajalla et al., "Climate Change in Lebanon: Higher-Order Regional Impacts from Agriculture" (Beirut: Issam Fares Institute for Public Policy and International Affairs, American University of Beirut, June 2014), https://www.aub.edu.lb/ifi/Documents/publications/working_papers/2013-2014/20140722_Higher_order_CC.pdf.

world, falling in the category of "high baseline water stress."[129] Projections show that Syria is expected to suffer from temperature increases in the coming decades, with the World Bank predicting that the Homs and Rif Dimashq Governorates will witness an estimated average temperature increase of 2.2–3.5 °C (36–38 °F) in the next 20–50 years.[130]

4.2.3 Per capita water availability and distribution

Indeed, both riparians are expected to see marked increases in their respective average temperature. As stated, this will put more stress on available water resources by increasing the water requirements for crops to attain yields similar to those in cooler years. The FAO's minimum per capita water availability figure in order for a country to be under "stress" conditions is 1,000 m^3 per person per year.[131] Lebanon's per capita water availability is estimated to be 940 m^3,[132] whereas Syria's figure is placed at 810 m^3.[133] How much water does the final 2002 Amendment allocate to the Orontes River inhabitants on a per capita basis? Taking the 403 MCM figure as stated in the treaties, and dividing it by this project's estimate of the population in all areas of the Orontes Basin south of Ar-Rastan of 2,047,817 gives a per capita water allocation of 197 m^3. Taking Lebanon's and Syria's allocations as stipulated by the treaties, and dividing

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[129] Rutger Willem Hofste, Paul Reig, and Leah Schleifer, "17 Countries, Home to One-Quarter of the World's Population, Face Extremely High Water Stress," World Resources Institute, August 6, 2019, https://www.wri.org/insights/17-countries-home-one-quarter-worlds-population-face-extremely-high-water-stress.

[130] "Syrian Arab Republic," Climate Change Knowledge Portal (CCKP) | The World Bank, accessed May 20, 2022, https://climateknowledgeportal.worldbank.org/country/syrian-arab-republic/climate-data-projections.

[131] "Water Scarcity," Food and Agriculture Organization of the United Nations (FAO), accessed June 25, 2022, https://www.fao.org/land-water/water/water-scarcity/en/.

[132] "Water Resources in Lebanon," Fanack Water, October 13, 2015, https://water.fanack.com/lebanon/water-resources/.

[133] "Water Resources in Syria," Fanack Water, accessed April 20, 2022, https://water.fanack.com/Syria/water-resources/.

them by their relevant population estimates of 372,614 and 1,675,203, respectively, reveals the riparians' individual per capita water distribution figures:

- Lebanon: 258 m^3/per person
- Syria: 183 m^3/per person

Note that this number is well below the 1,000 m^3 per person per year limit established by the FAO. Though it is important to note that these figures are not necessarily a reflection of the two areas' per capita water *availability*, they do provide further confirmation of the high-stress conditions that exist on the Orontes Basin. This paints a concerning picture for the inhabitants of the Orontes Basin in terms of their access to water especially when considered alongside the expected temperature increases.

4.3 Dependence Upon Water Resource

This project will describe the present use of the Orontes' flows within both riparians, analyzing their respective nature, sector, and economic dependence. Analyzing use cases is tied to analyzing the demographics and socio-economic conditions of the Orontes Basin, as the two statistics are inextricable from one another—with all areas of the basin being heavily tied to agriculture, the flows of the Orontes represent a lifeline for its communities.

The entirety of Lebanon's Baalbek-Hermel region is highly dependent upon agriculture. Major crops grown in the Lebanese portion of the Orontes Basin include potatoes, various vegetables, stone fruits, and cannabis.[134] Major livestock types raised include sheep and goats,[135] and an estimated 10–12 tons of fish are produced yearly in

[134] Jaafar et al., *Water Resources within the Upper Orontes*, 16.
[135] "BAALBECK EL-HERMEL GOVERNORATE," IDAL - Investment Development Authority of Lebanon, accessed April 20, 2022,

aquaculture farms along the length of the river.[136] Agriculture in the Baalbek-Hermel Governorate forms a lifeline for Lebanon. Over one-third of the firms based in the governorate are involved in agriculture related activities.[137] Reflecting these realities, and placing emphasis on the overwhelmingly consumptive use regime in place, the Orontes will be assigned a qualitative importance value of "high" for Lebanon.

The Orontes is under heavy use in Syria. Prior to the onset of the Syrian Civil War, the Orontes Basin accounted for as much as 25% of the country's total agricultural production.[138] In the relevant Syrian portion of the Orontes Basin, major crops grown include apricots, apples, wheat, sesame, as well as various vegetables.[139] The Orontes is of paramount importance to the governorate of Homs and its people—it has been estimated that agricultural activities constitute 70% of the governorate's economy.[140] Reflecting these facts, and again the highly consumptive nature of the use regime, the Orontes also will be assigned a qualitative importance value of "very high" to Syria.

4.4 Results: WRAs

The relevant statistics gathered throughout this exercise are shown below in Table 2 for ease of reference during the following exercise.

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https://investinlebanon.gov.lb/en/lebanon_at_a_glance/invest_in_regions/baalbeck_el-hermel_governorate.

[136] Ibid.

[137] "BAALBECK EL-HERMEL GOVERNORATE," IDAL.

[138] Haj Asaad and Jaubert, "Geostrategic Stakes and the Impact of the Conflict," 181.

