Research Paper

M. Nouar Shamout with Glada Lahn
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# The Euphrates in Crisis

## Channels of Cooperation for a Threatened River

CHATHAM HOUSE
The Royal Institute of International Affairs

# Contents

# Summary

The Euphrates River is of critical importance for water, food and energy security in Turkey, Syria and Iraq. Flowing south-east for 2,700 kilometres from eastern Turkey to the Persian Gulf, it supports over 60 million people and – along with the Tigris, with which it runs almost in parallel – has a rich history of sustaining civilization on the Mesopotamian plains.

This vast water resource is in crisis. Degradation of the river from over-exploitation, population growth, pollution and other factors has been a serious problem for many years. Now war and violent upheaval in Syria and Iraq are worsening the situation: threatening key infrastructure and preventing policy cooperation. Without urgent attention, stresses on the river's resources will add to the already catastrophic humanitarian crisis created by the conflict. In the longer term, a vision for cross-border coordination is essential if the river is to retain its vital role in the region.

## Multiple threats

The Euphrates has attracted international attention since 2013 as combatants in Syria and Iraq have competed for control of its vital structures. The forces of Islamic State of Iraq and al-Sham (referred to as ISIS in this paper, though now widely known as 'Islamic State' or IS) have sought strategic strongholds along the river. Different sections of the river are in the hands of various state and non-state actors, and control of major dams is contested. In many places, it is not even clear who has authority over the river.

The lack of security and blurred authority are compounding water challenges that predate the current conflict. Indeed the Euphrates was under serious stress long before the Syrian crisis erupted in 2011. Rapid and uncoordinated development in the riparian states (Turkey, Syria and Iraq) has changed the river's flow regime, causing a 40–45 per cent reduction in downstream water flow since the early 1970s. In the past 50 years, some 32 dams and barrages have been built on the river. Their construction – along with growth in water-intensive agriculture, pesticide use and industry – has wreaked havoc on downstream water quality and ecology.

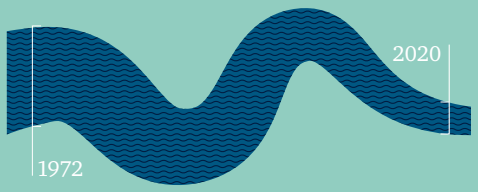
The river is the main source of water for 27 million people across the three countries, with tens of millions more reliant on the food and energy it enables. Its deterioration, combined with last decade's drought, has prompted mass migration from rural areas surrounding the Euphrates in Syria and Iraq. In southern Iraq, acute salinization and pollution have caused human illness and farm losses. In Syria, the resulting urban population pressures and food costs have increased social tensions.

Incremental pressures related to population growth, industry and hydro-engineering now threaten conditions for human development more broadly throughout the Euphrates region. Of particular concern are plans for continued upstream dam and infrastructure building. Turkey's Southeastern Anatolia Project (Güneydoğu Anadolu Projesi, or GAP) – a major development on the Tigris and Euphrates rivers and their tributaries for hydropower and agricultural irrigation, which began in the 1970s – is particularly significant. The project aims to support economic development in Turkey's southeast, but many Syrians and Iraqis have grave concerns about its impact on their water supplies.

Two overarching challenges concern all countries. One is climate change bringing both higher average temperatures and increased occurrence of extreme weather events. The World Resources Institute, for example, projects that in 2025 water conditions along the Euphrates will be up to eight times more stressed than in 2010.[1] The other concern is the weak capacity of the riparian states to respond either individually or collectively to the increased challenges they face. Institutional capacity has been depleted by conflict in Syria and Iraq, and there remains no mechanism for information sharing or emergency response across the river basin. Yet the likelihood of events requiring such a response – from drought to wilful destruction of infrastructure – is increasing.

The need for policy coordination between the riparian states and other stakeholders has never been greater.

**At least 40%**
**of the flow of the Euphrates to downstream countries has been lost due to over-exploitation since 1972**




The overall flow of the river is expected to reduce further and faster in the coming decade, exacerbated by climate change

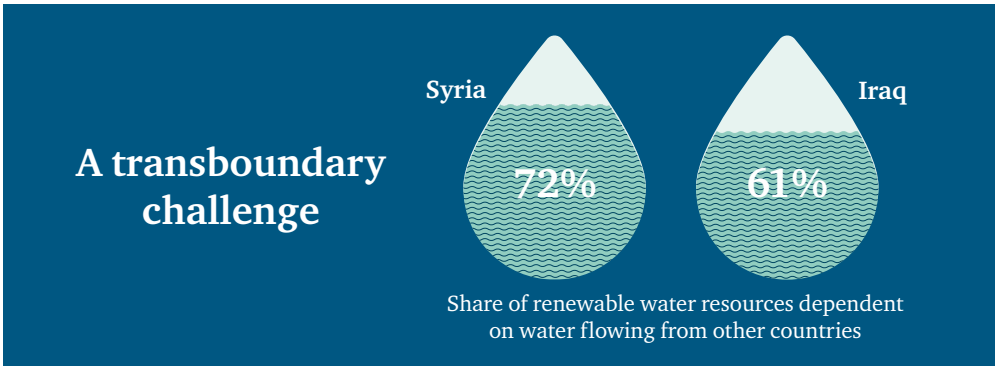
## A troubled history of water relations

This paper argues that the challenges facing the Euphrates cannot be met by one state acting alone. Indeed, the history of poor interstate coordination over the river is precisely one of the factors that have allowed the deterioration in its condition to occur. Despite almost a century of formal negotiations, agreement has been limited. Negotiations have been characterized by mistrust, poor communication and a lack of reliable, common data.

The author's interviews with 25 people in Turkey, Syria and Iraq formerly involved in, or close to, transboundary water negotiations, and a literature review, reveal three key factors that have impeded cooperation. First, a history of regional rivalry has prevented the concept of water sharing from taking hold. There is no comprehensive or long-term treaty between Turkey, Syria and Iraq on water sharing, and Turkey's rejection of the UN Watercourses Convention of 1997 inhibits the application of international principles to the issue. Second, centralized decision-making in each state has constrained the power of negotiating teams. And third, discussions have mostly been bilateral, despite the fact that the river flows through three countries; this has tended to upset the excluded third party in each negotiation.

[1] The projection is based on data from the Intergovernmental Panel on Climate Change (IPCC).

What can be done? This paper makes a number of recommendations based on short- and long-term goals. Given the security situation in Syria and Iraq, the severing of relations between Turkey and Syria, and the spread of ISIS's influence, resuming interstate talks over the river is unthinkable at present. However, building a common vision among concerned experts to prepare the ground for eventual cooperation should not be. Moreover, despite their limitations, bilateral protocols established between Turkey and Iraq, and between Turkey and Syria, between 2008 and 2010 – and emerging international river-basin cooperation experience – could provide the basis for a more constructive approach.




## Building a common vision for cooperation

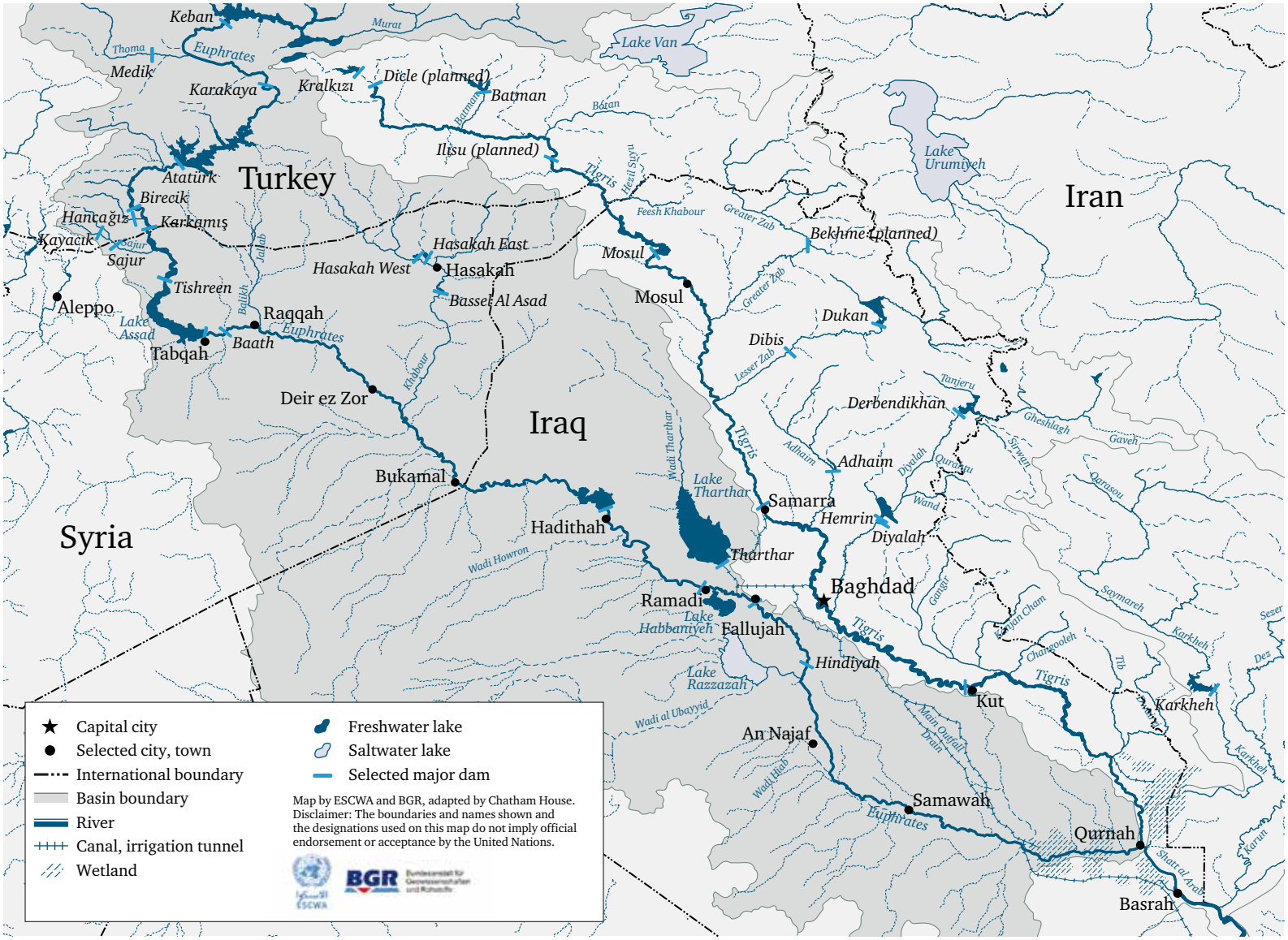
In the near term, opportunities for ad hoc interstate coordination on temporary measures to address urgent human needs should be seized. Independently of this, a **working group** of experts both inside and outside the riparian states could be set up to monitor events affecting the integrity of the river. This working group could advise responsible authorities and humanitarian agencies on issues such as water supply, sanitation failures or sudden releases of water from dams.

When political conditions improve, a more formal **river committee** should be established. Such a body would assemble a variety of interested parties, researchers and policy-makers with an evolving mandate that would both build trust and lead to increased management capacity for all riparians. The priorities for the committee's work could include:

- Building databases of all existing water-related agreements and disputes and pooling all available information on the river's hydrology and meteorology in each state.
- Defining the respective water needs and projected demands of each state, with a focus on identifying target areas for improving efficiency.
- Developing a durable agreement on water sharing. Rather than focusing on a division of flow, this could focus more on roles, joint responsibilities and specific processes for defusing tensions and resolving disputes.
- Building an early-warning system for the prediction of severe climate incidents in the Euphrates basin, to enable preparation against famine and flooding.

- Promoting regional cross-investment in the GAP, helping to alleviate the concerns of stakeholders in Syria and Iraq.
- Fostering wider economic interdependence between states, which could involve the export of oil and gas supplies from Iraq in return for hydroelectric power from Turkey, and food trade between all three countries.
- Reviewing legislation on water use and management in the three riparian states, in order to standardize regulations and best practice. Given the limitations on enforcing rulings in all three countries, pragmatism may dictate that such efforts be guided more by the principle, rather than the letter, of international law.

## Figure 1: Map of the Euphrates basin




Source: UN-ESCWA and BGR (2013), *Inventory of Shared Water Resources in Western Asia*, Beirut.

# Introduction

The Euphrates lies at the heart of a region with a history of great riparian civilizations (see Box 1). It is a vital resource to communities, agriculture and industry in Turkey, Syria and Iraq. Since 2013 the river has become a focus for conflict as forces of the Islamic State of Iraq and al-Sham (ISIS)[2] have seized territory along its course and used control over its waters to exert influence. But the health of this river and its tributaries was already endangered well before the Syrian crisis began in 2011. Rapid and uncoordinated development has affected the river's flow. Some 32 dams and barrages have been constructed over the last 50 years. Growth in water-intensive agriculture, pesticide use and industry has wrought havoc on downstream water quality and ecology.

### Box 1: The cradle of civilization

The Euphrates River has always been the life source for the Mesopotamian plains and civilizations.[a] This river, which springs from ice-capped mountains in Turkey, flows through semi-arid and arid plains in Syria and Iraq. These plains have witnessed many human achievements, among them the development of irrigation engineering; the first treaty describing borders between states and rights over waters; and – perhaps most pertinent to current challenges – the Code of Hammurabi of 1790 BC, which was the first legal text in history to regulate irrigation rights.[b] The importance of the river in the life of its people is also reflected in the sacred value accorded to it in Islam, Christianity and Judaism.[c] Interestingly, each religion regards the depletion of the Euphrates as a portent of the Day of Judgment.[d]

For millennia, Iraq was the dominant beneficiary of the Euphrates' waters. It used to be called 'Ardh Assawad' ('black land' in Arabic) in reference to the dark green vegetation covering the country. This changed in the 20th century with the collapse of the Ottoman Empire and the creation of the sovereign states of Syria, Iraq and Turkey between 1918 and 1923. For the first time in centuries, control over the Euphrates River was divided among three national governments.

[a] Mesopotamia means 'between the rivers' in Greek.
[b] Hatami, H. and Gleick, P. (1994), 'Chronology of Conflict over Water in the Legends, Myths, and History of the Ancient Middle East' in 'Water, war, and peace in the Middle East'. *Environment*, Vol. 36, No. 3, pp. 6–42 (Washington: Heldref Publishers).
[c] Islam (Hadith from Sahih Muslim, part 18 p. 186), Christianity and Judaism (Book of Genesis, chapter 2, verse 14).
[d] Islam (Hadith from Sahih Muslim, hadith No. 2894), Christianity and Judaism (Book of Revelation, chapter 16, verse 12).

