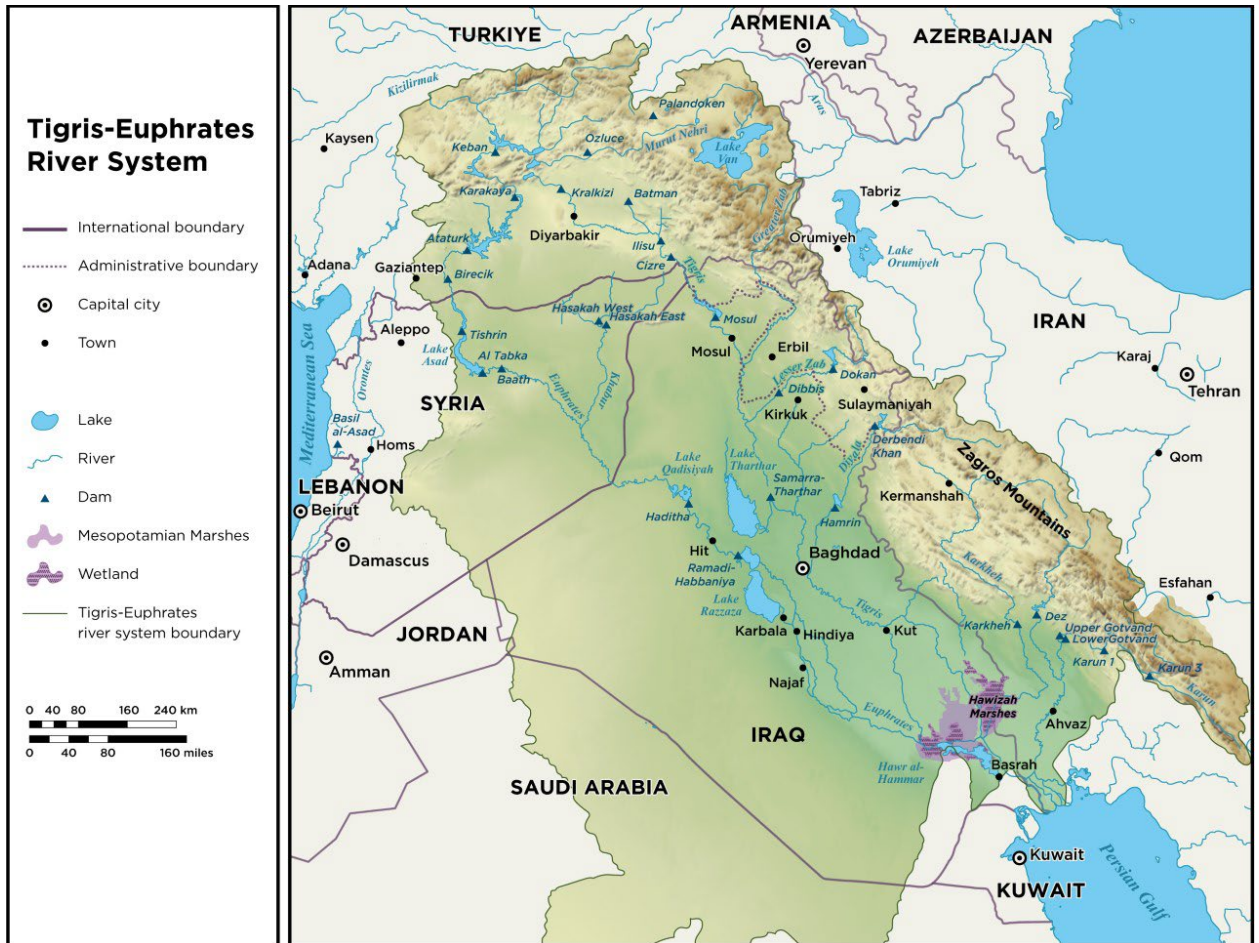


WATER SECURITY IN IRAQ

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Map and Figure 1, p. 8: Ribale Sleiman Haidar

EXECUTIVE SUMMARY

Iraq suffers from poor water security, a combination of increased consumption by Turkiye and Iran and extreme inefficiency in the way it uses the water it does have. Both upstream countries still aim to build more dams (although Iran's plans are opaque), so flows in shared watercourses are set to decline further. The quality of water in the shared watercourses – especially the Euphrates – has also fallen and is highly likely to fall still further.

In coming years, two other factors will almost certainly make Iraq's situation more difficult. One is increased demand in Iraq, a consequence of a growing population, post-conflict reconstruction and more general economic development. The other is climate change which, projections suggest, will significantly reduce water flows in the Tigris-Euphrates River System.

Taking all these factors into account, one authoritative report suggests that the overall volume of water available to Iraq will have fallen by over 20% by 2035. At this point, the gap between demand and supply will (without major reforms) have reached almost 11 billion cubic metres of water a year.¹ One otherwise-sober academic article describes the future of "agriculture and human conditions in Iraq in the 21st Century" as "very dark and gloomy".²

Iraq is in a weak position vis-à-vis both Turkiye and Iran. It is downstream of both countries on the Tigris and Euphrates and is a good deal weaker militarily than they are. Iranian influence over many of Iraq's political parties and militias mean that Baghdad is incapable of standing up to Tehran over the latter's use of shared water resources. Moreover, Iraq has little to offer either country to persuade them to adopt a more understanding attitude regarding the water resources they share or to enter into negotiations on permanent agreements.