[139] Ibid, 180.

[140] Tammam Yaghi, Abdel Aldarir, and Vinay Nangia, "Impact of Climate Changes on Water Resources Availability in the Orontes River Watershed : Case of Homs Governorate in Syria = تأثير التغير المناخي على إتاحة المصادر المائية في حوض العاصي : حالة محافظة حمص في سورية," *Jordan Journal of Agricultural Sciences* 12 (June 1, 2016): 499–519, https://doi.org/10.12816/0030034.

Table 2. Statistics for relevant areas.

	Lebanon	Syria
Population - whole country (millions)	6.9	17.5
Population - study area (millions)	0.373	1.675
Poverty Rate - study area (% of population classified as "poor")[141]	92%	90%
Contribution to total water in study area	High	Low
Per capita water distribution (per person per year)	258 m^3	183 m^3
Projected average temperature increase (degrees centigrade, c. 20–50 years)	2–5	2.2–3.5
Dependence on Orontes	High	Very High

The subsequent section of this chapter will turn to an exercise in which potential allocations for the Orontes' flows are constructed. The flow amount from which allocations will be made is 403 MCM, as measured at the Hermel Bridge gauge. A default "prior use" WRA will be assumed to be the 2002 Amendment, denoted as WRA-*d* (default).

WRA-I

Description: As has been shown, the Syrian portion of the Orontes basin south of Homs has a larger population than Lebanon's portion of the basin. The estimates

[141] It must be acknowledged that the methodologies used in the two reports that these values were taken from are different. Like most other data that this project strives to incorporate, it is extremely difficult to locate poverty rates based on uniform definitions from the same time frame for more than one country in the MENA region.

derived from remote sensing suggest that the relevant Syrian portion of the basin has a population of ~1,675,203 (82%), whereas the Lebanese portion of the basin has a population of ~372,614 (18%).

Technique: This WRA simply applies the percentage distributions of the population in the relevant areas between the two countries—18% in Lebanon and 82% in Syria—to the flow 403 MCM. This WRA is influenced by subparagraph *(c)* of Article 6 of the 1997 UNWC: the population dependent on the watercourse in each watercourse State. The allocation stipulated by this WRA would result in a per capita water allocation of approximately 197 m^3/person—the basin-level per capita water distribution as identified in Section 4.3.2.

Result: Lebanon is allocated 73 MCM (18%); Syria is allocated 330 MCM (82%)

WRA-II

Description: Population figures alone are not sufficient for the formulation of an agreement with fairness and equity as its end goal. Poverty rates are an indicator of a community's vulnerability. This project has shown that approximately 92% of households in Lebanon's Baalbek-Hermel Governorate are classified as being poor, and that approximately 87% and 90% of those living in Syria's Rif Dimashq and Homs Governorates, respectively, are classified as being poor.

Technique: This WRA is a modified version of WRA-II. It takes the relevant poverty rates and applies them to each country's population living in the relevant portions of the Orontes Basin. This results in 342,804 classified as "poor" in the Lebanese portion of the basin, and 1,482,555 classified as "poor" in the relevant Syrian

portion of the basin, for a total of 1,825,359. This WRA would be in accordance with the abovementioned subparagraph *(c)* of Article 6 of the 1997 UNWC, as well as subparagraph *(b)*: The social and economic needs of the watercourse States concerned.

Result: Lebanon is allocated 76 MCM (18.8%); Syria is allocated 327 MCM (81.2%).

WRA-III

Description: The goods produced from the flows of any river will not only be consumed in its immediate vicinity—grains, vegetables, fruits, fish, and dairy can all be transported with relative ease, reaching markets all over the country or even the world. Could the "population dependent upon the watercourse" described in subparagraph *c)* of Article 6 of the 1997 UNWC be considered to be the entirety of a nation?

Technique: This WRA simply allocates to Lebanon and Syria a share of Orontes water representing the size of their populations on a national level. The total population of Syria and Lebanon combined is 24.4 million: 6.9 million in Lebanon, 17.5 million in Syria.

Result: Lebanon is allocated 114 MCM (28.3%), Syria is allocated 289 MCM (71.7%).

WRA-IV

Description: The springs from which the Orontes River rises are all located within Lebanon. As noted by Saadé-Sbeih et al., significant quantities of subsurface flows from Lebanese recharge areas enter Syria in the area of the Orontes Basin south

of Homs.[142] As previously noted, Lebanon is home to one of the largest springs in the basin: Ain ez-Zarqa, with a flow of 347–429 MCM/year.

Technique: This WRA recognizes Lebanon as being the primary source of the Orontes' flows south of Ar-Rastan. Beaumont devises a methodology by which riparians of a transboundary watercourse are allocated 50% of the flows "generated" within their territories—i.e., water that "occur[s] as precipitation within the state and that…is not merely flowing through that particular country."[143] The remaining 50% is allocated amongst riparians based on historical use ratios. For the purposes of this project, the 2002 Amendment will be used as the ratio of prior use: 80% to Syria, 20% to Lebanon. As Turkey is not included in these agreements, Syria would get the entirety of the resulting 161.2 MCM, in addition to any water that is generated within its territory. Not in concordance with any specific article of the 1997 UNWC, this WRA can be understood as a composite of the principles of absolute territorial sovereignty and absolute territorial integrity.

Result: Lebanon is allocated 241.8 MCM (60%); Syria is allocated 161.2 MCM (40%).