Demographic pressures, hydro-engineering developments and climate change look set further to affect the river's flow, seasonal pattern and water quality, with associated impacts on agricultural land and the natural environment. In particular, Turkey is preparing to complete major works on both the Euphrates and Tigris rivers and their tributaries in the next 10 years. The Southeastern Anatolia Project (Güneydoğu Anadolu Projesi, or GAP) has added 12 dams (eight of which are on the Euphrates) and over 5,000 megawatts (MW) of hydropower capacity since 1977. A further three major dams for hydroelectric power are planned, along with large-scale expansion of irrigation channels for arable

[2] Also known as the Islamic State of Iraq and the Levant, this group renamed itself Islamic State in June 2014, declaring a 'caliphate' in the territory it had captured in Syria and Iraq.

land.[3] Prior to the current security crises in Syria and Iraq, the governments of both countries had also planned to increase use of water along the Euphrates – although these plans have been interrupted.

Without coordinated management and adaptation measures, changes in the river's flow will bring hardship to agricultural communities throughout the region. Reduced availability of surface water could undermine food security and cause unplanned migration, as has already been seen in parts of Iraq and Syria. Increased competition for resources would exacerbate distrust between countries, diminish internal social cohesion and, in the case of Syria, dampen prospects for effective post-war reconstruction.

But if intergovernmental cooperation is necessary, the means for achieving it are lacking. Since the formation of the three nation states, each country's government has contested rights to the river. The review of negotiations in this research paper shows that intermittent efforts over the last century have mainly been bilateral, have often ended in acrimony, and have brought no workable river-sharing agreement. Opportunities in the 1960s and early 1970s for formal technical coordination – which might have avoided many of the problems we see today – were derailed by politics.

The effects of these failures are now being compounded by violent conflict that threatens to permanently erode territorial governance arrangements. Critical infrastructure along the river has been damaged. Worse may be to come as hostilities involving ISIS forces intensify. Not only could this result in further interruptions of water flow and (potentially catastrophic) destruction of dams and other structures, but it also raises the possibility that sections of the river could become ungovernable indefinitely.

> Regardless of how the political geography changes in the coming months and years, there remains the need for long-term thinking. Policies will need to be developed not only to mitigate the effects of over-exploitation and poor management, but to ensure future sustainability of the river.

Yet regardless of how the political geography changes in the coming months and years, there remains the need for long-term thinking. Policies will need to be developed not only to mitigate the effects of over-exploitation and poor management, but to ensure future sustainability of the river. This paper aims to inform that process. It offers itself as a resource to experts, diplomats and politicians. It provides a baseline for dialogue: taking stock of the river's significance to Turkey, Syria and Iraq respectively, as well as of the threats to it as a water resource. Its findings and recommendations are based on a six-month study of the Euphrates negotiation processes, drawing on the available literature, interviews with experts[4] in the region, and discussions at a high-level workshop in June 2014.[5]

[3] The GAP project is composed of 13 sub-projects comprising dams, hydroelectric power and irrigation plans for 1.8 million hectares of land (18,000 square kilometres). It does not cover all dams on the Euphrates. General Directorate of State Hydraulic Works (DSI) website at www.dsi.gov.tr; the official GAP page at http://www.gap.gov.tr/dosya_ekleri/gap_son_durum/index.html; and DSI (2009a), 'Water and DSI', Ministry of Forestry and Water Affairs, General Directorate of State Hydraulic Works, accessed at http://www2.dsi.gov.tr/english/water-and-dsi/index.html#/1/, p. 34; DSI (2009b), *Turkey Water Report,* General Directorate of State Hydraulic Works, accessed at http://www2.dsi.gov.tr/english/pdf_files/TurkeyWaterReport.pdf. More information is available in a publication in Turkish, DSI (2013), 'Recent Status of GAP, 2013', General Directorate of State Hydraulic Works, accessed at http://www.gap.gov.tr/dosya_ekleri/gap_son_durum/index.html.

[4] The interviews were carried out between November and December 2013 in London, Beirut, Istanbul and Ankara. Respondents to the interviews have chosen to remain anonymous.

[5] The workshop – 'The Euphrates under Stress: Towards Tripartite Cooperation for Sound River Management' – was organized by Chatham House in cooperation with the United Nations Economic and Social Commission for Western Asia (ESCWA) and The Prince's International Sustainability Unit (ISU) on 9–10 June 2014. It brought together local academic experts, decision-makers, NGOs and international experts working in the region; discussions were held under the Chatham House Rule.

Section 2 of this paper outlines the geography and division of the river between states, the extent of each country's dependence on it, and the infrastructure developments that affect its flow. Section 3 considers the physical changes that the Euphrates has undergone over the past 50 years in terms of flow and quality. Section 4 considers the likely future challenges and the capacity of each state to manage them.

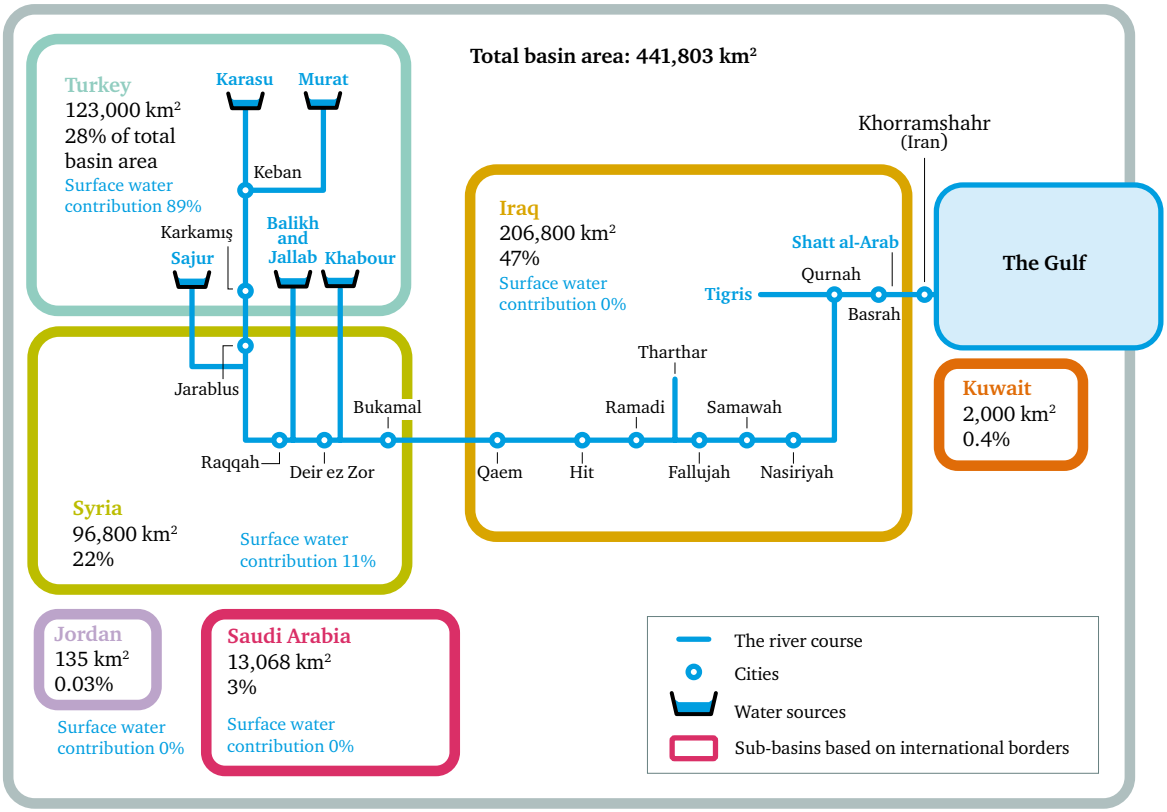
Finally, section 5 offers recommendations for politically realistic cooperation. This section draws on the history of transboundary water relations and international experience for insights as to how basin-wide cooperation could be achieved in future. It also proposes interim actions that could be taken to prepare for such cooperation and to keep tripartite channels of dialogue open.

# The Euphrates' Characteristics and Infrastructure

## The division of the Euphrates

The Euphrates is the longest river in western Asia.[6] It flows 2,700 kilometres through Turkey, Syria and Iraq, and into the Persian Gulf through the Shatt al-Arab. As shown in Figure 2, the river basin extends over six countries: Iraq, Turkey, Syria, Saudi Arabia, Kuwait and Jordan (the countries are listed here in order of basin area, from large to small).

**Figure 2: The Euphrates water system (main course, tributaries and sub-basins)**




Sources: Shamout, N., based on ESCWA (2013); U.S. Geological Survey; Google Earth Maps; and satellite images.[7]

[6] Western Asia refers to Turkey, Syria, Iraq, Iran and the Gulf states, which are all considered part of the Euphrates basin in this research paper, as well as Lebanon, Palestine, Jordan and Israel.

[7] UN Economic and Social Commission for Western Asia (ESCWA) (2013), *Inventory of Shared Water Resources in Western Asia,* http://waterinventory.org/sites/waterinventory.org/files/00-Information-brochure-Water-Inventory-web.pdf.

Figure 2 shows that Turkey supplies 89 per cent of the Euphrates' total flow, making it the main contributor to the river. Syria is the second biggest contributor, accounting for 11 per cent of the river's total flow.[8] (Turkey disputes this figure, claiming that the Syrian contribution comes from resources partially within Turkish borders.) Iraq does not make any considerable contribution to the river flow. The non-riparian countries sharing the Euphrates basin, namely Saudi Arabia, Jordan and Kuwait, receive no flow from the river and do not make any contribution to it.

Turkey, Syria and Iraq also share some tributaries of the Euphrates, as listed in Table 1.

### Table 1: Euphrates tributaries in Syria

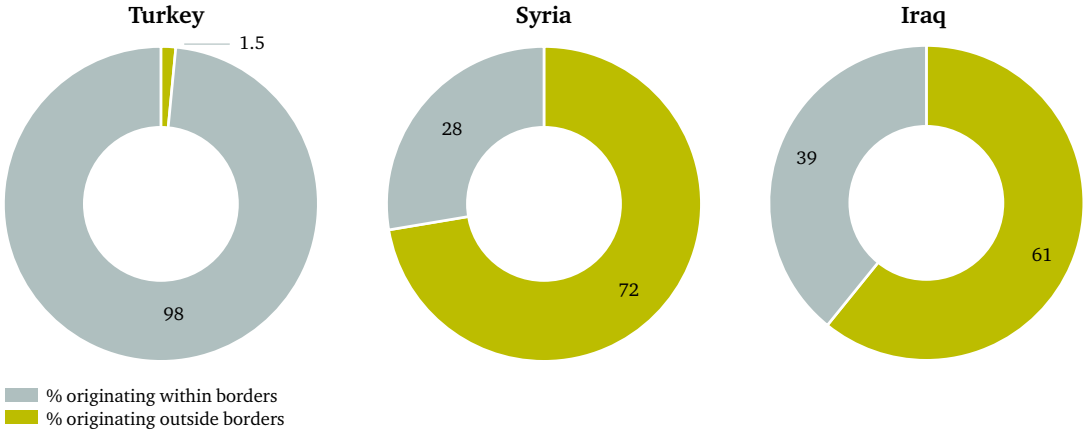
| River | Average flow ($m^3/s$) | Basin area ($km^2$) | Basin sharing | | | Length (km) | Dams and barrages | Planned irrigated lands (ha) |
|---|---|---|---|---|---|---|---|---|
| | | | Turkey (%) | Syria (%) | Iraq (%) | | | |
| Sajur | 3.1 | 2,860 | 40 | 60 | – | 108 | 2 | Not known |
| Balikh/Jallab | 3.8–4.4 | 13,600 | 62 | 38 | – | 196 | None reported | 303,000 |
| Khabour | 29.3 | 36,200 | 28 | 66 | 6 | 388 | 3 | 404,000 |

Source: ESCWA (2013).

## The water situation in the three riparian states

There are several ways to understand each country's reliance on the river. One is to consider the *dependence ratio*: an indicator that expresses the percentage of a country's total renewable water resources that originates outside its borders. This does not reflect the possible state-determined allocation of water to downstream countries, i.e. by mutual agreement.[9] The dependence ratios for Turkey, Syria and Iraq are shown in Figure 3.

### Figure 3: The dependence of Turkey, Syria and Iraq on transboundary water resources




Source: FAO (2015), AQUASTAT Database, estimates for 2012.[10]

[8] This comes from precipitation and smaller rivers shown in Figure 2.
[9] The full definition of the dependence ratio, as defined by the UN Food and Agriculture Organization (FAO), is available on the FAO's global water-information system website, http://www.fao.org/nr/water/aquastat/main/index.stm, FAO (2015), AQUASTAT website, Food and Agriculture Organization of the United Nations (FAO), accessed on 19 May 2014.
[10] FAO (2015), AQUASTAT website, Food and Agriculture Organization of the United Nations (FAO), accessed on 19 May 2014.

On this measure, Syria exhibits the heaviest dependence on transboundary water resources. However, a state's overall water status is not limited to its water dependence; factors such as water-management efficiency and water scarcity are also important. The water status of countries in the Middle East and North Africa (MENA) region was assessed in a late 2012 study, in which researchers used a number of water-poverty indicators (see Appendix A) to assess water scarcity based on the physical availability of water, as well as on the country's social and economic needs.[11] Table 2 summarizes the findings of this study for Turkey, Syria and Iraq.

### Table 2: A comparison of water-scarcity indicators

| Country | Falkenmark* | Criticality ratio* | Social water-scarcity index* |
|---|---|---|---|
| Turkey | No stress | No stress | Beyond the barrier |
| Syria | Scarcity | Very high stress | Beyond the barrier |
| Iraq | No stress | Low stress | Beyond the barrier |

* See Appendix A for definitions.
Source: Adapted from Jemmali, H. and Sullivan, C. (2012).

### Table 3: Aqueduct water risk indicators for commercial companies and investors

| | Overall water risk | Overall risk (Quality) | Baseline water stress* (1 = lowest stress, 5 = highest) | Baseline water risk, Euphrates area |
|---|---|---|---|---|
| Turkey | Low to medium | Medium to high | 3.02 | Low to medium |
| Syria | Medium to high | Medium to high | 3.85 | Medium to high |
| Iraq | Medium to high | High | 3.48 | Medium to high, High |

*A 2013 World Resources Institute Aqueduct working paper uses the following definition: 'Baseline water stress measures total annual water withdrawals expressed as a percentage of the total annual available blue water. Higher values indicate more competition among users.' Rankings are given in Appendix A.
Source: Gassert, F.; Reig, P.; Luo, T. and Maddocks, A. (2013).[12]

The scarcity indicators suggest that Syria faces the worst situation regarding the availability and use of water resources and the capacity to adapt to water stress. Rapid urbanization and the country's focus on water-intensive crop production to meet food self-sufficiency objectives have increased its dependence on water. The Euphrates accounts for 70 per cent of surface water resources and 50 per cent of total renewable water resources in Syria. Most of the major water projects in the country depend on the Euphrates to meet household demands for water. For instance, the city of Aleppo depends entirely on water from the Euphrates to meet the needs of its inhabitants. Salamiyah is another city that depends totally on water from the Euphrates. The river supplies water to the 300,000 inhabitants of the city and its suburbs.