Of these two powerful upstream riparians, Turkiye has at least shown some willingness to respond to requests from Baghdad for more water at times of shortage in Iraq. Iraqi ministers have had exchanges with Iranian counterparts about water but these exchanges do not seem to have made any difference to flows from Iran into Iraq.

There are bilateral agreements between Turkiye and Iraq (and Syria and Iraq) but there is no agreed legal regime covering the whole basin. No negotiations aimed at establishing such a regime are in prospect. There is no shortage of mechanisms, official and unofficial, that the four riparian countries could use to improve cooperation among them, had they the political will to do so. Unofficial ("Track 2") initiatives involving experts and former officials have not succeeded in gaining traction with the governments of the states concerned.

Nonetheless, there are many things that Iraq could do to live within its water means. In this endeavour, there are two major obstacles to be overcome: endemic corruption (which

¹ Figures derived from: Republic of Iraq – Ministry of Water Resources, Strategy for Water and Land Resources in Iraq (SWLRI), Executive Summary (2014). The document is marked 'Confidential' but it (the Executive Summary) was released into the public domain in 2022. The baseline for the comparison with 2035 is 2015, when the report was finalised.

² Nasrat Adamo et al., Global Climate Change Impacts on Tigris-Euphrates Rivers Basins Journal of Earth Sciences and Geotechnical Engineering, Vol.10, No.1, 2020, 77-125, 1792-9660 (online), p. 116
http://www.scienpress.com/Upload/GEO/Vol%2010_1_4.pdf

complicates international involvement in major infrastructure projects) and a lack of capacity among officials in the water sector, which makes reform of that sector very difficult.

Despite Iraq's challenging political circumstances (both internally and externally), there are possible FCDO interventions that could have a reasonable chance of success. These are more likely to be at the modest rather than the aspirational end of the scale. Such interventions could be:

1. Small-scale, dispersed assistance to farmers in the modernisation of their irrigation methods.
2. Assistance to farmers to help them switch from rice to other crops (e.g., vegetables) in vulnerable southern governorates.
3. Assistance to farmers to help them grow drought- and heat-resistant crops.
4. Capacity-building for officials (including engineers) both in the MOWR and at provincial level.
5. Technical support for an independent review by Iraqi officials of water management in Basrah Governorate.
6. The provision of equipment for monitoring water (surface flows and groundwater), in terms of both quantity and quality.
7. The remote monitoring of groundwater reserves.
8. Support for local NGOs active in water and environmental matters.
9. Help with public education campaigns designed to increase awareness of the need to conserve water and protect its quality.
10. A UK-Iraqi dialogue aimed at identifying ways in which Iraq could best engage with its neighbours over shared water resources.
11. Training for Iraqi water negotiators, should there seem to be a real prospect of negotiations with one or more of Iraq's riparians.

ABBREVIATIONS AND ACRONYMS

ABBREVIATIONS

Bcm: billion cubic metres

Bcm/a: billion cubic metres per annum

Bpd: barrels per day

Cm: cubic metres

Cusec: cubic metres per second

FC: flood control

Has: hectares

HP: hydro-power

Mcm/a: million cubic metres per annum

ACRONYMS

CoR: Council of Representative, Iraq's parliament

DSI: General Directorate of State Hydraulic Works (Turkiye)

GAP: Southeastern Anatolia Project

ICJ: International Court of Justice

JTC: Joint Technical Committee

KRG: Kurdistan Regional Government

KRI: Kurdistan Region of Iraq

MoU: memorandum of understanding

MOWR: Ministry of Water Resources (Iraq)

Ppm: parts per million

SWLRI: Strategy for Water and Land Resources of Iraq

TDS: total dissolved solids

TERS: Tigris-Euphrates River System

UNECE: UN Economic Commission for Europe

PART I: INTRODUCTION: THE PURPOSE OF THIS REPORT AND SOURCES USED

This report, which was commissioned and funded by the UK FCDO, sets out to examine the main factors which determine Iraq's present level of water security.³ It also indicates how these factors might develop in future, taking 2050 as its time-horizon. Its primary focus is the impact of Iran's regulation of the watercourses which it shares with Iraq, as this has been an understudied element of Iraq's water security to date. At the same time, to provide context and perspective, it also examines Turkish and Syrian use of shared watercourses.

Future Syrian use of these watercourses is extremely difficult to predict, for two main reasons. One is the lack of clarity about when the regime might regain control of its key water installations. The other is the likelihood that any reconstruction that would increase water use is many years in the future.

The factors determining Iraq's water security include both hydrological and political realities. On the former, this report will use the best-available published figures for water quantities and quality, which will serve to set out the hydrological context within which political relationships play out. Other concurrent projects funded by HMG will look in greater detail at the hydrological aspects, in order to provide the greater accuracy which may be needed for detailed ODA programming. This report therefore devotes a good deal of attention to political questions.