WRA-V

Description: What is the theoretical upper limit for allocation of Orontes water to Lebanon? How much water would be needed for Lebanon to fully take advantage of its portions of the Orontes Basin with conditions suitable for irrigated agriculture?

[142] Saadé-Sbeih et al., "Groundwater Balance Politics," 677.

[143] Peter Beaumont, "The 1997 UN Convention on the Law of Non-Navigational Uses of International Watercourses: Its Strengths and Weaknesses from a Water Management Perspective and the Need for New Workable Guidelines," *International Journal of Water Resources Development* 16, no. 4 (December 2000): 487, https://doi.org/10.1080/713672536.

Technique: This WRA reflects the amount of water Lebanon would need to make use of its maximum irrigable areas in its portion of the Orontes Basin. GIS was used to trim an area stretching approximately from Baalbek to the Lebanon-Syria border, and constrained by Mount Lebanon and the Anti-Lebanon mountains on the other axis. The resulting land use raster graphic showed this area is approximately 80,650 hectares. The seasonal CU equation introduced in Chapter 3 was used to calculate a hypothetical consumption estimate of 704 MCM. However, this WRA can be understood as a limit on WRA-IV; a riparian should only be allocated as much water as it can use. If a riparian's maximum irrigable area would require *less* than 50% plus its previous share ratio, it should receive that amount; if it would need more than the 50% plus previous share ratio, the quantity stipulated by WRA-IV would become maximum allocation for an upstream riparian. In the case of Lebanon on the Orontes Basin, the 704 MCM it would need to take advantage of its maximum irrigable area is larger than the 50% plus prior use allocation. As a result, Lebanon's maximum allocation is 241.8 MCM.

Result: Lebanon is allocated 241.8 MCM (60%); Syria is allocated 161.2 MCM (40%).

Summaries of the above-described WRAs are provided on the following page in Table 3 for reference.

Table 3. Summary of WRAs

	Allocation to Lebanon	Allocation to Syria	Source
WRA-*d*	96 MCM (23.8%)	307 MCM (76.2%)	n/a
WRA-I	73 MCM (18%)	330 MCM (82%)	Article 6, ¶ *c*
WRA-II	76 MCM (18.8%)	327 MCM (81.2%)	Article 6, ¶ *b* & *c*
WRA-III	114 MCM (28.3%)	289 MCM (71.7%)	Article 6, ¶ *c*
WRA-IV	241.8 MCM (60%)	161.2 MCM (40%)	Beaumont (2000)
WRA-V	241.8 MCM (60%)	161.2 MCM (40%)	n/a

4.5 Interpretations

This exercise has given a possible range of minimum and maximum allocations for the distribution of the 403 MCM of the Orontes' flows as measured at the Hermel Bridge gauge. Lebanon's minimum allocation was shown to be 73 MCM, whereas its maximum allocation is approximately 242 MCM. As for Syria, its minimum hypothetical allocation was approximately 161 MCM, whereas its maximum was estimated at 330 MCM. It is interesting to note the differences between the WRAs emphasizing "social" statistics (I–III), and those based around "physical" statistics (IV and V) with the former methodology usually resulting in Lebanon being allocated a share of water very close to the amount stipulated in the 2002 Amendment, whereas the physical statistics allocate a larger portion to Lebanon.

Another finding of particular interest uncovered during this exercise is the number of similarities between the Lebanese and relevant Syrian portions of the Orontes Basin. This is perhaps unsurprising owing to the two regions' being in close geographical proximity to one another, as well as their shared history. Certain statistics—such as the climate change-induced temperature increase predictions—are so

similar between the two riparians that it was not possible to make use of them to significantly alter the distribution schedule of the Orontes' flows. In addition, no WRA was constructed for per capita water availability/distribution. Although the numbers themselves are revealing, trying to attain parity in the per capita distribution of water would ultimately result in an allocation identical to WRA-I, which allocates water based on the population in the study area. Ultimately, a finalized WRA for the Orontes Basin would take into account all statistics listed. Further research ought to look into how these individual statistics should be weighed in relation to one another. Possible questions to explore could be when, or if, the "social" statistics should override the "physical" statistics and vice versa. According to Paragraph 3 of the 1997 UNWC's Article 6, the weight assigned to each statistic "…is to be determined by its importance in comparison with that of other relevant factors." This would imply that it is up to Lebanon and Syria to come up with an agreed-upon mechanism to weight the statistics; however, another question may be posed asking how a hydro hegemon could be prevented from only agreeing to a mechanism that would result in an agreement in its favor.

CHAPTER 5

DISCUSSION

This final chapter will turn to a synthesis of the information presented by this project, attempting to arrive at an answer to its guiding question. A brief discourse analysis is presented comparing the series of agreements between Lebanon and Syria on the Orontes with those on the Kabir River, focusing on aspects of resource pressures and hegemony. In this context, some of the challenges of using the 1997 UNWC under conditions of hegemony will be explored, with the institution of WRAs presented as a possible solution in such conditions. Finally, the project will conclude with a discussion of possible avenues available to Lebanon to bolster its position on the Orontes Basin, incorporating the ramifications of the consumption estimates disclosed in Chapter 3.