Local pressures on other rivers are also increasing dependence on the Euphrates. For instance greater Damascus, a region of some 6 million people prior to the conflict, has lost water flow through

[11] Jemmali, H. and Sullivan, C. (2012), 'Multidimensional analysis of water poverty in the MENA region', Social Indicators Research, Volume 115, Issue 1, pp. 253–77, http://link.springer.com/journal/11205.
[12] Gassert, F.; Reig, P.; Luo, T. and Maddocks, A. (2013), 'Aqueduct country and river basin rankings: a weighted aggregation of spatially distinct hydrological indicators', working paper (Washington, DC: World Resources Institute), November 2013, http://wri.org/publication/aqueduct-country-river-basin-rankings.

the Barada River, whose source springs 70 kilometres to the west. That river's water resources are completely utilized in meeting the demands of agriculture and the city. As a result the riverbed is almost dry for most of the summer months – a reflection of the degree of pressure on water resources in the region. The scarcity of water and escalating demand in the capital led the Syrian government to explore the option of a major pipeline project to convey water from the Euphrates to Damascus.

Iraq is hardly in a better position, despite receiving a 'no stress' rating on the basis of the fraction of total annual run-off available for human use. Although water in Iraq is not classified as a scarce resource based on physical availability, its quality is low. The country lies in an arid region with very little rainfall, making it almost fully dependent on surface water from the Euphrates and the Tigris. The Euphrates accounts for 35 per cent of water resources in Iraq.[13]

Like Syria, Iraq has experienced increased social and economic activity in the last decade, resulting in greater demand for water. This increased demand – coupled with the deteriorating water infrastructure – has reduced the country's ability to manage water resources effectively. Iraq's infrastructure has also been dramatically affected by war and economic embargoes. For example, 130,000 tons of munitions were dropped on Iraq in a 43-day span in 1991, devastating infrastructure such as power plants, water facilities and bridges and causing an estimated $232 billion worth of damage.[14] Although there is a programme for the rehabilitation of dams and hydroelectric plants, security and governance issues have slowed its progress.

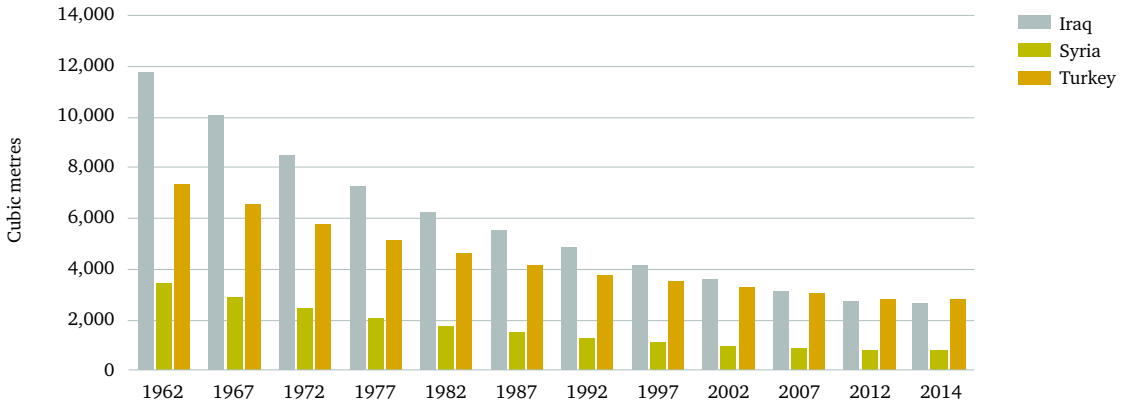
The water situation in Turkey is more secure than in the other two riparian states. There is no overall physical scarcity of water resources, although the Aqueduct calculation suggests problems with quality. Compared with its neighbours, the country has highly developed institutions and expertise in water management. Yet Turkey's economy, the largest in central and eastern Europe, is developing rapidly and will soon require even greater amounts of water. Thus, it is likely that the country's economic and social needs will continue to challenge the sustainable limits of available water resources. This is illustrated by the social water-scarcity index in Table 2, in which Turkey falls, along with its co-riparian states, 'beyond the barrier' in terms of socio-economic capacity to adapt to water stress.

Of the three riparian states, Turkey has the largest reserves of renewable water, of which only around one-fifth is consumed each year. In contrast, Iraq and Syria both withdraw more than four-fifths of the total renewable water available to them. The agricultural sector accounts for an average of 75 per cent of total withdrawals in the three countries. Iraq stands out as having the highest water consumption per capita by a significant margin compared with the other riparian states. This is a result of a complex set of factors that include poor infrastructure, large agricultural areas, outmoded methods of agriculture and irrigation, and water-intensive crop cultivation.

Figure 4 shows that Turkey, Syria and Iraq are all experiencing dramatic decreases in the total amount of renewable water resources available per capita. Population growth is the main reason for this continuous reduction. In addition, downstream countries have witnessed huge changes in river flow due to heavy exploitation in upstream countries, an aspect discussed later in this chapter.

[13] Zaeir, N. and Mohammad, H. (2007), 'Water statistics in Iraq', Ministry of Planning and Development Cooperation (2007) (Arabic), http://cosit.gov.iq/images%5Cpdf%5Cresearches%20ar%5C9.pdf.
[14] Baroud, R. (2013), 'Iraq at the brink: A decade after the invasion', *Al-Arabiya News*, February 2013, http://www.alarabiya.net/views/2013/02/15/266366.html.

## Figure 4: Renewable water resources available per capita, 1962–2014

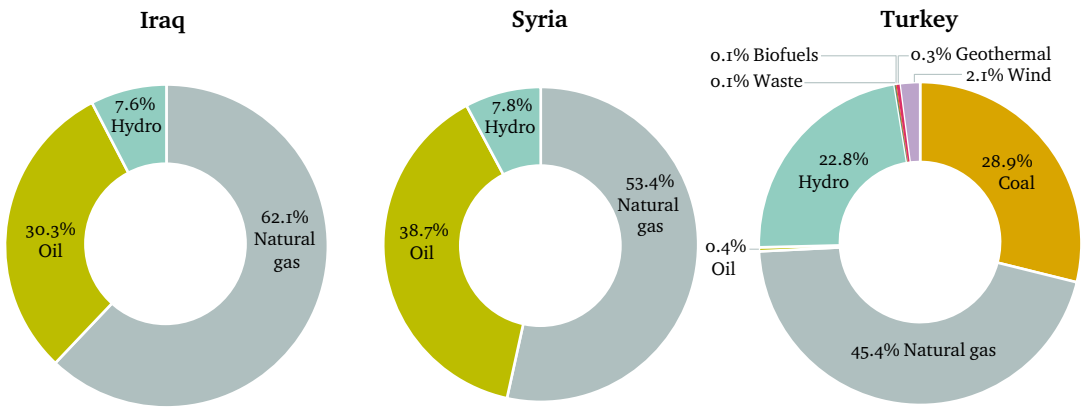



Source: AQUASTAT[15] and author's estimates.

However, this comparison is deceptive in that the quality of water in Iraq is poor, to the extent that the United Nations expects the country to struggle to meet demands for potable water in 2015. Meanwhile, major production expansion is expected in Iraq's oil sector, which will increasingly rely on water reinjection, a process that requires seawater desalination.[16]

Water from the Euphrates is not only essential for municipal, agricultural and oil-sector needs but also for hydroelectric energy – as illustrated in Figure 5. It is the dominant renewable energy source in Turkey, Syria and Iraq. This is of particular importance for Turkey and Syria due to their limited reserves of fossil fuels. All three countries plan to use more hydroelectric power.

## Figure 5: Electricity production by source in Iraq, Syria and Turkey, percentage share




Source: International Energy Agency (2011).[17]

[15] FAO (2015), AQUASTAT website, Food and Agriculture Organization of the United Nations (FAO), accessed on 19 May 2014.
[16] International Energy Agency (2012), *World Energy Outlook*, pp. 101–102, http://www.worldenergyoutlook.org/media/weowebsite/2012/iraqenergyoutlook/Fullreport.pdf.
[17] http://www.iea.org/statistics/.

## Current and future hydro-engineering projects in the three riparian states

Over the last half-century, large-scale hydro-engineering projects have taken place along the Euphrates River, resulting in changes to the river's shape and flow. Some 32 dams and barrages have been built, with the most extensive hydro-engineering having taken place in Turkey. All three countries plan further large-scale development of water resources for agricultural irrigation, energy, and industrial and municipal uses in the coming decade. This will add pressure to areas and communities that are already water-stressed.

Modern exploitation of the Euphrates began in 1936 when Turkey's Electricity Studies Administration (ESA) established an observation network to ascertain the hydrological characteristics of the river. The next stage was a detailed feasibility study for construction of the Keban Dam and hydropower plant. In 1954 the General Directorate of State Hydraulic Works (known as the DSI) was founded. The DSI became responsible for irrigation, agriculture and hydropower. While the Keban Dam was under construction, between 1966 and 1974, policy-makers conceived of the Southeastern Anatolia Project (GAP). This multi-decade undertaking envisioned the full development of the Euphrates–Tigris basin (which the Turkish government regards, not uncontroversially, as a single entity). It plans the construction of 22 dams and 19 hydropower plants on the main rivers and their tributaries (12 dams and 80 per cent of hydropower capacity had been completed as of end-2014). It also envisages the construction of agricultural irrigation channels servicing some 18,000 square kilometres of land (some 80 per cent of which is still to be built). GAP was intended for completion in 2023 to mark the centenary of the foundation of the Turkish Republic, but a number of projects have been put on hold or delayed due to financial, environmental and political difficulties, and the target year has been changed to 2047.

The ambitious scale of the GAP reflects Turkey's formidable projected water needs. The government expects annual water demand to rise from 50 billion cubic metres ($m^3$) in 2012 to 112 billion $m^3$ in 2023. It forecasts that surface water will account for 95 billion $m^3$ of that total, while 3 billion $m^3$ will come from neighbouring countries and 14 billion $m^3$ from groundwater.[18]

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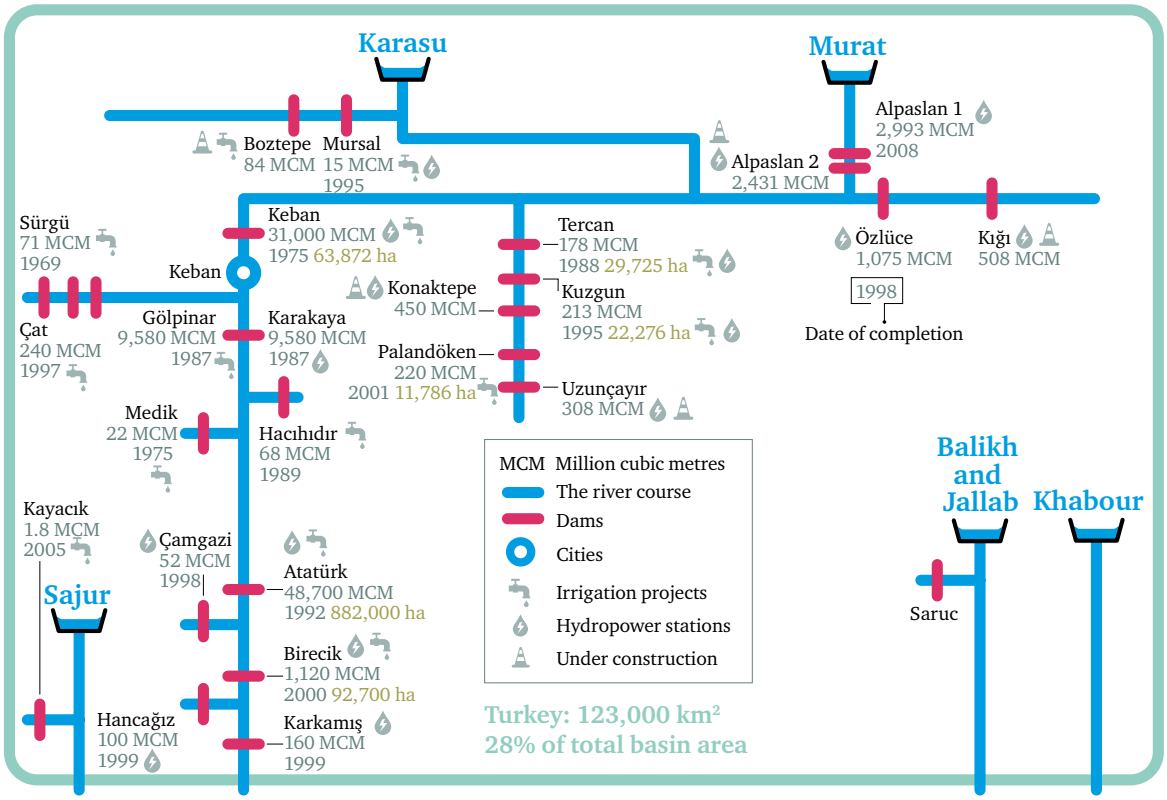
Turkey has significant capacity to control downstream river flow. As of 2014, some 141 dams are distributed over southeastern Anatolia, eastern Anatolia and central Anatolia. The dams vary in size and intended purpose. Some are located directly over the Euphrates and Tigris rivers' main courses and tributaries, while others are located over smaller local rivers or intermittent *wadis* (valleys) and water courses. A country's storage capacity gives an idea of its ability to deal with fluctuations in river flow. Turkey has an estimated 90 billion $m^3$ of water-storage capacity. This means that the country is capable in theory of preventing all flow of the Euphrates from entering Syria for two to three years (based on average yearly flows).

[18] *Water and the DSI* (2013) (publication in Turkish summarizing DSI projects), Ministry of Forestry and Water Affairs, General Directorate of State Hydraulic Works.