The report makes recommendations for actions that might be undertaken by HMG and other donors or development agencies. In so doing, it seeks to avoid proposing actions that do not seem viable, given the Iraq's particular circumstances and the challenges of operating there.

As regards sources, the report draws on a wide range of published material, including official statements, academic articles and think-tank and media reports. The author has also drawn on presentations and interventions made at workshops and conferences and has interviewed several well-informed interlocutors. All but three of these interlocutors preferred to remain anonymous – an indication of the sensitivity of water questions in the Middle East.

The author is grateful to officials in the FCDO and MOD who commented on an earlier draft. Any remaining errors and other shortcomings are solely the author's responsibility.

PART II: ANALYSIS

THE RESOURCE: HOW MUCH WATER DID IRAQ HAVE IN THE "PRE-DAM" ERA?

Given the low levels of precipitation in most parts of Iraq (the Kurdish mountains being the main exception), surface flows from Turkey, Iran and (to a lesser extent) Syria are the main source of

³ Water security is defined by the UN as: "The capacity of a population to safeguard sustainable access to adequate quantities of and acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability." "Water Security & the Global Water Agenda: A UN-Water Analytical Brief", Revised Version, October 2013

https://www.unwater.org/sites/default/files/app/uploads/2017/05/analytical_brief_oct2013_web.pdf

Iraq's economically-exploitable water. These surface flows are the Tigris and Euphrates rivers and their tributaries. A third major river, the Karkheh, flows into the Hawaizah/Hoor-Al-Azim marshes which extend across the border from Iran into southern Iraq. At times of high flow, the Karkheh flows into the marshes and out into the Tigris; at other times, it flows into the Shatt al-Arab (in Farsi, the Arvand Rud), thus serving to maintain the water quality of the Shatt by providing inflows of freshwater.⁴

A fourth major river, the Karun, flows entirely within Iranian territory until it reaches its confluence with the Shatt. Like the Karkheh, it serves to maintain the water quality of the Shatt by providing inflows of freshwater: the volume of flow from the Karun and its quality affect the level of salinity and other water-quality indicators in that watercourse. (For convenience and brevity, the Karkheh and Karun are considered in this report to be part of the "Tigris-Euphrates River System" or TERS.)

Almost all the water in the Euphrates (Arabic: Furat; Turkish: Firat) as it crosses the border into Iraq comes from Turkiye. Turkiye contributes 89% of the flow of the river and Syria 11%.⁵ These figures probably understate Turkiye's contribution, since much of the water in the three main tributaries (Sajur, Balikh and Khabour) which join the Euphrates in Syria comes from surface flow in Turkiye or from underground flow that feeds the rivers in Syria. Iraq's contribution to the flow of the Euphrates is negligible.

As for the Tigris (Arabic: Dijlah; Turkish: Diçle), 65% of the flow of the river (at its confluence with the Euphrates at Qurna) from Turkiye, 13% from Iraq and 22% from Iran.⁶ The percentage of the flow deriving from Iran appears to include the Karkheh, although the source does not make this clear.

⁴ UN ESCWA/BGR, "Inventory of Shared Water Resources in Western Asia", 2013, Chapter 3: Tigris River Basin, Figure 10, Box 2, p. 119; and p. 121 and endnote 1

https://waterinventory.org/sites/waterinventory.org/files/chapters/Chapter-03-Tigris_River-Basin-web_0.pdf This report, published in 2013, represents the most comprehensive attempt to date to delineate the water resources in the region but some of the published sources used are not wholly dependable.