5.1 Utilization of the 1997 UNWC in the Shadow of Hegemony

In pursuit of an answer to this project's guiding question, it is worth taking a brief look at another river shared by Lebanon and Syria—the Kabir.[144] Rising from numerous springs spread across the Lebanese governorates of Akkar and Baalbek-Hermel and the Syrian governorates of Tartous and Homs, the Kabir River flows in a westerly direction forming the Lebanese-Syrian border for 50 km before discharging into the Mediterranean Sea near the Lebanese town of Arida. The Kabir Basin spans an area of approximately 950 km^2, with 26% lying in Lebanon and 74% in Syria.[145] The

[144] In Arabic, "*an-Nahr al-Kabir al-Janoubi*," (lit. "the Southern Great River") to distinguish it from another "kabir" river in Syria: "*an-Nahr al-Kabir ash-Shmali*" (lit. "the Northern Great River).
[145] ESCWA and BGR, "Chapter 8 - Nahr El Kabir Basin," in *Inventory of Shared Water Resources in Western Asia*, E/ESCWA/SDPD/2013/Inventory (Beirut: United Nations, 2013), 257 https://waterinventory.org/sites/waterinventory.org/files/chapters/Chapter-08-Nahr-el-Kabir-Basin-web.pdf.

total basin population is 530,000—approximately 100,000 (19%) in Lebanon and 430,000 (81%) in Syria.[146] In April of 2002, Lebanon and Syria signed an agreement on the allocation of the Kabir's flows and the construction of a joint dam on the watercourse.[147] The 2002 al-Kabir agreement allocates Lebanon 40% of the river's flows, while Syria receives 60%. This 40-60 split departs sharply from each country's share in both the basin area and population. This is because the 2002 al-Kabir agreement "…follows each riparian country's share in the catchment area that drains to the [proposed] dam location," instead of each riparian's contribution to the total basin, which, as noted by ESCWA and BGR, was not taken into account.[148] Regardless of the methodology used during the negotiations on the 2002 Kabir Agreement, there is much praise for the document as an agreement enshrining cooperative efforts, with ESCWA lauding the agreement as a pinnacle example of collaboration between the countries under its jurisdiction, noting that

> [u]nlike the negotiations regarding the Orontes…[those regarding the Kabir] were remarkably easy and distinguished by good will on both sides…[m]embers of the Lebanese delegation noted the ease with which the negotiations over the agreement had been carried out, and the delegation made clear its satisfaction with the outcome.[149]

Why would the negotiations on the Kabir—which were undertaken in roughly the same time frame as those on the Orontes—be marked by such an atmosphere of cooperation? Along similar lines, why was the 2002 Kabir Agreement never amended, while it took two amendments to the 1994 Agreement on the Orontes to arrive at a mutually agreeable use convention? A hypothesis posited earlier in this project may provide an

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[146] Ibid, 251.

[147] Hereinafter, "the 2002 Kabir Agreement."

[148] ESCWA and BGR, "Nahr El Kabir Basin," 257.

[149] ESCWA, "Regional Cooperation between Countries in the Management of Shared Water Resources: Case Studies of Some Countries in the ESCWA Region" (New York: United Nations, December 19, 2005), 15, https://archive.unescwa.org/file/31178/download?token=Km1KZU3K.

answer here—basins that are not under significant conditions of stress may experience less negative hegemonic conditions, and hence negotiations between riparians on the use of the basin should be relatively straightforward. The "remarkable ease" by which Syria and Lebanon negotiated a use convention for the Kabir's flows, as well as the Lebanese delegation's praise of the agreement would suggest that the river is not a critical resource to Syria. This is contrasted with the negotiations on the Orontes, which reportedly were much more difficult, indicating that the river constitutes a much more important resource to the two riparian states, and is hence under much more pressure from heavy consumptive use. There could be many reasons behind the relatively low importance assigned by both riparians to the Kabir River; while it is beyond the scope of this project to explore these reasons, a point still stands—Syria showed relatively little disinclination to Lebanon being assigned nearly half of the Kabir's flows, while it took eight years, three documents, and countless hours of negotiating to bring about a mutually-agreeable use regime on the Orontes. This provides us with yet further confirmation of Syrian hydro hegemony in the Orontes Basin—Syria vigorously fought to preserve its access to the Orontes' flows, while it readily agreed to Lebanon receiving more water than it contributes to the Kabir basin.

This opens up a question of just how much the 1997 UNWC can be relied upon "in the shadow of hegemony." Perhaps its feasibility as a platform from which negotiations can be launched is limited to transboundary basins that are not under hegemonic conditions. Some literature has suggested that in its pursuit to be a practical framework for attaining the most fair and equitable use of a transboundary watercourse, the 1997 UNWC takes too many factors into account, while simultaneously failing to demarcate how these factors ought to be assessed in relation to one another; in trying to

create a framework that satisfies all demands, the UNWC becomes a document largely "without teeth." In his criticism of Article 6 of the UNWC, Beaumont states that it is far too open-ended to be of any practical use for negotiators, ultimately concluding that

> an article has been produced which would keep academics in discussion for years even if they were trying to solve the question of what "equitable and reasonable" actually meant in the context of the guidance given in Article 6.[150]

While these instruments of IWL are useful as a framework for devising a functional agreement, they should be treated as such. They are not a paragon of all things equal, fair, and good in the arena of transboundary governance. States, like humans, are complex entities; the factors that do or do not make them work effectively cannot be condensed into a single document. By providing a plethora of possible usage conventions that can be tailored to specific demands of riparians, WRAs can be seen as an "enhancement" of the 1997 UNWC. Furthermore, WRAs may have something of a mitigating effect on the more negative aspects of hegemony by virtue of their ability to provide a bound of minimum and maximum hypothetical allocations of water to riparians of a transboundary watercourse. Such a methodology will only become more relevant as pressures on water resources increase in the age of the Anthropocene, not only in the Orontes Basin, but all transboundary river basins under significant pressure.