## Figure 6: Turkish exploitation of the Euphrates water system

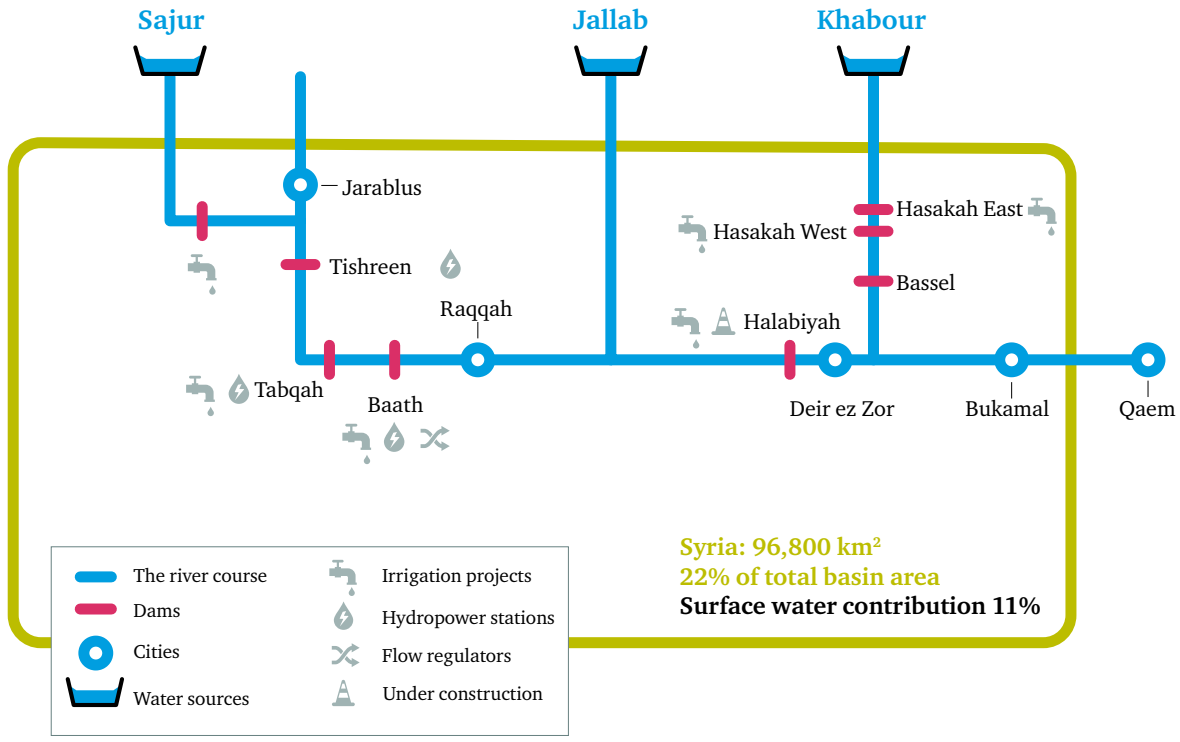



Note: The figure is not intended to reflect the hydrological system of the Euphrates.
Sources: Shamout, N. based on ESCWA (2013); U.S. Geological Survey; Google Earth Maps and satellite images.

In Syria, the first dam on the Euphrates was the Tabqah Dam[19], completed in 1973. Located 40 kilometres upstream of the city of Raqqah[20], it is the largest earth-filled dam in the world. In 1987, the Baath Dam was completed to regulate water flowing from the Tabqah Dam and generate hydroelectric power. The last dam to be commissioned on the Euphrates in Syria was the Tishreen Dam in 1999; this was also for hydropower generation. On the Khabour tributary, three main dams were established for storage and irrigation purposes: the Bassel, Hasakah East and Hasakah West dams. A dam was also built on the Sajur tributary for storage purposes; it was commissioned in 2005. Of the three riparian states, Syria has the lowest water-storage capacity, estimated at 14 billion $m^3$.

[19] The Tabqah Dam is also known as the Euphrates (Al-Forat) Dam and The Revolution (Al-Thawra) Dam.
[20] Pronounced 'Arraqa' in Arabic.

## Figure 7: Syrian exploitation of the Euphrates water system



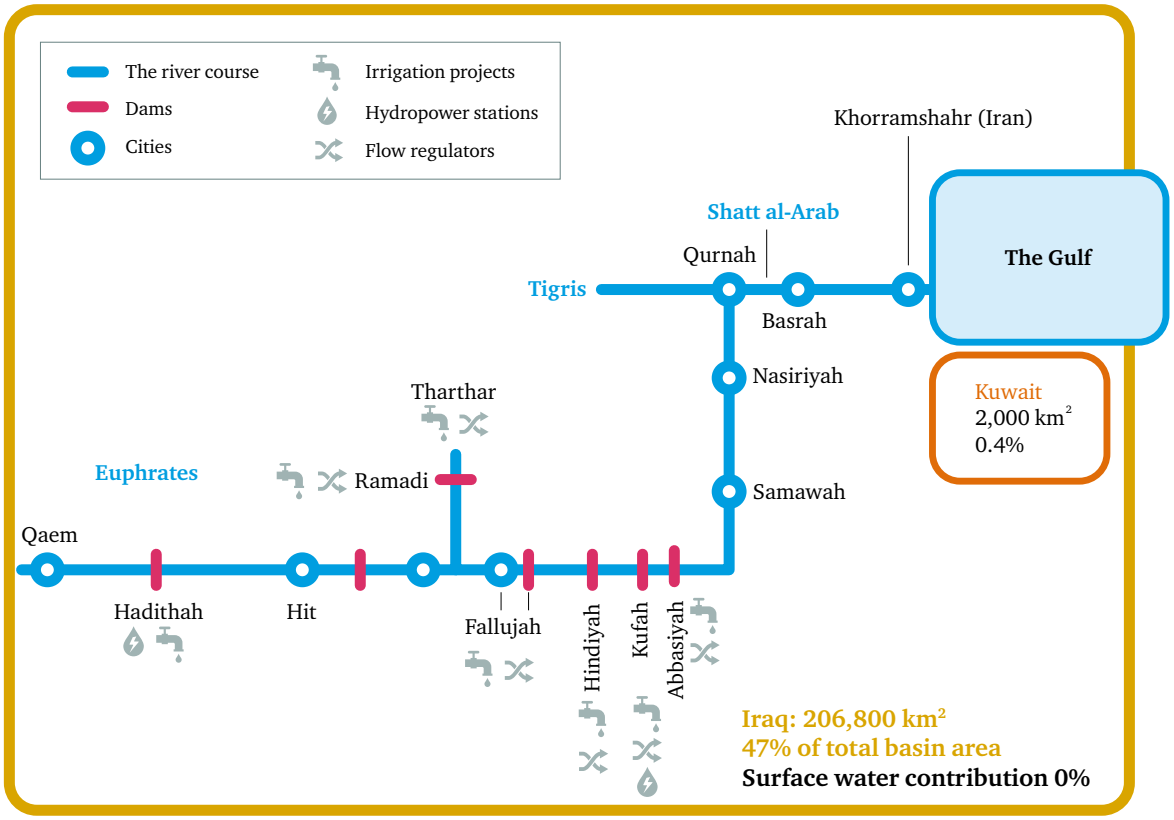

Note: The figure is not intended to represent the hydrological system of the Euphrates.
Sources: Shamout, N. based on ESCWA (2013); U.S. Geological Survey; Google Earth Maps and satellite images.

The Syrian government plans to build a new dam – Halabiyah/Zalabiyah – in the area northwest of Deir ez Zor. The dam will be designed to irrigate 27,000 hectares and generate 1,000 MW of hydropower.

In Iraq, the main dam on the Euphrates is the Hadithah Dam. It is used for both irrigation and hydropower generation, and has an installed capacity of 660 MW and storage capacity of 8.5 billion $m^3$. Fourteen more small to medium-sized dams regulate the river flow according to irrigation needs. These structures accommodate only one or two hydropower stations, as shown in Figure 8.

The Iraqi government plans to construct another 27 dams on the Euphrates and Tigris rivers. According to the government, these dams will increase water-storage capacity from 115 billion $m^3$ to 145 billion $m^3$ and will be used to support irrigation and hydropower generation.

## Figure 8: Iraqi exploitation of the Euphrates water system



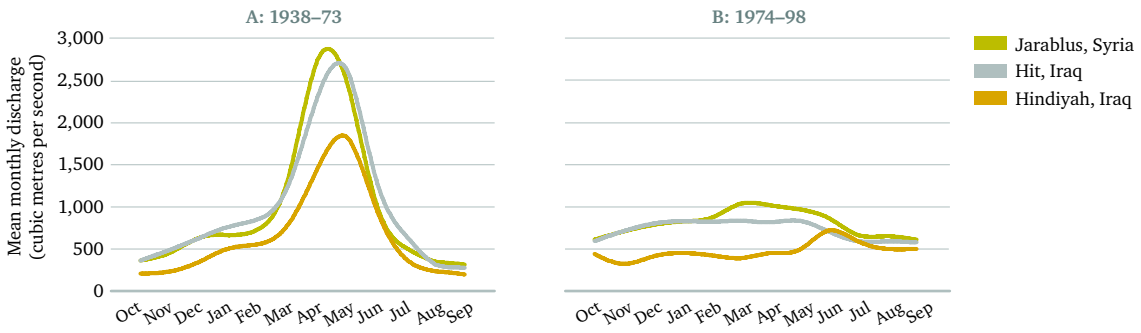

Note: The figure is not intended to represent the hydrological system of the Euphrates.
Sources: Shamout, N. based on ESCWA (2013); U.S. Geological Survey; Google Earth Maps and satellite images.

# What is Happening to the Euphrates?

## Changes to flow

Roughly 75–80 per cent of the Euphrates' water is used in agriculture in Turkey, Syria and Iraq.[21] As irrigation has expanded and new dams have been added, the water volume flowing from Turkey through Syria to Iraq has dropped. Since Turkish and Syrian dams came into operation in the 1970s, the flow into Iraq has dropped dramatically – from 700 cubic metres per second ($m^3/s$) to the current level of 260 $m^3/s$.[22] Figure 9 shows a comparison of the average-flow hydrograph of the Euphrates before and after modern exploitation projects.

**Figure 9: Changes in the Euphrates' flow regime before and after modern exploitation projects**




Source: ESCWA (2013).

Hydrograph A shows that the river had a snow-melt system, with a high-flow season (flood season) between March and July, and a low-flow season between August and February. Hydrograph B shows that the river's flow system has changed from a snow-melt system to a regulated-flow system.

For a limited period this change had a positive impact on the agricultural sector in the downstream countries, as it prevented floods and regulated water flow. For winter crops, water is most needed between September and October, which would normally be the river's dry season.[23] In addition, the flood season endangers crops during the harvest period, and regulating the flow reduced this risk.

However, as the flow itself declined, the negative impacts on Syria and Iraq started to outweigh the positives. A comparison of the hydrographs in Figure 9 illustrates the alarming fact that the river has lost 40–45 per cent of its flow since the early 1970s, when most of the major dam infrastructure was established. This drop is a result of the huge storage facilities that have been built along the river. The change in the flow volume has had a negative effect on the river's ecology, as demonstrated by the salinization of the Shatt al-Arab River in Iraq (discussed below).

[21] Çarkoğlu, A.and Eder, M. (2001), 'Domestic Concern and The Water Conflict over The Euphrates-Tigris River Basin', *Middle Eastern Studies*, Vol. 37, No. 1, pp. 41–71.
[22] This is according to the agreements regulating the flow between Turkey and Syria (1987), and between Syria and Iraq (1990), respectively; see Appendix B.
[23] ESCWA (2013).

In addition to pressures arising from the use of surface water, heavy exploitation of groundwater has radically depleted reserves in Syria and Iraq over the last decade. New technology has allowed observation of these changes, with NASA images from the Gravity Recovery and Climate Experiment (GRACE) satellites revealing a dramatic increase in the dryness of the soil and in the depletion of below-ground water levels between January 2003 and December 2009.[24] The Euphrates and Tigris basins register the second fastest rate of regional groundwater storage loss in the world after India.

## Quality of water

Water quality in Syria and Iraq is deteriorating to the point that salinity in some regions is more than double the natural level.[25] Drainage of irrigation water into the river is one of the main causes of this deterioration. It is also responsible for the release into the river of hazardous chemicals such as fertilizers and pesticides. The volume of irrigation drainage is so great that it has, for instance, changed the flow regime of the Jallab River from intermittent to continuous. At the same time it has seriously affected water quality: by 2010, salinity levels had risen by around 13 per cent over their average in the late 1990s.[26]

Salinization in the lower part of the Euphrates basin is a cause of acute concern. The current security situation in Iraq makes reliable data-gathering difficult, but in 1995 it was reported that 17 million tons of salt had been washed into the Persian Gulf through the man-made drainage canal known as the Third River – designed to reclaim water affected by high salinity.[27] Studies show that the level of salinity in the area of the Hindiyah Barrage in southern Iraq, for example, has risen at least fourfold since 1980, to a level considered unfit for most agricultural irrigation and unhealthy for animals to drink.[28] In Nasiriyah and Basrah, water from the Shatt al-Arab River is becoming more brackish as the weakened flow of the river has allowed seawater to intrude from the Gulf at high tide.

The drop in water quality threatens the river's ecosystem; it has also had negative impacts on agricultural productivity in both Syria and Iraq.[29] The Iraqi governorates of Dhi-Qar and Muthanna have been particularly affected by dehydration, sanitation-related illnesses, animal deaths, farm losses and displacement.[30]

[24] Voss, K. A.; Famiglietti, J. S.; Lo, M.; de Linage, C.; Rodell, M. and Swenson, S. C. (2013), 'Groundwater depletion in the Middle East from GRACE with implications for transboundary water management in the Tigris-Euphrates-Western Iran region', *Water Resources Research*, Vol. 49, Issue 2, pp. 904–14, doi:10.1002/wrcr.20078. See also NASA Earth Observatory, 'Freshwater Stores Shrank in Tigris-Euphrates Basin', 13 March 2013, http://earthobservatory.nasa.gov/IOTD/view.php?id=80613.
[25] ESCWA (2013).
[26] Based on ACSAD and Ministry of Irrigation figures given in ESCWA (2013), *Inventory of Shared Water Resources in Western Asia,* chapter 2, 'Shared Tributaries of the Euphrates', p. 89, http://waterinventory.org/sites/waterinventory.org/files/chapters/Chapter-02-Shared-Tribiutaries-of-the-Euphrates-River-web_0.pdf.
[27] FAO (2015), AQUASTAT website, Food and Agriculture Organization of the United Nations (FAO). Website accessed on 19 May 2014.
[28] Kornfeld, I. (2014), 'The Middle East: Climate Change, Water Insecurity and Hydrodiplomacy', in Percival, R. V.; Lin, J.; and Piermattei, V. (2014), *Global Environmental Law at a Crossroads* (Massachusetts: Edward Elgar), pp. 83–100.
[29] UN Iraq (2013), 'Water in Iraq Fact Sheet', International Relief website, accessed 20 May 2014, http://reliefweb.int/sites/reliefweb.int/files/resources/Water-Factsheet.pdf.
[30] International Organization for Migration (IOM) (2012), *IOM Iraq Special Report: Water Scarcity*, http://environmentalmigration.iom.int/iom-iraq-special-report-water-scarcity, see pp. 8–9 and 18–19.