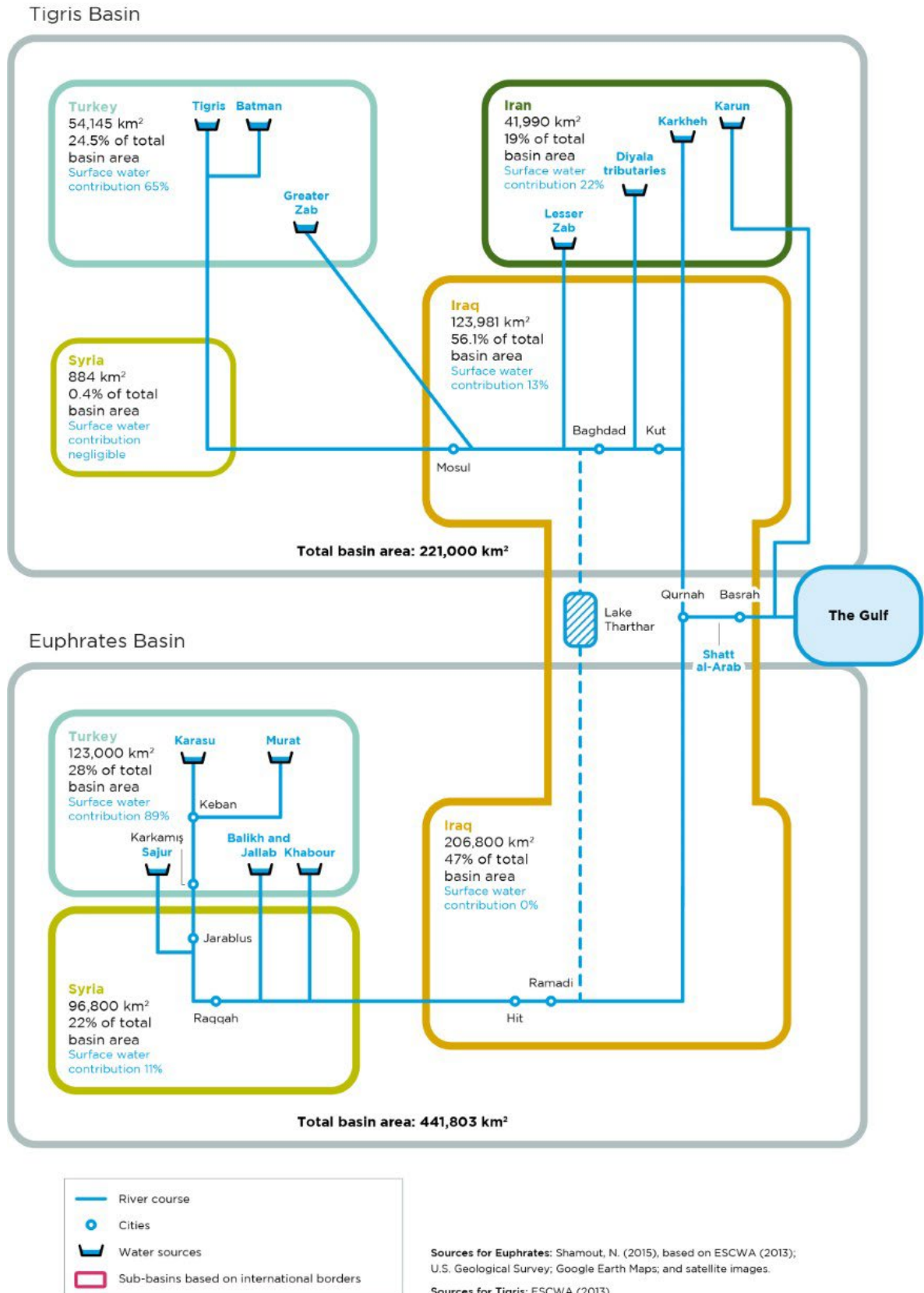
⁵ "Turkey supplies 89 per cent of the Euphrates' total flow, making it the main contributor to the river. Syria is the second biggest contributor, accounting for 11 per cent of the river's total flow. (Turkey disputes this figure, claiming that the Syrian contribution comes from resources partially within Turkish borders.) Iraq does not make any considerable contribution to the river flow." M. Nouar Shamout with Glada Lahn, *The Euphrates in Crisis: Channels of Cooperation for a Threatened River*, Chatham House Research Paper (2015), p. 11

https://www.chathamhouse.org/sites/default/files/field/field_document/20150413Euphrates_0.pdf, p. 11

⁶ UN ESCWA/BGR, "Inventory of Shared Water Resources in Western Asia", 2013, Chapter 3, Tigris River Basin, p. 110. The source for the alternative set of figures (Graph a) in Figure 5) seems less reliable but the figures probably exclude the Karkheh.

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Figure 1: The Tigris-Euphrates River System: Main Features



The largest tributary of the Tigris which joins the river in Iraq is the Greater Zab, which rises in Turkiye. According to Al-Khassab (1958), 42% of the flow of the Greater Zab comes from Turkiye.⁷ The main tributaries of the Tigris which have their headwaters in Iran are the Lesser (or Little or Lower) Zab and the Diyala. On the basis of basin areas, around a quarter of the flow of the Lesser Zab would have come from Iran. In “pre-dam” conditions, about 77% of the water which flowed into the reservoir impounded by the Derbandikhan (Darbandikhan) Dam in the Kurdistan Region of Iraq (KRI) came from the Sirwan (Sirvan) and Zamkan (Zmkan), tributaries of the Diyala that rise in Iran; the remaining 23% came from tributaries that rise wholly within Iraq.⁸

The main difference between the Euphrates and Tigris in terms of Iraq’s water security is that the flow of the Euphrates comes almost entirely from outside the country whereas 13% of the flow of the Tigris rises within the country. In terms of average annual volumes, however, the two rivers in their natural state provided roughly the same amount of water to Iraq. The flow of the Euphrates at Hit in Iraq averaged 30.6 bcm/a over the period 1938-1973;⁹ that of the Tigris at Kut in Iraq averaged 32 bcm/a over the period 1931-1973.¹⁰

The natural flows of both the Tigris and Euphrates are highly seasonal, with the peaks coming in spring and early summer, following the melting of snow in the mountains where they and their tributaries rise. There has also been a great deal of variation in the flow of the rivers from year to year. During the 1938-73 period, the flow in the Euphrates in the lowest year was just half the average; in the highest year, it was almost twice.¹¹ During the 1931-73 period, the flow in the Tigris in the lowest year was less than half the average; in the highest year, it was slightly less than twice.¹²