5.2 Boosting Lebanon's Stance—Available Avenues

In Chapter 4, five WRAs using different methodologies were calculated, giving a range of possible allocations of water to Lebanon and Syria. Comparing the WRAs to the 2002 Amendment provides some interesting insights. On the surface, WRAs I–III

[150] Beaumont, "The 1997 UN Convention on the Law of Non-Navigational Uses of International Watercourses," 482.

(based upon the relevant regions' demographic and socioeconomic statistics) resemble the 2002 Agreement to a degree—the first two allocate Lebanon approximately 20 MCM less than the 2002 Amendment, whereas the third resulted in an allocation 18 MCM greater than the 2002 Amendment. One possible answer to this project's guiding question using these three WRAs as a framework is that the 2002 Amendment ought to be considered "fair and equitable." However, a different answer would be provided by WRAs IV and V. WRA-IV on one hand recognizes Lebanon as the source of the Orontes, and on the other tries to balance this with prior use conventions, resulting in Lebanon receiving 146 MCM more than its allocation as stated in the 2002 Amendment. WRA-V can be understood as a limit that confirms WRA-IV as the maximum amount Lebanon should be allocated. These WRAs on the upper bounds of water allocation to Lebanon suggest that the 2002 Amendment would need to be further amended to allocate Lebanon more water in order for it to be considered "fair and equitable." In light of this, the subsequent sections will explore the question of how Lebanon might obtain a "better deal"—whether this be through additional allocation or other methods—on the use of the Orontes' flows, incorporating the implications of the consumption estimates presented in Chapter 3, as well as newly emerging principles and norms of transboundary watercourse governance. It must be noted that the avenues explored below assume Syria's and Lebanon's general orientations to be based around notions of goodwill and equity; it is likely that in a "real world" scenario, negative, dominating aspects of Syria's hydrohegemony would form an obstacle to the implementation of at least some of the concepts described below.

5.2.1 The Dilemma of Prior Use

One of the largest puzzles in any transboundary watercourse is striking a balance between cases of significant historical use and those of so-called "late developers." Indeed, the 1997 UNWC itself can be seen as an attempt to rectify the differences between these two use cases, with Articles 5 and 6 (reasonable and equitable utilization and related factors) often being seen as representing the interests of late developers on a transboundary watercourse, while Article 7 (obligation to not cause significant harm) is frequently invoked by riparians with a long-established historical use pattern. In a survey of over 450 international water treaties, Zhao et al. note that the prior users of transboundary watercourses have historically been given priority over late developers; however, the authors note a trend by which the rights of late developers have been gradually gaining more protection.[151] Such a shift in the principles and norms of transboundary watercourse governance could very well be beneficial to Lebanon in the case it attempts to receive a greater share of the Orontes' flows. Furthermore, Zhao et al. make note of a gradual shift occurring in the underpinnings of the "no harm" principle itself, whereby the traditional focus on whether or not harm to a prior user has occurred has been challenged by the "due diligence" principle, which holds that the harming state's conduct—not the mere fact that significant harm occurred—ought to be taken into consideration.[152] While these are noteworthy developments that may very well help Lebanon bolster its position vis-a-vis Syria on the basin, the point still stands that the latter has a well-established historical use regime that it is highly reliant upon

[151] Yue Zhao et al., "Protection of Prior and Late Developers of Transboundary Water Resources in International Treaty Practices: A Review of 416 International Water Agreements," *International Environmental Agreements: Politics, Law and Economics* 22, no. 1 (March 2022): 201–228, https://doi.org/10.1007/s10784-021-09550-7.
[152] Ibid, 213.

until this day. As a result, it might be difficult for Lebanon to obtain a greater share of water beyond its allocation stipulated in the 2002 Amendment. As has been shown in this project, one critical issue in revising the Orontes agreements between Lebanon and Syria is that the river is under significant pressure by both riparian states, though particularly the latter. Assigning Lebanon a greater share of the flows could very well have detrimental effects on the Syrian portion of the basin, potentially resulting in food insecurity. By virtue of its significantly larger population, Syria will need a greater share of the Orontes' flows than Lebanon in order to produce more food. It is posited that such requirements can be seen as Syrian "utilization rights" to a greater share of the Orontes' flows than Lebanon. The following section explores these rights, contrasting them with ownership rights and attempting to strike a balance between them.

5.2.2 Ownership rights vs. utilization rights

A solution to the dilemma of prior users versus late developers may be found in the concepts of ownership and utilization rights. Might it be possible for one to own a resource, but not have the right to use it? Along similar lines, could one have the right to utilize a resource owned by a different party? This project suggests that not only are such arrangements possible, but that they also might facilitate better relationships between riparians of transboundary watercourses. In the context of the Orontes Basin, Syria may very well have an indisputable right to utilize significant quantities of water originating within Lebanese territory; simultaneously, Lebanon can be seen as having full ownership rights over these waters. By explicitly assigning Lebanese ownership to these waters that are needed by Syria, yet originate from within the cedars nation, a door is opened for Lebanon to receive compensation for the use of what could be seen

as “its” water. Such compensation might traditionally take the form of funds, but it could take other various forms, such as energy transfers or developmental assistance. While Syria would remain the largest benefactor of the Orontes’ flows, Lebanon would still receive benefits—albeit indirectly and/or transformed into another good or service—from flows that originate within its territory but are used in Syria. Such an arrangement would bestow upon Syria a position of seniority, recognizing the realities of its historic use, while also respecting the fact that significant quantities of the waters it uses originate within Lebanese territory. Future research could integrate this concept into the mapping of WRAs on the Orontes Basin, as it would undoubtedly affect the allocation of water to either riparian, and the potential for compensation.