# Shared Future Challenges

## The universal threat from climate change

The effects of climate change are expected to add to the pressures on the Euphrates in the future. Climate models show that by the end of this century the river basin is likely to see a 3–4°C increase in temperature. This will increase rates of evaporation and could result in a 30–40 per cent drop in rainfall over the river basin[31], most importantly over the Turkish part of it, where most of the river flow is generated (see Figure 2, page 10). Increased evaporation would also exacerbate the likely drop in river flow.

Regional studies conducted by the Water Foundation – a Turkish not-for-profit research organization – for the Turkish government are more pessimistic. The research suggests that by 2020 the river flow in Turkey will have dropped by 15–20 per cent compared with 'normal levels' established between 1960 and 1990.[32] A fall in precipitation has already been recorded at weather stations across the Euphrates basin. One result is that the Euphrates tributaries in Syria now contribute much less to the main river flow than in the past, with their total contribution having dropped from an estimated 8 per cent in the 1980s to less than 5 per cent today.[33]

> The research suggests that by 2020 the river flow in Turkey will have dropped by 15–20 per cent compared with 'normal levels' established between 1960 and 1990.

The World Resources Institute's 2013 Aqueduct study, based on 2007 climate-change scenarios from the Intergovernmental Panel on Climate Change (IPCC), plots the 2025 water outlook for Turkey, Syria and Iraq. The study's projections range from 'severely' to 'exceptionally' more stressed than the 2010 baseline assessment in all but the WRI's most optimistic global-warming scenario (called 'B1'[34]). In B1 most of the area around the Euphrates in Turkey and northern Syria remains at a similar or drier low- to moderate-stress level, although regions from Ankara to Kayseri in Turkey are extremely and exceptionally more stressed. Even under this 'positive' scenario the Euphrates area in Syria south of Raqqah is seen as 'extremely more stressed' and Iraq is accorded an 'exceptionally more stressed' rating. Table 4, below, gives an idea of what these projections would mean.

[31] IPCC (2013), *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F.; Qin, D.; Plattner, G.-K.; Tignor, M.; Allen, S.K.; Boschung, J.; Nauels, A.; Xia, Y.; Bex, V.; and Midgley, P.M. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Annex I: Atlas of Global and Regional Climate Projections, p. 1368, http://www.climatechange2013.org/images/report/WG1AR5_AnnexI_FINAL.pdf.
[32] The Water Foundation (2013); an unpublished study from 2013 conducted by the Water Foundation Istanbul on behalf of the Turkish government was discussed with the author in an interview in November 2013 in Istanbul.
[33] ESCWA (2013).
[34] B1 projects a global mean temperature rise of under 2°C by the end of this century as the most optimistic scenario. See Appendix A for a summary of scenario assumptions.

### Table 4: Governance relevance of projected water stress along the Euphrates as the climate changes

| | |
|---|---|
| **Severely more stressed** | 'Conditions are 2.0–2.8 times more stressed than baseline. Awareness of looming increases in water stress should be widespread. Planning agencies should actively consider adaption measures and associated investments. Without sufficient investment, communities may face new restrictions on water use and/or occasional supply disruptions.' |
| **Extremely more stressed** | 'Conditions are 2.8–8.0 times more stressed than baseline. Looming changes in water stress should be among the foremost concerns of residents and planning agencies. Without major investment, future supply disruptions may be widespread and affect the core economy.' |
| **Exceptionally more stressed** | 'Conditions are more than 8.0 times more stressed than baseline. Basic services (e.g. power, drinking water distribution) are likely at risk and require significant intervention and major sustained investments.' |

Source: FAO (2011).[35]

Climate change is also likely to increase the severity and frequency of droughts, floods and heavy storms in the region. Although it is not possible to definitively attribute individual weather events to climate change, recent occurrences are in line with the expected pattern.[36] The drought of 2006–10 wreaked devastation on agricultural populations in Syria and southern Iraq. It is estimated that by 2009, over 800,000 Syrians had lost their livelihoods, with hundreds of thousands migrating to cities.[37] Several studies link the Syrian uprising and subsequent outbreak of civil war to this drought and how poorly it was managed.[38] And weather extremes add to the challenges. In 2012 Baghdad suffered its worst recorded floods in 30 years, and Damascus was paralysed by snowstorms in December 2013.[39] The winter of 2014/15 has brought torrential rain and flooding to both Turkey and Syria.

## Demographic challenges

Under the Ottoman Empire, the entire population of Turkey, Syria and Iraq was less than that of Istanbul today. Since 1923, the region's population has swelled eightfold to almost 130 million, a development that has intensified competition for water. In Turkey, the annual rate of population growth has now dropped to 1.3 per cent (2012 data), but the UN still expects the country's population to exceed 86 million by 2030.[40] With growth rates of 2 and 2.5 per cent respectively, the populations of Syria and Iraq could be expected to rise to a combined total of 79 million over the same period, meaning the region would register an increase of 40 million in just 20 years.[41]

[35] Definitions excerpted from: FAO (2011), 'The Coca-Cola Company Freshwater Sustainability Analyses: Interpretative Guidelines', http://www.fao.org/nr/water/aquastat/water_use/Cocacola2011_freshwater_sustainability_analyses.pdf.
[36] Kelleya, C.P.; Mohtadib, S.; Canec, M. A.; Seagerc, R.; and Kushnirc, Y. (2015), 'Climate Change in the Fertile Crescent and implications of the recent Syrian drought', *Environmental Sciences*, *PNAS* doi: 10.1073/pnas.1421533112.
[37] IRIN (2010), 'SYRIA: Drought pushing millions into poverty', 9 September 2010, http://www.irinnews.org/report/90442/syria-drought-pushing-millions-into-poverty.
[38] Kelleya, C.P. et al. (2015), 'Climate Change in the Fertile Crescent and implications of the recent Syrian drought', *Environmental Sciences*, *PNAS* doi: 10.1073/pnas.1421533112; de Châtel, F. (2014), 'The Role of Drought and Climate Change in the Syrian Uprising', *Islamicommentary*, 31 January 2014, https://islamicommentary.org/2014/01/francesca-de-chatel-the-role-of-drought-and-climate-change-in-the-syrian-uprising/; Plumer, B. (2013), 'Drought helped cause Syria's war, Will climate change bring more like it?', *Washington Post*, 10 September 2013, http://www.washingtonpost.com/blogs/wonkblog/wp/2013/09/10/drought-helped-caused-syrias-war-will-climate-change-bring-more-like-it/.
[39] Disaster Report (2012), 'Natural Disasters List December 27, 2012-Baghdad worst flooding in 30 years kills four', http://www.disaster-report.com/2012/12/ecent-natural-disasters-list-december-27.html.; Ashkenazi, E. (2013), 'From Syria to Gaza, winter storm takes its toll', *Haaretz*, 14 December 2013, http://www.haaretz.com/news/middle-east/1.563510.
[40] United Nations, Department of Economic and Social Affairs, Population Division (2013), *World Population Prospects: The 2012 Revision*, DVD edition, http://esa.un.org/unpd/wpp/index.htm.
[41] Ibid. Period defined as 2010–30. The projected combined population of 165 million is close to the UN's projection of 167.7 million people for the three countries by 2030.

Of course, these projections may be reconfigured by conflict deaths and migration since March 2011. In February 2015 the UN Refugee Agency, UNHCR, registered 3.8 million Syrian refugees, most of whom are fleeing to neighbouring Lebanon, Jordan and Turkey.[42] By late 2014, Iraqi refugees fleeing ISIS and sectarian violence numbered over 100,000 in Turkey and over 10,000 in Jordan, with numbers rapidly growing.[43]

## Capacity to manage river challenges

The water crisis along the Euphrates is likely to be compounded by future hydro-engineering developments, particularly if such projects are not coordinated with neighbouring countries' plans. The ambitious scale of infrastructure projects planned by Turkey, and potentially added to by Syria and Iraq, has spurred concerns about the sustainability of the river basin and the dependability of water flow to downstream countries. The riparian states have no means of coordinating their national plans for the development of the Euphrates, and there are no competent bodies to carry out this task. Rather, a state of competition has been allowed to develop in which each country has an incentive to develop projects as quickly as possible.

Turkey has already invested heavily in the development of the Euphrates basin within its borders. The country has developed a comprehensive water-resource management policy which includes harnessing the hydroelectric and irrigation potential of major river resources, yet there is an urgent need for further reflection on the impacts of completed projects and the action needed in the future.

Expert studies on climate-change impacts, such as the IPCC forecasts mapped in the *Aqueduct Water Risk Atlas*, predict that Turkish sections of the Euphrates will be among the areas most affected by surface-water evaporation. Turkey would benefit from a study of how its agriculture can be enhanced and made more resilient. The country should also consider how it can maintain economic growth if water is scarce. Such analyses should take into consideration riparian rights and the need to make the country's water-resource management more resilient.

In Syria and Iraq, the problems of river management are now critically impeded by conflict and/or territorial control by armed groups. In the summer of 2014, a major offensive by the extremist group ISIS resulted in the seizure of a vast swathe of the Euphrates River basin in Syria and Iraq. As a result, ISIS militias gained a degree of control over the flow of the Euphrates in both countries. Box 2 gives more information about the spread of ISIS's control over the river. The map in Figure 10 indicates the areas of fighting concentrated around the Euphrates and Tigris.

For Iraq this conflict – combined with a lack of internal order – makes infrastructure development difficult. The country plans to build hydropower stations and restore its agricultural sector. To succeed in this effort, the government needs to modernize its water sector, and establish and implement a robust water-resource management strategy.

In Syria, the situation is even more complex. The river flows through regions that are under the control of different militias. These militias have no experience in managing river flow. Of particular concern is the damage done to the Tabqah Dam – a critical piece of infrastructure both for irrigation in the Lake Assad region and for drinking water in the city of Aleppo. The

[42] UNHCR (2015), 'Syria Regional Refugee Response Interagency Information-Sharing Portal', http://data.unhcr.org/syrianrefugees/regional.php.
[43] UNHCR (2014), 'Sharp increase in Iraqi refugees fleeing ISIS into Jordan and Turkey', UNHCR Briefing notes (23 September 2014), http://www.unhcr.org/54214cfe9.html.

dam was shelled during fighting and sustained some damage to its concrete body, with one of its hydropower turbines forced out of service by an explosion. At the time of writing the dam remains under the control of ISIS.

The situation in Syria, combined with reduced water flow from Turkey, has resulted in a dangerous reduction in flow on the Euphrates' main course. Indeed, it was reported in May 2014 that water depth at the Jarablus Syrian border point had dropped from 6 metres to 1 metre.[44] Hindering future management is the loss of information from water-resource and project archives due to the war. Many local experts and technicians have either left the country or died, which means that opportunities to transfer knowledge to the younger generation are much reduced. Even before the conflict broke out in 2011, Syria lacked a clear vision for addressing climate change or an effective strategy for dealing with related crises, such as droughts and floods.

### Box 2: A fourth actor on the river? ISIS and its use of water as a weapon

In 2013 and 2014, the fundamentalist group ISIS took control of many of the water-storing, flow-controlling and regulating structures on the Euphrates in both Syria and Iraq. In Syria, ISIS has controlled the Tabqah Dam, the largest dam and main water-storage and flow-regulating body on the Syrian section of the Euphrates, since early 2013. Since then, the water level behind the dam has dropped dramatically. This has rendered the water intake for the Aleppo governorate and parts of the Raqqah governorate out of service, depriving more than 5 million Syrians of access to safe water. Some reports have blamed Turkey, accusing the country of blocking the Euphrates' flow at the city of Jarablus. Other reports have accused ISIS of depriving the governorate of Aleppo of water as punishment for refusing to recognize ISIS's authority.[a]

In one of its declarations, ISIS announced that it had placed explosives in the body of the dam and that it would detonate them if it were to come under attack. These threats were taken seriously both by the Syrian and Iraqi governments. Destruction of the dam would release a flood wave of 11 million $m^3$ of water. This would surge into Iraqi territories, destroying the cities in its course and threatening the lives of 3 million people in Syria and Iraq.[b]

In Iraq, ISIS controls the Fallujah regulator. The militia has already used the regulator to stop the river flow, depriving southern governorates of water while flooding a number of cities upstream of the regulator, including Abu Ghraib.[c] This incident shows that ISIS is both willing and able to use water as a weapon.

River infrastructure has also become a focus for international intervention in the conflict. In August 2014 there was intense fighting around the Mosul Dam on the Tigris River in northern Iraq, as ISIS attempted to take the dam and was repelled by a combination of Kurdish Peshmerga forces on the ground and US airpower. President Barack Obama justified the US airstrikes in a letter to Congress, stating: 'The failure of the Mosul Dam could threaten the lives of large numbers of civilians, endanger US personnel and facilities,

[a] Wakala News (2013), 'Risks resulting from blowing the Euphrates dam', http://www.shahbapress.com/news/521.
[b] Almayadeen News Agency (2014), 'Information about the intention of ISIS militia of blowing AlBaath and AlForat Dams on the Euphrates in north Syria', 13 September 2014, http://www.almayadeen.net/ar/news.
[c] Alalam News Agency (2014), 'Dehydration and flooding are the new weapons of ISIS in Iraq', 7 April 2014. http://www.alalam.ir/news/1583141.