In addition to surface flows, Iraq also has ground-water resources. These are a relatively small part of the country’s water budget. According to a report prepared by Italian consultants for the MOWR, groundwater could only sustainably provide 5.243 bcm/a or about 6.5% of Iraq’s 2015 water consumption.¹³

⁷ Al-Khassab, W. H., The water budget of the Tigris and Euphrates Basin, University of Chicago, Dept of Geography, Research Paper no. 54 (1958), cited by Nadhir Al-Ansari (ed.), Jnl of Water Resources, Special Publication No. 2, 1987, Hemrin Reservoir, a Geological and Hydrological Investigation
<https://www.researchgate.net/publication/282334278>

⁸ Dana Muhammad Faraj et al., The impact of the Tropical Water Project on the operation of Darbandikhan dam, Journal of King Saud University - Engineering Sciences, 2022, ISSN 1018-3639,
<https://doi.org/10.1016/j.jksues.2022.06.003>
<https://www.sciencedirect.com/science/article/pii/S1018363922000629>

⁹ UN ESCWA/BGR, “Inventory of Shared Water Resources in Western Asia”, 2013, Chapter 2, Table 2, p. 58

¹⁰ UN ESCWA/BGR, “Inventory of Shared Water Resources in Western Asia”, 2013, Chapter 3, Table 3, p. 110

¹¹ UN ESCWA/BGR, “Inventory of Shared Water Resources in Western Asia”, 2013, Chapter 1, Table 2, p. 58

¹² UN ESCWA/BGR, “Inventory of Shared Water Resources in Western Asia”, 2013, Chapter 3, Table 3, p. 110

¹³ Republic of Iraq – Ministry of Water Resources, Strategy for Water and Land Resources in Iraq (SWLRI), Executive Summary (2014). The document is marked ‘Confidential’ but was released into the public domain in 2022.

Figure derived from figures in Table 1.

THE USE OF WATER BY STATES UPSTREAM OF IRAQ, TO DATE

None of the dams and other regulation works on the Tigris and Euphrates was built with the agreement of other riparians. (See Annex 1, p. 51, for a list of the main dams in the TERS.) All were decided and implemented unilaterally although in a few cases they led to bilateral agreements within the basin.

Beginning in the first half of the 20th century, Iraq built various dams and other works to regulate the Euphrates and Tigris. (Iraq's first regulatory work, the Hindiya Barrage, was built in 1913, when the country was still part of the Ottoman Empire.) The Mosul Dam on the Tigris, the main purpose of which was the generation of HP for the city of the same name, was completed in 1985; it is the largest dam in Iraq.¹⁴ As Iraq was the riparian furthest downstream, these works had no impact on the availability of water to the other riparians. Before Syria and Turkiye began to build large dams on the Euphrates and Tigris, the greatest water management challenge in Iraq was flood control rather than drought. As part of its effort to control flooding, Iraq dug a canal to divert excess water from the Tigris into a depression in the desert, which became Lake Tharthar. Later canal-digging connected the lake to the Euphrates and with the Tigris further downstream. High rates of evaporation from the lake rendered the water in both rivers much more saline than it would normally have been.¹⁵

After nearly half a century of upstream dam-building, the "natural" flows of the rivers which previously entered Iraq are in a way irrelevant. However, some sense of the flows of these rivers into Iraq will give an idea of how the availability of water to Iraq has declined since the mid-1970s. Moreover, knowing what these natural flows would have been for any given quantity of precipitation across the TERS catchment area would also be important in the event of any negotiations seeking to achieve agreement on the apportionment of volumes of flow.

In the mid-1970s, both Turkiye and Syria embarked on major dam-building programmes on the Euphrates. Syria's largest project on the Euphrates was the Tabqa (or Thawra) Dam, completed in 1973 and designed to generate HP and retain water for irrigation in the Euphrates valley. Following the completion of the Tabqa Dam, Syria constructed two further, much smaller dams on the Euphrates: the Baath Dam downstream of Tabqa (1987, to regulate flow from Tabqa) and the Tishreen Dam upstream of Tabqa (1999, to generate HP). Syria has also built three dams on the Khabour, for both irrigation and HP.¹⁶

Syrian abstraction of water from the Tigris is limited by the fact that the river is nowhere wholly within Syria. Rather, for a short distance (39 kms), it forms the border between Syria and Turkiye and, for an even shorter distance (5 kms) the border between Syria and Iraq.¹⁷ Syria cannot,

¹⁴ UN ESCWA/BGR, "Inventory of Shared Water Resources in Western Asia", 2013, Chapter 1, Table 3, p. 63, and Chapter 3, Table 4, p. 113

¹⁵ Omar Khaleefa, Assistant prof. Dr. Ammar Hatem Kamel, SSRG International Journal of Civil Engineering Volume 8 Issue 6, 1-7, June 2021, ISSN: 2348 – 8352 /doi:10.14445/23488352/IJCE-V8I6P101 <https://www.internationaljournalsrsg.org/IJCE/2021/Volume8-Issue6/IJCE-V8I6P101.pdf>

¹⁶ UN ESCWA/BGR, "Inventory of Shared Water Resources in Western Asia", 2013, Chapter 1, p. 64

¹⁷ "According to the Syrian Ministry of Irrigation, the Tigris defines the Syrian-Turkish border for 39 km and the Iraqi-Syrian border for 5 km." UN ESCWA/BGR, p. 65, quoting Daoudy, M., Turkey and the Region: Testing the Links Between Power Asymmetry and Hydro-Hegemony, CERl (Centre d'Etudes et de Recherches Internationales), 2005.

therefore, unilaterally build works on the river but can, under agreements with Iraq (2002) and Turkiye (2009), pump water from it, for irrigation.