5.2.3 River Basin Organizations

Another avenue available to Lebanon to possibly bolster its position on the Orontes Basin is the creation of a basin-wide association to jointly manage the river with Syria and Turkey. Zhao et al. note that transboundary watercourse basins that have river basin associations have a greater prevalence of granting prior users and late developers equal rights, due to their general propensity to foster cooperation rather than competition.[153] According to Lebanese water expert and diplomat Dr. Fadi Comair, the formation of a regional basin authority is amongst the largest obstacles faced today by the Orontes’ riparians in terms of improving basin-wide governance. Meetings were held between Lebanese and Syrian delegates as late as the early 2010s concerning the establishment of such an association. However, plans have been on hold ever since due to the effects of the ongoing Syrian Civil War.[154]

[153] Zhao et al., “Protection of Prior and Late Developers,” 223.
[154] Personal correspondence with Dr. Fadi Comair.

An Orontes Basin Association would facilitate better basin governance in several ways. In Chapter 3, consumption estimates were given for the portions of the Orontes Basin relevant to this project: 88 MCM for Lebanon, and 746 MCM for Syria. The high number for Syria was accounted for by groundwater abstractions from the wells that are seemingly omnipresent throughout the Syrian portion of the basin south of Ar-Rastan, the majority of which were likely drilled before the cut-off date for new well construction in late 1994. Such abstractions are liable to decrease the ability of both riparians to use this groundwater in the future, particularly if they are occurring at a rate beyond the aquifer's recharge rate. An Orontes Basin association may help rectify the intensive groundwater abstractions ongoing in the Syrian portion of the basin south of Ar-Rastan by determining their size and frequency. Is the aquifer well studied enough to know if these abstractions are occurring significantly beyond the recharge rate of the aquifer? Such an association could help answer such questions, and provide technical expertise for lessening the abstractions should it be determined that they are indeed harmful. This will undoubtedly lead to a greater atmosphere of equity across the basin by ensuring that future generations in Lebanon and Syria alike do not suffer future consequences from current over abstractions of groundwater. Furthermore, as this project has demonstrated, there is an acute lack of accurate data on the Orontes Basin. A basin-wide organization would provide a platform through which relevant basin data could be gathered, monitored, and analyzed. The availability of quality, accurate data would give policymakers a more accurate understanding of the "on-the-ground" realities of the basin, ultimately helping them make better decisions. The availability of quality, accurate data might also reduce some of the negative aspects of hegemony by

preventing—or at least reducing—possible non-compliance with the terms of the 2002 Amendment, or whatever agreement may be in place in the future.

5.3 The 2002 Amendment—Yearning for Implementation

Syria's intensive groundwater abstractions are evidence of two inherent flaws contained within the series of treaties between Lebanon and Syria on the use of the Orontes: they fail to specify an allocation to Syria, and they fail to account for the fact that Syria was able drill a quantity of wells magnitudes larger than that in Lebanon before the cut-off date in September 1994. While the agreements may very well have room for improvement based on this reality, the fact remains that Lebanon has not taken full advantage of the terms contained within the agreement. Therefore, before Lebanon tries to obtain a greater share of water, it ought to focus its efforts upon maximizing its ability to use the water it is currently allocated by fully implementing the provisions contained within the amendment, such as construction of the two dams in the Lebanese portion of the basin. The minutes of the meetings of the Lebanese-Syrian Committee on Shared Water held from 2003–2004 reveal plans formulated by the two riparians in order to fully implement the agreement, including the provisions concerned with the construction of the dams. The construction of the dams would have been implemented in two stages—the construction of the diversion dam and two pumping stations which would provide the Bekaa and Hermel regions with an additional 2000–3000 hectares of irrigation; and the construction of a storage dam with hydroelectric facilities, providing a further 3500–4000 hectares of irrigation.[155] The minutes further disclose plans to carry out a comprehensive environmental survey on the Orontes Basin. Various international

[155] المجلس الأعلى السوري اللبناني, "محضر اجتماع اللجنة الوزارية للمياه المشتركة - دمشق 30/10/2003," October 20, 2003, http://syrleb.org/SD08/msf/1507753207_.pdf.

organizations, such as ESCWA, UNDP, and the European Commission were consulted to assist the two riparians in carrying out this survey. As noted in minutes dating from early 2004, these organizations "…all showed a willingness to help when they were asked for it by the competent authorities of the two brotherly nations."[156]

This project acknowledges that much of the blame for the lack of progress on the dams' construction lies with Lebanon's southern neighbor, who destroyed the under-construction diversion dam during its 2006 war on Lebanon. Following this, the Chinese company that was contracted to build the two dams demanded compensation for the losses it suffered as a result of the bombing. A committee was formed in 2011 to address this issue, though the literature is not clear on how—or whether—this issue was resolved.[157] Furthermore, there has been seemingly little desire within Lebanon to restart this project.