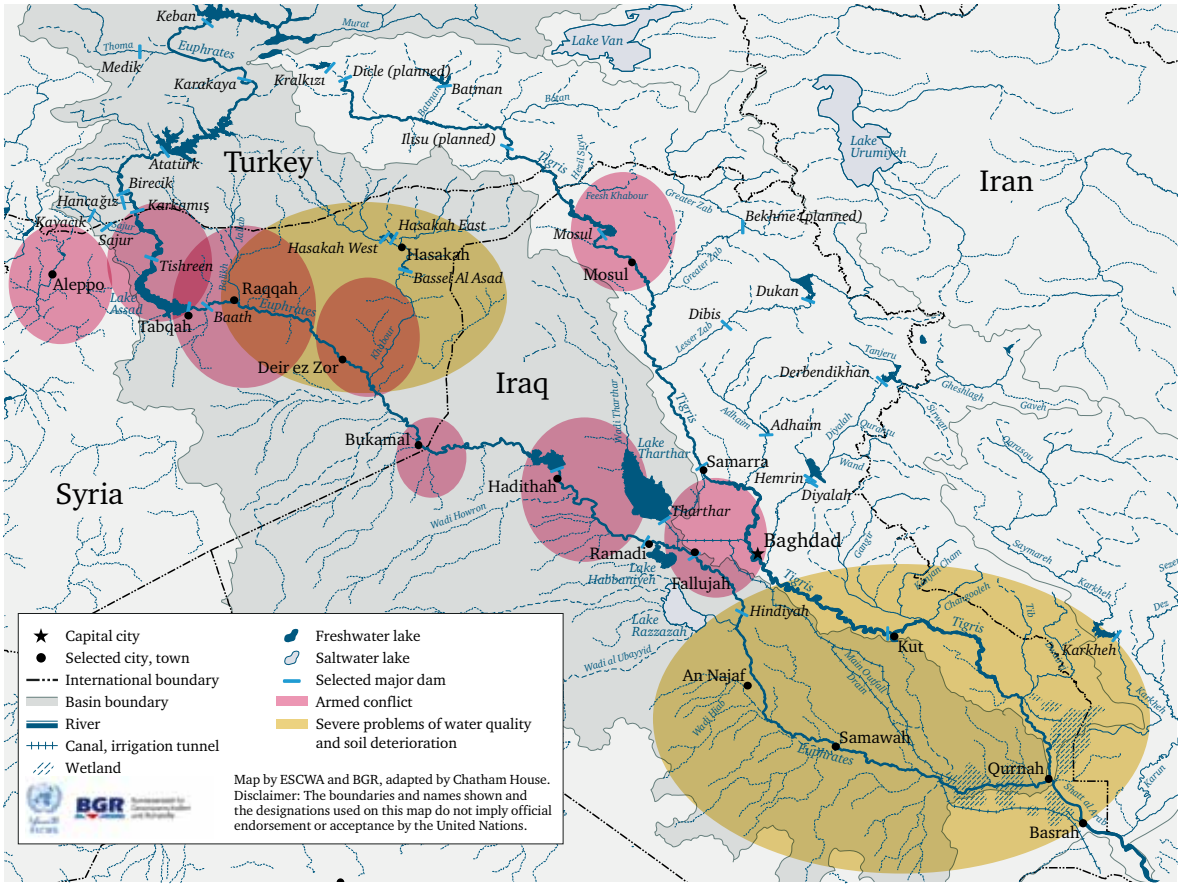
[44] Based on communication between Dr N. Shamout and an anonymous expert in the region, May 2014.

including the US Embassy in Baghdad, and prevent the Iraqi government from providing critical services to the Iraqi populace.'[d] On 17 August 2014 Peshmerga forces and the Iraqi army recaptured the Mosul Dam complex, with the support of airstrikes by US fighter jets, bombers and drones.[e]

At the time of writing fighting between ISIS and the Iraqi army is still going on in the region surrounding the Hadithah Dam – the second largest dam on the Euphrates and Iraq's second largest generator of hydroelectricity. At the time of writing the Iraqi security forces had managed to hold back ISIS.

[d] Text of a letter from the President to the Speaker of the House of Representatives and the President pro tempore of the Senate, The White House Office of the Press Secretary, 17 August 2014, http://www.scribd.com/doc/237053437/Iraq.
[e] Dearden, L. (2014), 'Iraq crisis: Why is the Mosul dam so important and how could it kill half a million people?', the *Independent*, 19 August 2014, http://www.independent.co.uk/news/world/middle-east/iraq-crisis-why-is-the-mosul-dam-so-important-and-how-could-it-kill-half-a-million-people-9677923.html.

## Figure 10: Threats to water management and availability in the Euphrates and Tigris basins




Source: UN-ESCWA and BGR (2013), *Inventory of Shared Water Resources in Western Asia*, Beirut.

# The Way Forward

The unsustainable and uncoordinated water-management practices hitherto pursued by Turkey, Syria and Iraq, combined with the mounting environmental challenges described in the earlier sections of this paper, are pushing the Euphrates to its limits as a sustainable source of water and agricultural nutrients. If the situation continues, all countries will be losers.

Under the current conditions of political crisis and conflict, intergovernmental action on long-term water management will not happen. Instead there is a need for coordination, where practicable, on short-term measures to address urgent needs connected with the loss of water supplies and threats to river infrastructure. At the same time, efforts must be made to keep open channels for official dialogue and to prepare the technical groundwork for such a time as a basin-wide approach between states becomes possible. As Grey et al. suggest, 'Starting from a low base might mean negotiating a "shared vision", which sets a goal of a better future, and then builds shared knowledge to provide the evidence to change the perceptions of benefits and catalyse cooperation.'[45] There may even be interim opportunities for (metaphorical) bridge-building through ad hoc bilateral cooperation in response to the crises on the river.

This section offers some specific recommendations based on regional stakeholder experience, opinions and research into the history of transboundary negotiations between states.

## Reviewing the Euphrates negotiation process

In order to start creating a sustainable governance framework and management processes for the Euphrates River, it is essential to understand the reasons for the lack of coordination in the past. The negotiation process between nation states regarding the sharing of the Euphrates is about one century old – from the agreement to establish a committee to study the river, negotiated with the involvement of France and Britain as mandatory powers in the 1920s, to the agreements between Turkey and Iraq and Turkey and Syria in 2008 and 2009 respectively. This section analyses the series of official negotiations and agreements set out in Appendix B, with views from stakeholders in the region on the reasons for the limited progress to date. This derives from a six-month study of the Euphrates negotiation process and is based on the available literature,[46] interviews with experts[47] in the region and discussions at the previously mentioned Chatham House workshop in June 2014. The study may prove useful in defining the factors that have hindered the progress of negotiations to date, in order that similar problems might be avoided in future.

[45] Grey, D.; Sadoff, C.; and Connors, G. (2009), 'Effective Cooperation on Transboundary Waters: A Practical Perspective', *Getting Transboundary Water Right: Theory and Practice for Effective Cooperation,* Report 25, Stockholm International Water Institute (SIWI).

[46] Dr Latif Rashid (senior adviser to the Iraqi president and previous minister of water resources), related articles, http://latifrashid.iq/; Dr Hassan Aljanabi, Iraqi ambassador at the UN Food and Agriculture Organization (FAO) and UN World Food Programme (WFP), related articles and books, different websites; Sahib Al-Rubeai (Iraqi-Syrian water research expert), related articles and books, www.watersexpert.se; Kibaroğlu, A. and Scheumann, W. (2013), 'Evolution of Transboundary Politics in the Euphrates–Tigris River System', *Global Governance*, pp. 279–305; official website of the Turkish ministry of environment and forestry, http://www.ormansu.gov.tr; official website of the Turkish ministry of foreign affairs, http://www.mfa.gov.tr; Syrian ministry for water resources, http://www.irrigation.gov.sy; Iraqi ministry for water resources, http://www.mowr.gov.iq/.

[47] The interviews were carried out between November and December 2013 in London, Beirut, Istanbul and Ankara. Respondents to the interviews have chosen to remain anonymous.

One of the biggest problems is that negotiations have been overwhelmingly bilateral. The first official tripartite meeting to bring together government representatives from the riparian states took place in Baghdad in 1965, and there have been few such meetings since then. Reading media coverage of meetings leaves the impression that the will to agree is there on the part of the three countries, but that efforts always result in failure.

Like any negotiations over issues perceived to be intertwined with sovereignty and national pride, talks regarding the Euphrates River have also been affected by the political climate. Consider the temporary bilateral agreement between Syria and Turkey, signed in 1987 under the title 'Protocol on Economic Cooperation'. Under this protocol Syria and Turkey agreed that the latter would release 500 $m^3/s$ through the Syrian-Turkish border. The agreement was a response to a security threat from the Kurdish rebel group Partyia Karkerên Kurdistan (PKK), which was believed to be planning to bomb the foundations of the Atatürk Dam in Turkey. The agreement also included security assurances under which Syria pledged to prevent and limit the mobilization of the PKK on its territories. The situation was so serious that negotiations took place directly between the Syrian and Turkish presidents (then Hafez al-Assad and Turgut Özal) and their prime ministers.

Many observers consider this agreement to have been a success, as it marked the first time that a precise amount of sustained, shared water flow had been formalized. Others say the deal was damaging, as it set a precedent in which water was used in exchange for security, rather than on the basis of any concept of rights or shared needs. One clear drawback of this bilateral agreement was that it decided Syria's share of water flow, and therefore Iraq's share as well, in the absence of Iraqi negotiators. It took the Syrian government three more years to persuade the Iraqi government to sign a similar bilateral water-sharing deal. The 1990 agreement stated that 42 per cent of the water entering Syria from Turkey would go to Syria while the remaining 58 per cent would continue to Iraq. The agreement did not mention the previous Turkish-Syrian agreement; nor did it refer to that document's agreed water flow of 500 $m^3/s$, a figure which Iraq considered unacceptable.

> International law has also proven inadequate as a tool for solving disputes or augmenting cooperation, as Turkey does not accept the UN Convention on the Law of the Non-Navigational Uses of International Watercourses, which entered into force on 17 August 2014.

Another obstacle to interstate cooperation is that any agreements signed have always lacked the required instruments for execution. For example, since 1920 the establishment of a technical water-management committee has been agreed three times in principle but has never materialized in an effective form.

International law has also proven inadequate as a tool for solving disputes or augmenting cooperation, as Turkey does not accept the UN Convention on the Law of the Non-Navigational Uses of International Watercourses,[48] which entered into force on 17 August 2014. Syria was the first country to sign the convention (which it ratified in 1998). Iraq acceded to the convention in 2001 but has not yet ratified it.

[48] United Nations (1997) Convention on the Law of the Non-Navigational Uses of International Watercourses, New York, 21 May 1997, https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-12&chapter=27&lang=en.

Interviews and published studies attribute the failure of negotiations to factors summarized below:

- Deep mistrust between the representatives of each state inhibits meaningful official talks. The governments of Turkey, Syria and Iraq hold a series of grievances against one another with regard to alleged misuse of the Euphrates. Syria and Iraq still accuse Turkey of over-exploitation, and Iraq accuses both Turkey and Syria of polluting the water with effluent from irrigation drainage. Syria accuses Turkey of being the main source of river pollution due to heavy agricultural activity. Turkey has sporadically insinuated that both Syria and Iraq are, in effect, free-riding on a Turkish resource. According to Ferruh Anık, a senior Turkish official: 'Every Turkish citizen pays taxes for his/her water. This is not free water. What the Syrians and Iraqis are getting now, that's free water.'[49] These accusations tend to overshadow any official negotiation over transboundary water resources.
- Political tension and conflict continually interfere with and override water-sharing negotiations and agreements. For example, in the 1960s and 1970s political relations between Syria and Iraq were tense as the two wings of the Ba'ath Party competed for dominance. As a result, the two countries missed an important opportunity to launch a joint technical committee, proposed during negotiations in the early 1970s, at a time when competition over water resources was very limited compared with today's complex situation (see Appendix B). This is in spite of the sustained efforts of negotiators, who met more than six times in five years.
- As mentioned, agreements thus far have existed in principle but have lacked clear execution instruments or mechanisms. The first technical committee for water-resource cooperation came into existence after a 1983 agreement between the three riparian states. The committee was functional as a data-exchange platform at least until the breakdown of relations between states over Turkey's filling of the Atatürk Dam in 1990.
- Declarations by the three riparian states' leaders tend to exhibit a sense of conflict between sovereignty and resource-sharing, especially with regard to water. The proposed agreements have on many occasions emphasized the need to isolate management of transboundary water resources from other political issues and regional events. Nevertheless, Iraqi experts have pointed out that Turkey used water as a political tool in 1991, when water flow in the Euphrates dropped from 500 $m^3/s$ to 150–180 $m^3/s$. This coincided with international political pressure on Iraq following its occupation of Kuwait. The Turkish government subsequently increased the flow again in response to public opinion and political criticism, but the incident reflects the impact of politics on transboundary water management.
- Limits on the decision-making power of the negotiating teams have often forced them to break meetings at critical points due to the need for consent from higher authorities. As a result, meetings have been repeatedly adjourned and rare opportunities for consensus lost. Many of the experts interviewed for this paper have pointed out that assigning limited power to delegations was a deliberate negotiation tactic on the part of country leaders who wished to avoid binding commitments.
- Inadequate pre-meeting communication of agendas has caused disputes to arise over the issues to be addressed. For instance, Turkey considers the Euphrates and Tigris to be one hydrological unit, while Syria and Iraq disagree. Raising this issue during negotiations – instead of agreeing the terms of reference beforehand – has often resulted in fierce argument and deadlock.

[49] Hakkı, M.M. (2006), 'Turkey, Water and the Middle East: Some Issues Lying Ahead', *Chinese Journal of International Law*; July 2006, Vol. 5 Issue 2, pp. 441–458.

- Preparation for negotiations has been poor in other respects. Even when the scope and terms of discussion have been agreed in advance, the preparation committee has subsequently failed to provide adequate supporting data and materials. In many cases this has been due to political unwillingness, for instance when the required information has been considered a matter of national security. A lack of technical and negotiating expertise has also been a factor for Iraqi and Syrian delegations.
- The inconsistent composition of delegations has been a problem for the Iraqi and Syrian sides. Both countries' negotiating teams have tended to change personnel from one meeting to another, causing experience and knowledge to be lost. In contrast, the Turkish negotiating team remained constant, accumulating knowledge and experience, between 1965 and 1994.
- The treatment of water, rhetorically and institutionally, as a sensitive security issue entwined with sovereignty has inhibited potentially useful integration with other areas of state-to-state cooperation. According to one Iraqi diplomat, orders were given to diplomats during the negotiation of other (non-water-related) agreements between the three riparian states not to raise the subject of water. This practice created an impression that water was a taboo issue.
- Turkey is perceived by Syrian and Iraqi negotiators to have a proprietorial attitude to transboundary water flows generated inside its borders.

## Short-term approaches: managing the river in crisis

Both the tools of river management and the territorial governance arrangements affecting the river are being eroded by the current security crisis. Since 2013, records of the river flow within Syria have been unavailable and measurement stations have been unmanned or out of service. This has resulted in at least a year's gap in data on the river's flow patterns. As explained in Box 2 in the previous section, the incursion of ISIS forces and the military responses from local and international actors continue to complicate the situation. The future balance of power in the region is far from certain. The Euphrates' importance to the region in providing renewable water resources means that Syria and Iraq, in particular, are vulnerable to worsening humanitarian conditions.

The efforts of experts and concerned parties to address this crisis must adapt to current circumstances. One practical proposal for the short term, which emerged from the Chatham House workshop in June 2014, was to establish a working group to observe different events affecting the integrity of the river. This group, composed of experts both inside and outside the riparian states (in communication with a network of contacts and focal points on the ground), would play a monitoring role and pass concise briefings to the responsible authorities and humanitarian agencies as needed, or in cases of emergency.