Turkiye had much more ambitious plans for the exploitation of both the Euphrates and the Tigris. These were incorporated into the framework of the Southeastern Anatolia Project (Turkish acronym: GAP), initiated in 1977. The GAP is "... a comprehensive scheme of modernization that aimed at transforming the socio-economic, sociopolitical, and sociocultural structure of the GAP region—encompassing around 10% of Turkey's total surface area and population."¹⁸ The GAP included 22 dams and 19 HP stations and foresaw the irrigation of 1.8 million hectares of land.

Turkish activity focused first on the Euphrates, with the largest project being the Ataturk Dam, completed in 1990. Unlike the first two big dams on the river (the Keban and Karakaya Dams), the Ataturk Dam was designed to store water for irrigation as well as to generate HP. As the filling of the reservoir behind the Ataturk Dam and subsequent abstractions for irrigation threatened to reduce the flow of the river considerably, the project caused alarm in Damascus and Baghdad. In 1987, Turkiye and Syria signed an agreement under the terms of which Turkiye undertook to "release a yearly average of more than 500 cusecs at the Turkish-Syrian border". This was slightly more than half the average natural flow of the Euphrates. The agreement was intended to be temporary and to apply "During the filling up period of the Atatürk Dam reservoir and until the final allocation of the waters of Euphrates among the three riparian countries".¹⁹

Turkiye's works on the Euphrates have had a noticeable impact on the volume of water reaching Iraq. As far as the observed flow of the Euphrates in Iraq in the post-dam period is concerned, Kareem and Alkatib note that the two branches of the river in Najaf Governorate had a combined average flow of 7.588 bcm/a during the period 2010-20.²⁰ This represents around a quarter of the already-noted pre-dam average of 30.6 bcm/a, as measured further upstream at Hit. (Factors other than Turkish abstractions may have been partly responsible for the decline in the flow of the river.)

Having completed most of the works on the Euphrates, Turkiye turned to the Tigris. The largest project on the Tigris was the Ilisu, inaugurated in 2021 and designed mainly to generate HP. The filling of the reservoir was done with a certain amount of coordination with Iraq although there was no formal agreement on the flow to be maintained during the process.²¹

¹⁸ Arda Bilgen (2020), Turkey's Southeastern Anatolia Project (GAP): a qualitative review of the literature, *British Journal of Middle Eastern Studies*, 47:4, 652-671, DOI: 10.1080/13530194.2018.1549978

¹⁹ Protocol of Economic Cooperation, Article 6. See Aysegul Kibaroglu (2015) Transboundary Water Governance in the Euphrates Tigris River Basin <https://www.e-ir.info/2015/07/22/transboundary-water-governance-in-the-euphrates-tigris-river-basin/>

²⁰ Kareem, Hayder H. and Alkatib, Aseel A. "Future short-term estimation of flowrate of the Euphrates river catchment located in Al-Najaf Governorate, Iraq through using weather data and statistical downscaling model" *Open Engineering*, vol. 12, no. 1, 2022, pp. 129-141. <https://doi.org/10.1515/eng-2022-0027>

²¹ Fehim Tastekin, Is a water crisis brewing between Turkey and Iran? *Al-Monitor*, 13 May 2022 <https://www.al-monitor.com/originals/2022/05/water-crisis-brewing-between-turkey-and-iran>

The average flow of the Tigris, as measured at Baghdad during the period 1990-2019, was 615 cusecs – around 36% lower than during the period 1960-1989 (960 cusecs).²² Another source gives the average flow at Baghdad for the period 2005-21 as 535.9 cusecs, suggesting a further decline.²³ The same source gives the flow at Kut in southern Iraq for the same period as 231.8 cusecs, which represents a striking decline over the flows in the pre-dam period (1931-1973), which averaged around 1,032 cusecs.²⁴ One must, of course, bear in mind that this decline in flow at Baghdad may not be due entirely to increased abstractions upstream: lower precipitation over the catchment over the later periods may be partly responsible.²⁵

Iran's planning for and implementation of projects on the tributaries of the Tigris are much less transparent than Turkey's. The same is true of Iran's projects on the Karun. According to a Carnegie report, "The regime (...) deliberately cuts access to data and reduces transparency, so that no one knows how water is used."²⁶

However, it is clear that Iran has constructed numerous dams and diversion works on the Tigris tributaries and on the Karun, especially in the last two decades. A well-known Iranian water expert told the author that Iran had modelled itself on Turkey in terms of water management (indeed, Iran was "jealous" of Turkey's success in this field) and believed that building dams was a good thing to do.²⁷