Though they may largely be blueprints currently, the 2002 Amendment and related minutes address many of the issues still faced by Lebanon and Syria across many contexts two decades after their drafting. The yet-to-be-built diversion and storage dams in the Lebanese portion of the basin comprise a headspring of untapped potential for the inhabitants of the Baalbek-Hermel region and Lebanon as a whole. An addition of 5,500–7,000 irrigated hectares facilitated by the two dams would constitute an increase in Lebanon's irrigated area in the basin to the tune of 20–27% over its total irrigated area of 13,800 hectares. An additional round of benefits is found when we consider that the diversion dam is intended to serve both countries. The groundwater abstractions in the Syrian portion of the basin identified by this project are liable to

[156] المجلس الأعلى السوري اللبناني, "محضر اجتماع اللجنة الوزارية للمياه المشتركة - بيروت 31/3/2004," March 31, 2004, http://syrleb.org/SD08/msf/1507753477_.pdf.

[157] "Shared Water Resources in Lebanon," Fanack Water, July 27, 2022, https://water.fanack.com/lebanon/shared-water-resources-in-lebanon/#_ftn6.

reduce the availability of groundwater in both riparians' portions of the basin; though it may not offset them in their entirety, the diversion dam would reduce these abstractions by providing Syria with additional flows.

Such developments would be highly advantageous for the two riparians, and would constitute a significant improvement from the *de facto* situation on the Orontes Basin. Indeed, the full implementation of the 2002 Amendment may be the best option available to Lebanon to improve its stance on the basin, while preparing for greater pressures upon its water resources in the age of increased temperatures of the Anthropocene.

5.4 Avenues for Future Research and Concluding Remarks

This project has given a comprehensive survey of the current state of affairs between Lebanon and Syria on the Orontes Basin. The project's area of study focused on the area of the basin south of Ar-Rastan, Syria, due to the fact that the groundwater recharge areas in this area fall primarily within Lebanese territory. The series of treaties between the two countries on the Orontes' use were examined, laying out their strengths and weaknesses and placing them within the larger context of both Syrian-Lebanese relations and the institution of international transboundary resource governance as a whole. Using GIS software, the size of the areas in the Lebanese portion of the Orontes Basin exempted by the 1997 Annex were estimated to be 3,713 hectares. Subtracting this number from the estimated quantity of irrigated hectares of 13,800 provided by Jaafar et al. results in a figure of 10,087 hectares. As for the Syrian portion of the Orontes Basin south of Ar-Rastan, an estimation of irrigated hectares was made using a land use map from Jaubert and Haj-Asaad, resulting in a figure of 84,460.53 hectares.

From these figures, water consumption figures for Lebanon and Syria were estimated to be 88 MCM and 746 MCM, respectively. The reasons for Syria's striking water consumption here are twofold: first, none of the three treaties make a specific allocation to Syria, and two, the Syrian portion of the basin has an extremely high well density. It is likely that such intensive abstractions are depleting the various aquifers that feed the basin.

An exercise was undertaken in which a number of hypothetical water rights allocations (WRAs) were developed based upon different statistics in relevant portions of the two riparian countries. This exercise demonstrated that the answer to the question of whether the final 2002 Amendment is "fair and equitable" will depend on how this question is approached. Using methodologies centered around questions of demographics and socioeconomic conditions, this project suggests that the 2002 Amendment can be considered "fair and equitable." A different methodology emphasizing Lebanon's position as upstream riparian and prior use allocations indicate that Lebanon ought to be allocated a greater share of the Orontes' flows. This project has also looked at the use of the 1997 UNWC's Article 6 under hegemonic conditions, identifying WRAs as a way to "enhance" the convention so that it is more straightforward to use under hegemonic conditions, due to their ability to provide minimum and maximum bounds for allocations to riparians. In possibly renegotiating a treaty with Syria, Lebanon's greatest challenge will once again be convincing Syria that a win-win situation is possible if the treaty were to be revised again. Though it may be difficult for one crisis-stricken nation to convince another crisis-stricken nation to give up quantities of a vital resource, trends identified in this project show that there is an increasing incidence of affording late developers on transboundary watercourses greater

usage rights. An exploration was undertaken of ownership rights and utilization rights, and how assigning such rights to Orontes riparians might be a way to increase fairness and equity in the river basins by opening up the possibility of Lebanon receiving compensation for water that can simultaneously be seen as belonging to Lebanon yet needed in Syria.

Ultimately, Syria and Lebanon both are at a turning point in their histories—the former's decade-long civil war is coming to an end, and the latter is in the midst of the most severe crisis of its post-civil war era. As Syria gradually becomes re-legitimized within the regional and international communities, might this changing political context affect Syria's hegemonic basin stance, creating an environment more amenable to the 2002 Amendment being revised? How will the ongoing crisis in Lebanon affect its water requirements? This critical point in the two countries' histories might be the one of the best opportunities to reexamine and revise a wide range of issues affecting these two Levantine countries. Future research ought to look into the above questions, and explore how the present-day political realities in Syria and Lebanon might affect their shared water resources.

In any case, it is important that Lebanon fully implement the 2002 Amendment in its totality before it attempts to re-enter negotiations with Syria on the Orontes' use. The two dams proposed in the 2002 Amendment would do much to improve the status quo in the Lebanese portion of the basin by providing an increase in irrigated areas. Finally, it is posited that there is a need for improved basin governance. Such a development could take the form of an Orontes Basin Association. Ultimately, this would lead to better data and monitoring, especially of groundwater and well-pumping. It could also very well help with the full implementation of the 2002 Amendment,

especially in building the planned infrastructure, and perhaps increase the ease by which funding is secured. Such an organization could very well be the "missing link" that would increase fairness and equity across the basin, and ensure that future generations living in Lebanon, Syria, *and* Turkey are able to not only use the flows of the Orontes, but use them sustainably.