With developments unfolding rapidly and multiple actors on the ground, reports on the water situation have often been unclear and confusing, inhibiting appropriate action. By establishing a reputation for objective reporting and analysis, such a group might help reduce tensions between parties by presenting timely, unbiased information to avoid the spread of inflammatory accusations through the media.

It is possible that such a group, given funding and support, could help form a bridge between (a) managing urgent needs in the context of the current security crisis and (b) developing long-term water-management protocols if and when future political conditions are stable enough to allow official cooperation. The working group's actions could include modelling the effects of events

and processes affecting the river to allow better preparation and response to water-supply failures. This is urgently needed given the potential for unscheduled releases of water from dams or even complete destruction of dams by armed groups. Rapid response would be crucial, with the window of opportunity for action to evacuate people limited. The system could also incorporate data about agricultural use of water and supply networks to enable better anticipation of impacts, and this knowledge would simultaneously help serve long-term river management.

## Longer-term solutions: institutionalizing cooperation

In the longer term, the transboundary nature of the challenges will require an integrated management plan for the river: one that recognizes its hydrology, respects the sovereignty of the riparian states, and employs innovative ideas to encourage interdependence.

As suggested by Küçükmehmetoğlu et al. (2010), experts from the three countries should be able to reach solutions jointly, avoiding international interference, with each country getting optimum benefit from scientific negotiations based on a common model for the Euphrates River, to be based on actual data from each riparian state.[50] Some platforms of engagement and protocols developed between Turkey and Iraq, and between Turkey and Syria, since 2008 could lay the foundations for this kind of basin-wide river management (see Appendix B), although progress has been halted by armed conflict.[51] In line with the international evolution of thought on transboundary water management, these ideas emphasize the use of water for mutually beneficial economic and social development and ecosystem sustainability. There is a particular focus on the importance of sound water-demand management, where the sharing of experience on issues such as irrigation efficiency and environmental allocation can bring dividends for all parties.[52]

> To institute this comprehensive approach in future will require consistent commitment and shared development of knowledge… The task requires a full-time, sustainably financed, knowledgeable body, recognized and trusted by the three riparian states.

To institute this comprehensive approach in future will require consistent commitment and shared development of knowledge. Experience to date has proven that a committee of just a few people meeting once a month, often without the representation of one of the countries, is not enough. The task requires a full-time, sustainably financed, knowledgeable body, recognized and trusted by the three riparian states. This body could be called a committee, commission or high commission, whatever fits the politics in the riparian states, but this paper will refer to it as the 'river committee'.

There are several examples of similar coordination internationally. The Mekong River Commission (which brings together representatives from Cambodia, Laos, Thailand and Vietnam) and the Incomati Tripartite Permanent Technical Commission (Mozambique, South Africa, Swaziland) have successfully established robust multi-country working relationships based on mutual needs,

[50] See, for example, Küçükmehmetoğlu, M.; Şen, Z.; and Özger, M. (2010), 'Coalition possibility of riparian countries via game theory and fuzzy logic models', *Water Resources Research*, Vol. 16, Issue 12, doi:10.1029/2009WR008660.
[51] See also Kibaroğlu, A. and Scheumann, W. (2013), 'Evolution of Transboundary Politics in the Euphrates–Tigris River System: New Perspectives and Political Challenges', *Global Governance*, 19 (2013), pp. 279–305, particularly pp. 289–292.
[52] Sadoff, C. and Grey, D. (2002), 'Beyond the River: The Benefits of Cooperation on International Rivers, *Water Policy*, 4, pp. 389–403.

threats and benefits. The increasing number of river basin committees among provincial and state governments in the US and China, as well as the EU's Water Framework Directive, could also provide lessons for the countries of the Euphrates.

Based on the lessons from past negotiations between Turkey, Syria and Iraq described above, this paper recommends the adoption of the following guidelines to maximize the proposed river committee's chances of success:

1. **The committee's mission should be guided by the principles, but not necessarily the letter, of international law.** Given concerns about sovereignty, the river committee's remit should be framed in terms of achieving optimum use of the Euphrates' waters while meeting the three riparian states' needs over time. It should not focus on division of flows but rather should draw on acceptable international principles and laws, even without all parties being signatories to those laws.
2. **The committee should be delegated sufficient authority to enable it to fulfil its mission. Establishing the right governance structure will be crucial.** The committee would need to report to a ministerial-level board made up of representatives from the three countries, but its remit should allow for work to continue even where politics prevents trilateral meetings at the highest level.
3. **The committee should be constituted in a manner flexible enough to allow evolution of its remit and structure.** In the absence of a full river-sharing agreement between states, the committee could be given interim status for an initial 'clarification' period. This would be followed by a second 'agreement development' period and – were an agreement to be signed – a third 'fully effective' period.

## Proposed committee activities:

### 1. Provide a shared basis of understanding to underpin and support formal cooperation

During the initial 'clarification' period, the committee should foster working relationships between experts from the three countries, through the preparation of materials to cement a common understanding of hydrology and riparian needs. These studies should clarify key issues of disagreement and the reasons for the failure of past negotiations, and could be aided by international supervision and support where necessary. For example, the committee could proceed by:

- Establishing a database of all existing water agreements between the three riparian states, the implementation of these agreements, and their limitations and challenges. The database would also record the three riparian states' commitments to international conventions and agreements related to transboundary waters.
- Listing all current transboundary water-related disputes between the three states, defining the reasons for the disputes, and clarifying the current positions of each party.
- Initiating a database of the river hydrology and meteorology in the three states based on available data, and identifying necessary data improvements for a dynamic picture of the Euphrates' flow regime.

- Using geographic information systems and local knowledge to map the river's interaction with agricultural land and energy infrastructure. This would be with the aim of enabling future early-warning systems to identify climate change-related issues, extreme weather events and incremental degradation of the river environment.
- Studying the borders and specifications of the Euphrates basin and sub-basins. This study would enable the committee to address the controversial question of whether the Euphrates and the Tigris rivers form one basin or two, and how this should affect river management.
- Defining the riparian states' respective water needs in different sectors, along with expected growth in water demand. This would include identifying target areas for efficiency improvement and critical water needs for each country.
- Promoting awareness in each country of the challenges facing the Euphrates basin due to increasing demand for water, climate change and expected severe climate incidents. These campaigns should target two audiences: decision-makers and the general public. Their goals would be both to build support for cooperation in the Euphrates basin and to collect data on people's concerns and perceptions of water issues.

### 2. Develop a durable cooperation agreement

If the first stage was successful, the river committee could move on to develop a durable agreement for water sharing between the three riparian states. This would not necessarily be focused on a division of flow but rather on roles, joint responsibilities and specific processes for defusing tensions and resolving future disputes. It would be presented as a 'tool' to build cooperation over time, rather than to control competition over resources. Given a common grounding on previous joint technical and other preparatory studies, the committee should be able to devote its time during the drafting process to ironing out differences in legal language, diplomatic approach and formalities.

In all cases, a comprehensive river-sharing agreement between states should:

- Be founded on the principle that sustainable cooperation over water resources will enable the riparian states to reduce water-related conflicts and extend cooperation, increasing the prosperity of all the people living in the region;
- Clearly define the river basin or basins and other related transboundary resources;
- State all laws and regulations accepted by the three riparian states as forming the basis on which the agreement is built;
- Name the three riparian states involved, and ideally a neutral representative from a mutually recognized organization such as the Organization of the Islamic Conference (OIC), which could act to break tied votes and engage in arbitration if requested;
- Define the authorities responsible for implementing the agreement in each of the three states;
- State acceptance of the principle of arbitration in any dispute or misinterpretation between the involved parties in issues related to the agreement;
- State the minimum water flow for each downstream riparian state, based on the countries' critical needs and ascertained through the preparatory studies;

- State the acceptable water-quality parameters for the flow entering each of the riparian states (with the acceptable limits being flexible and taking account of seasonal factors); and
- Clearly define the roles and responsibilities of each of the parties, including the river committee.

### 3. Assist with and ensure implementation of the agreement

After the signature of a tripartite agreement, the river committee could focus on supporting tasks to ensure its successful implementation. These could include:

- **Maintaining and improving a database on the river's hydrology and meteorology,** based on information provided by the three riparian states and the committee's experts. The database would be used by the committee to predict any changes in the Euphrates' flow regime.
- **Leading awareness campaigns about the efficient use of water** in different human activities. The campaigns should take into consideration the local conditions of each riparian state, and could support the understanding and dissemination of basin-wide responsibilities among users.
- **Building an early-warning system for the prediction of severe climate incidents in the Euphrates basin.** This warning system should be supported by new or existing regional climate modelling and by response scenarios agreed with the relevant authorities in each of the riparian states. The committee should collaborate with the authorities in the three states on deciding the mitigation and adaptation measures needed to deal with climate challenges at basin rather than national level. Planning at the basin level would offer a greater number of sustainable options and solutions.
- **'Socializing' the GAP.** The committee could play a useful role in surveying existing and planned water structures over the river course, with the aim of building integrated investment in these structures, for mutual benefit. For instance, Turkey is seeking funding for its dams and hydro-engineering structures, while Iraq and Syria are suspicious of Turkey's plans and are taking diplomatic steps to thwart them. Instead, Turkey could request funding from the other two states, establishing partnerships with them. This would make the Southeastern Anatolia Project (Güneydoğu Anadolu Projesi, GAP) more acceptable regionally, and could support food security in Iraq and Saudi Arabia. Such an achievement would contribute significantly to the establishment of a climate of trust.
- **Fostering wider economic interdependence.** Drawing on a range of economic and social development expertise, the committee could interact with officials and networks in each country to encourage more interdependent relations between riparian states. These relations would be connected with, but not limited to, water use. Trade, investment and cross-border power supply could be encouraged. To give one example of potential cooperation, Turkey wishes to enhance its oil and gas security while mitigating potentially heavy transmission losses on planned hydropower projects in southern Anatolia (which would inefficiently serve distant Turkish population centres). Meanwhile, Iraq needs electricity but has oil and gas to sell. A mutually beneficial solution, therefore, could involve Turkey selling and transmitting hydro-generated power over short distances to nearby buyers in northern Iraq, and in return receiving a steady supply of Iraqi oil and gas.

- **Reviewing legislation regulating water use and management in the three riparian states.** The committee's role would be to propose modifications to existing legislation to facilitate integrated management of shared water resources. In this respect, the committee could learn from other regions' experiences, such as the EU's efforts at transboundary water-resource management. This step should be of interest to Turkey, in particular, given that Turkey will need to comply with EU legislation in order to achieve accession.

# Conclusion

National development plans over the past half-century have involved large-scale exploitation activities on the Euphrates River, which have significantly altered the river's flow volume and regime. Daily deterioration of the river's resources is becoming an impediment to reconstruction and future peace in the region.

A combination of rising water demand, uncoordinated infrastructure plans and climate change is likely to reduce water flow further, increasing competition for resources between states and creating fresh impediments to political stability and economic growth. Syria and Iraq are already designated 'water scarce' countries, with Turkey considered vulnerable to future stress. The water condition in all three countries is projected to worsen with climate change.

Changes to the Euphrates River's flow, greater evaporation rates during hotter summers and more frequent extreme weather events will present major governance challenges to all three countries. How these are addressed will have implications for neighbouring regions. Further human catastrophe and migration as a result of water-supply and harvest failures would negatively affect the economic interests of the EU and wider western Asia.

The risk of such a crisis will only subside if the national and local governments of the riparian countries coordinate their responses, in accordance with international rules. Given the transboundary nature of the water challenges the region faces, the riparian authorities must consider collaborative approaches to crisis mitigation and response. Due to the simple fact that the river is a hydrological unit that does not recognize political borders, one riparian state acting alone will not be able to meet the challenges.

Cooperation is urgently needed, yet almost a century of state-to-state relations has not produced an effective and sustainable process for managing the river's resources. The factors impeding agreement are becoming more complex, due to armed conflict, population and climate changes, and development pressures. Each country is at a different stage of economic development. Dramatic demographic changes, economic growth and heavy reliance on water-intensive agricultural methods have increased competition for water. Rights over the river remain disputed, and intertwined with emotive issues of sovereignty and a history of fraught political relations. Even the most basic communication between parties is hindered by deep political instability, especially since the onset in 2011 of the Syrian crisis and the related upheaval across the Arab world.

In the current political and security climate, intergovernmental action seems unthinkable. But political will may align in future. At that point more symmetric knowledge, and agreement on priorities among technical practitioners, would facilitate practical dialogue and action. Cultivating approaches based on mutual understanding and cooperation, and discussions based on scientific models, will help to guide politicians and representatives of the three countries towards benefit-sharing solutions. This is the most rational approach to ensuring future water sustainability in the three countries.

In this context, based on numerous conversations with officials and technical experts from each country, this paper has outlined a proposal for a river committee. This would be formed from experts

from each of the countries and would have a mandate supportive of tripartite cooperation. Several initial studies which the committee could carry out are also suggested. These include a scientifically based model for the Tigris and Euphrates rivers, which would lay to rest disagreement over whether they constitute one or two basins, and a mapping of the river's interaction with agricultural land and energy infrastructure.

These kinds of activities could also pave the way for more formal political cooperation. Moving forward requires careful consideration of the facts on the ground and recognition of the reasons both for past failures and (such as they have been) successes. It is therefore in the interest of all parties concerned to support regional cooperation and heed calls for increased efforts to build knowledge and cement relations among experts. The aim should be to promote readiness to support basin-wide mitigation, adaptation and restoration efforts when the political opportunity arises.

In the meantime, it is essential to keep open the channels of dialogue among country experts and government representatives where possible. There may be ad hoc opportunities for coordination between Turkey and Iraq on short-term measures to address urgent human needs. Besides that, establishing a working group of experts to monitor events affecting the integrity of the river and to advise responsible authorities and humanitarian agencies on water-related emergencies may help bridge the gap in a situation of crisis.