An academic study published in 2014 concluded that the upper part of the Diyala catchment in Iran "is considerably dammed and highly committed to meet multi-user water demands, particularly large-scale irrigation projects and inter-basin water transfer systems to nearby basins."²⁸ These Iranian projects appear to be having a marked effect already (although some of this effect may be due to natural year-to-year variation or climate change, or both): during the period 2004-2017, the average annual inflow to the Derbendikhan reservoir had fallen to 2.46 bcm, from 5.1 bcm during the period 1961-2004.²⁹

²² Haitham A. Hussein et al., Hydrological characteristics of the Tigris River at the Baghdad Sarai station, Ain Shams Engineering Journal, Volume 14, Issue 2, 2023, 101846, ISSN 2090-4479, <https://doi.org/10.1016/j.asej.2022.101846> .

(<https://www.sciencedirect.com/science/article/pii/S2090447922001575>)

²³ Hala Mohammed Al-Sekar and Moutaz Al-Dabbas, The Influence of the Tigris River Discharge on the Hydrochemistry with Time, from Baghdad to Amara, Southern Iraq, Iraqi Geological Journal, 31 October 2022. The flow at Kut in southern Iraq was 231.8 cusecs.

²⁴ UN ESCWA/BGR, Chapter 1, Table 2, p. 58

<https://waterinventory.org/sites/waterinventory.org/files/chapters/Chapter-01-Euphrates-River-Basin-web.pdf>

The table gives the figure of 32 bcm/a, which equates to approximately 1,037 cusecs.

²⁵ Al-Sekar and Al-Dabbas, The Influence of the Tigris River Discharge on the Hydrochemistry with Time (2022)

²⁶ Cornelius Adebahr and Olivia Lazard, How the EU Can Help Iran Tackle Water Scarcity, Carnegie Europe, 7 July 2022 <https://carnegieeurope.eu/2022/07/07/how-eu-can-help-iran-tackle-water-scarcity-pub-87281>

²⁷ Telephone interview with author, 13 January 2023.

²⁸ Furat A.M. Al-Faraj, Miklas Scholz, Assessment of temporal hydrologic anomalies coupled with drought impact for a transboundary river flow regime: The Diyala watershed case study, Journal of Hydrology, Volume 517, 2014, Pages 64-73, ISSN 0022-1694, <https://doi.org/10.1016/j.jhydrol.2014.05.021> .

(<https://www.sciencedirect.com/science/article/pii/S0022169414003850>)

²⁹ Faraj et al., The impact of the Tropical Water Project (2022)

The net effect of dams and diversion works on the tributaries of the Diyala in Iran is that only 22% of the long-term average natural flow of the river is likely to reach Iraq in an average year. In dry years, it will be less.³⁰ In 2021, officials at the Derbendikhan Dam complained that a combination of Iranian damming of the Sirwan and Zamkan rivers and low rainfall had meant that the dam could only produce around a third of the electricity normally generated.³¹ The same year, Mahdi Rashid al-Hamdani, Iraq's then water minister, accused Iran of "completely" blocking the flow of water into Iraq, causing a "catastrophe" in Diyala province.³²

In these circumstances, "groundwater extraction will likely be adopted as a main source for water [in the Diyala basin in Iraq]."³³ However, there is even less information in the public domain about Iran's use of the groundwater reserves which it shares with Iraq than there is regarding surface water. The same applies to the rates at which those reserves are recharged. While Iran may be collecting data but not sharing it, monitoring of these transboundary reserves within Iraq itself is inadequate, because of the deterioration of the relevant infrastructure.³⁴

Iran completed a dam on the Lesser Zab at Sardasht in 2017, reducing the flow into the reservoir impounded by the Dukan Dam in Iraqi Kurdistan. "More than half" of the water which flows into the Dukan reservoir reaches it via the Lesser Zab, with the rest coming from watercourses that rise wholly within Iraq.³⁵ The Sardasht Dam has had a serious impact on water supply to towns in neighbouring areas of the KRI, as well as on irrigated agriculture and fisheries in these areas.³⁶

A 2019 report by Human Rights Watch (HRW), based on satellite imagery, identified 14 dams on the Sirwan in Iran, six on the Karkheh and 12 on the Karun.³⁷ Of the dams on the Karun, the most notable are the Upper and Lower Gotvand Dams. The former's main function is the generation of HP, while the latter diverts water for the irrigation of 42,000 has of farmland.³⁸

The HRW report used satellite imagery not only to identify dams in Iran but also to attempt some assessment of how much land was being irrigated with water from the Tigris tributaries, the Karkheh and the Karun. Given the paucity of data on Iran's use of these rivers, it is worth quoting the HRW report at some length. The principal uses of water uncovered by the report were sugar

³⁰ Al-Faraj and Scholz, Assessment of temporal hydrologic anomalies (2014).