APPENDIX

This appendix discusses the methodology used within the QGIS to obtain population figures for areas of the Orontes Basin relevant to this project, which were provided in Chapter 3. As with water consumption figures and irrigated areas, accurate and up-to-date population figures for the relevant Syrian and Lebanese portions of the Orontes Basin are difficult to come by. In Lebanon, a census has not been conducted since 1932. As for Syria, a detailed census conducted in 2004 provides the most recent official figures, but the ongoing civil war has resulted in massive population displacement that is internal and external in nature, including both to Lebanon in general, and the Lebanese portion of the Orontes Basin specifically.

In order to ensure the most accurate population figures are used, this project will rely on population maps interpreted with QGIS software. First, 2020 population density maps in the form of TIFF files with 1 kilometer resolution for Syria and Lebanon were obtained from the WorldPop program,[158] which were then loaded into the relevant QGIS project file. Next, the Lebanese population density TIFF file was cropped using the Orontes Basin shapefile as a mask. The Syrian population shapefile was cropped using a shapefile of the Orontes Basin modified to only show the areas south of Ar-Rastan as a mask. The resulting population density graphics are shown on the following pages, in Figures *a* and *b.* In these figures, brighter colors should be interpreted as areas with higher population density. Next, a raster layer unique value report was run on both maps. The results from the generated attribute tables were imported into Microsoft

[158] WorldPop and Center for International Earth Science Information Network (CIESIN), Columbia University, "Global 1km Population Individual Countries" (University of Southampton, 2020), https://doi.org/10.5258/SOTON/WP00670. *(This dataset is available under a Creative Commons BY-4.0 license and any copy of or work based on this dataset requires this attribution)*

Excel, and the figures from the “value” column were summed for each country, resulting in the following population figures, rounded to the nearest integer:

- Lebanon: 372,614
- Syria south of Ar-Rastan: 1,675,203

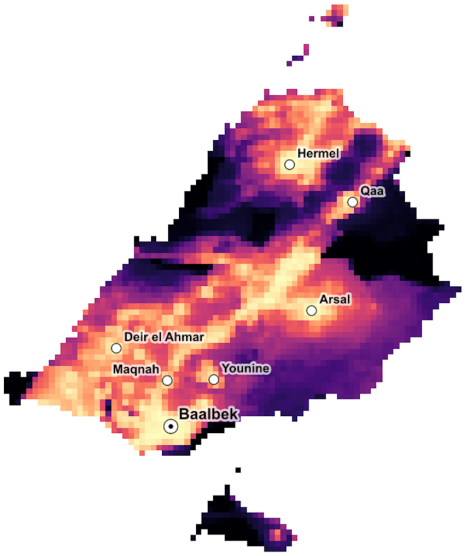

Figure *a*. Orontes Basin population density - Lebanon [map]. Data layers: WorldPop; Center for International Earth Science Information Network (CIESIN); Columbia University; OpenStreetMap QuickOSM [computer files]. American University of Beirut, Lebanon: Generated by Christopher Peterson, June 28, 2022. Using: QGIS - 64 Bit [GIS]. 3.16.16-Hannover.

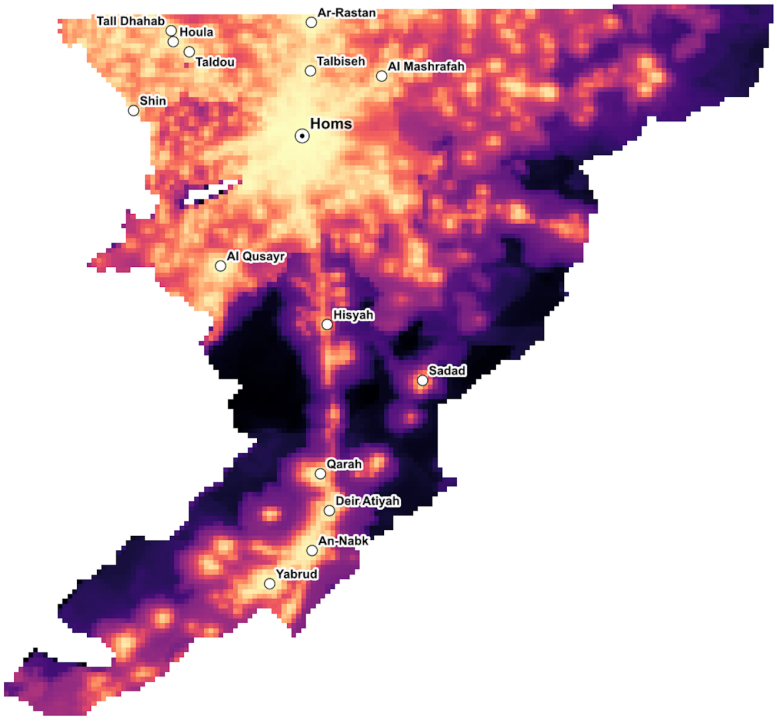

Figure *b*. Orontes Basin population density - Syria south of Ar-Rastan [map]. Data layers: WorldPop; Center for International Earth Science Information Network (CIESIN); Columbia University; OpenStreetMap QuickOSM [computer files]. American University of Beirut, Lebanon: Generated by Christopher Peterson, June 28, 2022. Using: QGIS - 64 Bit [GIS]. 3.16.16-Hannover.

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