# Appendix A: Indicators and Methodology

### Table A1: Types of water-poverty indicators

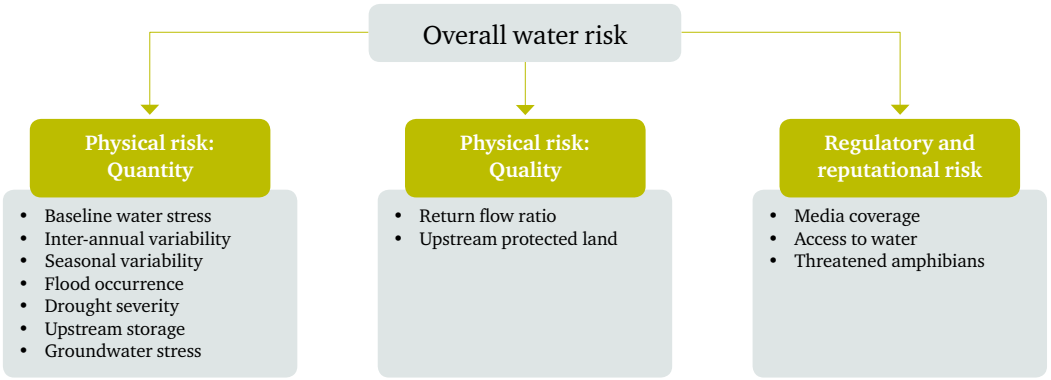
| **Indicator** | Water-crowding index (WCI, or Falkenmark Index) | | Criticality ratio indicator (CRI) | | Social water-scarcity index (SWSI) | |
|---|---|---|---|---|---|---|
| **Measure** | The amount of the total annual water run-off available for human use per capita. | | The percentage of total annual withdrawals relative to available freshwater resources. | | Uses the World Development Index (WDI) divided by the Human Development Index (HDI) as a proxy for social adaptive capacity to water stress. | |
| **Ranking** | <500 $m^3$ per capita per year | Absolute scarcity | 0–10% | No stress | <5 | Relative sustainability |
| | | | 10–20% | Low stress | | |
| | >500 <1,000 $m^3$ per capita per year | Water scarcity | 20–40% | Mid-stress | 5–10 | Stress |
| | >1,000 <1,700 $m^3$ per capita per year | Water stress | 40–80% | High stress | 10–20 | Scarcity |
| | >1,700 $m^3$ per capita per year | No stress | 80–100% | Very high stress | >20 | Beyond the barrier |
| **Functionality** | Focuses on availability of resources relative to population. | | Concentrates on the availability of resources relative to demand. | | Aims to reflect the capacity to adapt to water stress (understood through distribution of wealth, education system and political participation) through economic, technological or other means. | |

Source: Shamout, N. based on Jemmali et.al (2012).

## Aqueduct water risk framework

The water risk framework used takes into account several types of stress, as shown in Figure A1 below.

### Figure A1: Water risk framework




The Aqueduct indicators aim primarily to show the exposure of companies and investors to water-related risks in their operations and assets around the world. They take into account a variety of measurements, as shown above, where data are available. There were no groundwater data for Turkey and Syria, for example.

The return flow may not be an adequate indicator of pollution. Rather, it looks at the extent to which a region is dependent on wastewater treatment infrastructure. It measures 'the percent of available water previously used and discharged upstream as wastewater. Higher values indicate higher dependence on treatment plants and potentially lower water quality in areas that lack sufficient treatment infrastructure and policies'.[53]

Reputational and regulatory risks relate to potential impacts on companies using water in the country. Baseline water stress measures 'total annual water withdrawals (municipal, industrial, and agricultural) expressed as a percentage of the total annual available blue water. Higher values indicate more competition among users'.[54]

### Table A2: Baseline water-stress measurements

| |
|---|
| 4–5: Extremely high stress (>80%) |
| 3–4: High stress (40–80%) |
| 2–3: Medium–high stress (20–40%) |
| 1–2: Low–medium stress (10–20%) |
| 0–1: Low stress (<10%) |

## Methodology for projections of future water stress

The analysis takes three benchmark scenarios of economic and environmental change used by the Intergovernmental Panel on Climate Change (IPCC scenarios A2, A1B and B1) in its Fourth Assessment Report.[55] These are paraphrased in brief below:

### Table A3: Projected increase in global mean warming (°C)*

| Scenarios | 2011–30 | 2046–65 | 2080–99 |
|---|---|---|---|
| A2 – Per capita economic growth is slow while population growth continues. Economic development is primarily regionally oriented and technological change more fragmented and slower than in other scenarios. | 0.64 | 1.65 | 3.13 |
| A1B – Rapid economic growth is accompanied by a global population that peaks in mid-century and declines thereafter. New and more efficient technologies are used in the energy system, and this change is balanced across all sources with similar improvement rates applying to all energy supply and end-use technologies. | 0.69 | 1.75 | 2.65 |
| B1 – Population peaks in mid-century and declines thereafter. This is accompanied by rapid change in economic structures, with reductions in material intensity and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social and environmental sustainability, including improved equity, but without additional climate initiatives. | 0.66 | 1.29 | 1.79 |

* The table records the global mean warming (annual mean surface air temperature change) from the multi-model ensemble mean for three time periods relative to 1980 to 1999 for each of the scenarios.
Source: IPCC (2007).[56]

[53] Reig, P.; Shiao, T.; and Gassert, F. (2013), 'Aqueduct Water Risk Framework', working paper, Washington, DC, World Resources Institute, http://www.wri.org/publication/aqueduct-water-risk-framework.
[54] Gassert, F.; Landis, M.; Luck, M.; Reig, P.; and Shiao, T. (2013), 'Aqueduct Global Maps 2.0', working paper, Washington, DC, World Resources Institute, http://www.wri.org/publication/aqueduct-metadata-global. See also Gassert, F.; Reig, P.; Luo, T.; and Maddocks, A. (2013), 'Aqueduct country and river basin rankings: a weighted aggregation of spatially distinct hydrological indicators', working paper, Washington, DC, World Resources Institute, November 2013, http://wri.org/publication/aqueduct-country-river-basin-rankings.
[55] IPCC (2007), *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S.; Qin, D.; Manning, M.; Chen, Z.; Marquis, M.; Averyt, K.B.; Tignor, M.; and Miller, H.L. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, United States. Note that for its fifth Assessment Report (AR5), the IPCC has adopted Representative Concentration Pathways (RCPs) for climate modelling and research. See: IPCC (2013), Summary for Policymakers. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F.; Qin, D.; Plattner, G.-K.; Tignor, M.; Allen, S.K.; Boschung, J.; Nauels, A.; Xia, Y.; Bex, V.; and Midgley, P.M. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, United States.
[56] IPCC (2007), *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report*.

# Appendix B: The History of Interstate Negotiations Over the Euphrates River

| Date | Participants | Result | Remarks |
|---|---|---|---|
| 1920 | Mandatory powers:<br>• France on behalf of Syria<br>• Britain on behalf of Iraq | Agreement for establishing a coordination committee for examining the utilization of the Euphrates and Tigris rivers. | • Followed the collapse of the Ottoman Empire and the end of the First World War. |
| 1920 | • France on behalf of Syria<br>• Turkey | Negotiation regarding the Kwaiq River, which referred to the utilization of the Euphrates River. | |
| 1921 | • France on behalf of Syria<br>• Turkey | Ankara Treaty on the rights of riparian states in using transboundary waters, and the right of the city of Aleppo in using Euphrates water for meeting the city's demand (Article 12). | |
| 1923 | • The Allies<br>• Turkey | Article 109 of the Lausanne Treaty emphasized the principle of separating transboundary water management from any other political issues, and that transboundary water management should respect the mutual benefit of the riparian states. The treaty clearly adopted the principle of arbitration. | • The Lausanne Treaty was the final treaty concluding arrangements at the end of the First World War and defined the borders of modern Turkey. |
| 1926 | • France on behalf of Syria<br>• Turkey | The Convention of Friendship and Good Neighbourly Relations, with emphasis on the commitment by both parties to coordinate their plans for the use of the Euphrates River. | • Syria was under French occupation. |
| 1946 | • Iraq<br>• Turkey | Article 3 of the Convention on Friendship and Good Neighbourly Relations between Iraq and Turkey stated that:<br>• Turkey would install permanent flow measurement on the river's course<br>• Turkey would periodically provide Iraq with the measurements. | |
| 1962 | • Iraq<br>• Syria | Agreement to exchange all available information regarding the Euphrates River. This included:<br>• A call for the establishment of a mutual committee responsible for negotiating on behalf of the two countries.<br>• Joint opposition to any plans for the control of the river's water. | • This was a response to the intention letter sent by Turkey in 1957 regarding the plans for building the Keban Dam.<br>• Poor political relations prevailed between Iraq and Syria.<br>• The committee was never formed. |
| 1965 | • Turkey<br>• Syria<br>• Iraq | Issues discussed included:<br>• Water sharing;<br>• Reservoir- and dam-filling schedule. | • The meeting was unproductive due to the defensive attitudes of participants. |
| 1966–67 | Syria<br>Iraq | Issues discussed included:<br>• Water sharing;<br>• Irrigated land and actual water demand. | • A series of meetings was held in Damascus.<br>• The last meeting failed due to bad preparations and lack of necessary information. |

| Date | Participants | Result | Remarks |
|---|---|---|---|
| 1967 | • Syria<br>• Iraq | At this meeting to share data, Syria claimed 40 per cent of the flow of the Euphrates and Iraq refused the claim, requesting that Syria be more efficient in using water. | • The meeting was in Damascus.<br>• Political relations were poor. |
| 1967 | • Syria<br>• Iraq | Syria suggested the principle of approving a base flow. Under this proposal, Syria would get 40 per cent of the flow, Iraq 60 per cent. Any flow exceeding the agreed base flow would be divided equally. Iraq refused. | • The meeting was in Baghdad.<br>• Political relations were poor.<br>• The meeting failed as Iraq refused the proposed concept of sharing. |
| 1971–73 | • Syria<br>• Iraq | A series of meetings took place through this period. Iraq proposed:<br>• The establishment of a coordination concept for negotiation;<br>• The establishment of historical rights over the Euphrates River (a concept refused by Syria);<br>• Collection and sharing of information on water demand in each country;<br>• Acceptance of the Soviet arbitration committee's decision. | • Political relations between the two countries were poor.<br>• The negotiation teams agreed to the Soviet arbitration committee's conclusion but the decision was revoked by the central authorities of Syria and Iraq. |
| 1971 | • Turkey<br>• Iraq | Technical cooperation protocols were signed in which Article 3 stated:<br>• Both parties would coordinate during the filling of the Keban Dam.<br>• Direct negotiations would take place about shared waters, starting with the Euphrates. | • The meeting took place in Ankara.<br>• Coordination was poor, and the filling of the Keban Dam damaged mutual relations. |
| 1973–74 | • Syria<br>• Iraq | A number of meetings took place between the two countries to set guidance for the Euphrates' flow while filling the Keban and Tabqah dams. | • Poor political relations prevailed between Syria and Iraq.<br>• The two countries were heading towards war, which was defused by the Arab League and Saudi Arabian mediation. |
| 1980 | • Turkey<br>• Iraq | Signing of a protocol for technical and economic cooperation, which stated:<br>• A joint technical committee should be established to study cooperation over the Euphrates and the Tigris.<br>• The committee should review all issues related to transboundary waters between the three countries.<br>• The findings should be reported within two years to a ministerial committee responsible for deciding a fair share for each state.<br>• Pollution controls for transboundary waters should also be addressed. | |
| 1983 | • Turkey<br>• Syria<br>• Iraq | Syria joined the protocol of 1980. | • Iraq was present in the committee during the UN trade embargo on Iraq.<br>• The committee held 17 meetings up to 1992 but was not able to achieve a final agreement for sharing the Euphrates River.<br>• Relations broke down during the 1990s, mainly over Turkey's development of GAP and specifically the filling of the Atatürk Dam. |

| Date | Participants | Result | Remarks |
|---|---|---|---|
| 1987 | • Turkey<br>• Syria | Signing of a protocol on economic cooperation, which stated:<br>• Turkey would release on average 500m$^3$/s through the Euphrates.<br>• A security agreement would limit the mobility of the PKK on Syrian territory. | • The agreement came after a tense period between the two countries, and threats of a PKK bombing of the Atatürk Dam. |
| 1990 | • Syria<br>• Iraq | Signing of an agreement for sharing the Euphrates' waters between Syria and Iraq:<br>• Syria to keep 42 per cent of the Euphrates' flow coming through its territories from Turkey.<br>• Iraq to have the remaining 58 per cent of the Euphrates' flow. | • This agreement was delayed for 23 years, after the same arrangement was discussed in 1967;<br>• This agreement did not recognize the sharing agreement signed between Turkey and Syria in 1987, which was a temporary agreement but has lasted until the present.<br>• Iraq subsequently demanded an increase to the flow from Turkey to Syria previously agreed between Turkey and Syria. |
| 2008 | • Turkey<br>• Iraq | Establishment of the High-Level Strategic Cooperation Council, which introduced a mechanism for meetings between relevant ministries to discuss transboundary water issues. | |
| 2009 | • Turkey<br>• Syria | Establishment of the High-Level Strategic Cooperation Council, where 50 protocols were signed, four of which related to regional waters. These set out:<br>• Cooperation on shared water forms;<br>• Specific focus on water quality;<br>• Cooperation on developing shared water-pumping stations and dams, and a joint water policy. | |
| 2009 | • Turkey<br>• Iraq | Signing of a cooperation agreement comprising 48 memoranda of understanding, one of them on water. Key points were:<br>• Agreement on sharing hydrological and meteorological information;<br>• Exchange of knowledge in this field. | |

# About the Authors

**Dr M. Nouar Shamout** is a water-management consultant with 11 years of experience in the field of teaching, technical management of water, and political analysis of transboundary water relations. From 2004 to 2014 Nouar lectured at the Faculty of Civil Engineering's water and environment department at the University of Damascus – as associate professor from 2004 and deputy dean for administration and student affairs from 2010 to 2013. He was also engaged as a consultant in practical water studies organized by governmental and multilateral institutions, including Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the European Bank of Investment (EIB). In early 2013 he was enlisted by the WHO as a water, sanitation and health (WASH) expert to help develop a water-quality monitoring system for early warning of contamination. In 2013 he won an Academy Fellowship at Chatham House in London to lead a project on transboundary water management between Turkey, Syria and Iraq. Nouar has a BSc in engineering (1996) from the University of Damascus and a PhD in engineering (2003) from the University of Manchester.

**Glada Lahn** is senior research fellow in the Energy, Environment and Resources Department at Chatham House. Since joining Chatham House in 2004, she has managed several international projects on natural resource governance. Her research areas have included petroleum sector governance, Asian foreign resource investment, and Arctic oil and gas developments. She has worked extensively with partners in the Arab Gulf states on issues of energy and water conservation. Glada currently leads the Valuing Vital Resources project on the use of costs and market incentives for sustainability in energy, water and food. In early 2015 she joined the organizing committee of the Moving Energy Initiative, a multi-stakeholder partnership promoting sustainable energy access in humanitarian settings. From 2002 to 2004, she was senior research fellow at the Gulf Centre for Strategic Studies. She has a BA in Arabic and international relations and an MA in Near and Middle Eastern studies from the School of Oriental and African Studies, University of London.

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The Royal Institute of International Affairs
Chatham House
10 St James's Square, London SW1Y 4LE
T +44 (0)20 7957 5700 F +44 (0)20 7957 5710
contact@chathamhouse.org www.chathamhouse.org

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