³¹ Alannah Travers, Water levels plummet in dams across the Kurdistan Region, Rudaw (Kurdish news agency), 15 December 2021 <https://www.rudaw.net/english/kurdistan/151220211>

³² Muhammad Jawad Adib, Iran, Iraq exchange accusations over water flow, Al-Monitor, 25 January 2022, <https://www.al-monitor.com/originals/2022/01/iran-iraq-exchange-accusations-over-water-flow#ixzz7qAd8fgky>

³³ Jafar Y. Al-Jawad et al., Decision-Making Challenges of Sustainable Groundwater Strategy under Multi-Event Pressure in Arid Environments: The Diyala River Basin in Iraq, *Water* 2019, 11(10), 2160; <https://doi.org/10.3390/w11102160> <https://www.mdpi.com/2073-4441/11/10/2160#B26-water-11-02160>

³⁴ Jafar Y. Al-Jawad et al., Decision-Making Challenges of Sustainable Groundwater Strategy (2019)

³⁵ Salam Abdulqadir Abdulrahman (2018) The drying up of the Lower Zab River and future water disputes between Iran, Kurdistan Region and Iraq, *International Journal of Environmental Studies*, 75:1, 29-44, DOI: 10.1080/00207233.2017.1406725

³⁶ Qaladze working to save water supply after Iran cut river's flow, Rudaw (Kurdish news agency), 3 June 2023, <https://www.rudaw.net/english/kurdistan/030620181>

³⁷ Human Rights Watch, "Basra is Thirsty: Iraq's Failure to Manage the Water Crisis", July 2019 <https://www.hrw.org/report/2019/07/22/basra-thirsty/iraqs-failure-manage-water-crisis>

³⁸ Wikipedia, Upper Gotvand Dam https://en.wikipedia.org/wiki/Upper_Gotvand_Dam, visited 14 January 2023.

plantations and fish farming: “... historic satellite imagery analyzed reveals a substantial expansion in the area of land allocated for water-intensive sugar plantations and fish farming over a 25-year period.” (Author’s comment: sugar-cane is a very “thirsty” crop; fish farming uses less water, apart from evaporation from the fish ponds, but is highly polluting.) “Imagery shows that the water consumption by the Iranian sugar industry in this area has had a substantial impact on falling water flow into the Shatt al-Arab. Starting in the mid-1990s, sugar plantations started to expand in the Shush region [ancient Susa], where the Karkh (sic) and Karun approach each other, and this rapidly accelerated through the early 2000s, with new plantations developed further south along the rivers.” HRW was not able to quantify how much water these various projects were consuming but concluded that “the overall impact on water flow reduction into the Shatt al-Arab has been substantial.”³⁹

As regards the Karun, the Iranian water expert previously cited noted that Iranian over-abstraction often leads to the river running dry within Iran, before it reaches the Shatt. This hurts downstream Iranian consumers as well as Iraqis. However, Iranian actions that disadvantage Iraq (whether in respect of the Karun or elsewhere) are not deliberately intended to do so: rather, they are the result of mis-management and of an attitude that puts Iran’s needs first.⁴⁰

A press report from 2020 details the severe impact of Iranian dams and diversion works on the Lesser Zab and Sirwan.⁴¹ Iran is diverting water out of the basins of both these rivers: to rehabilitate Lake Urmia in the case of the Lesser Zab⁴² and to irrigate farmland elsewhere in south-western Iran in the case of the Sirwan, with up to 1.387 bcm being diverted annually via the Nowsud tunnel.⁴³

As well as reducing the flow of water into Iraq, Iran’s use of the water of the Tigris tributaries “... has adversely affected the restoration process of the Al-Hawizeh [Hawaizah/Hoor-Al-Azim] Marshes, one of the three major Iraqi Marshes (Richardson 2016).”⁴⁴ So has Iran’s construction of barriers/dykes in the Hawaizah marshes along the border with Iraq. According to Masoumeh Ebtekar, the former head of Iran’s Department of the Environment, the purpose of the project, which was ordered by the Supreme National Security Council in 2010, was to drain the wetlands to facilitate oil exploration.⁴⁵ The Iranian water expert interviewed by the author agreed that this was one of the goals but added that the primary purpose was to improve border security. Another purpose was to reduce the flow of water across the border from Iran into Iraq, the gradient being in favour of Iraq.⁴⁶ It may well be that all these factors were instrumental in the

³⁹ Human Rights Watch, “Basra is Thirsty: Iraq’s Failure to Manage the Water Crisis”, July 2019, <https://www.hrw.org/report/2019/07/22/basra-thirsty/iraqs-failure-manage-water-crisis>

⁴⁰ Telephone interview with author, 13 January 2023

⁴¹ Kakalaw Abdulla and Dler Abdulla, Iraqi Kurdistan faces water 'catastrophe' as Iran cuts off rivers, Middle East Eye, 3 September 2020, <https://www.middleeasteye.net/news/iraq-kurdistan-water-catastrophe-iran-rivers>

⁴² Islamic Republic News Agency (IRNA) website, Tehran, in Persian (translated by BBC Monitoring), 24 February 2023

⁴³ Wikipedia, Daryan Dam, https://en.wikipedia.org/wiki/Daryan_Dam, last visited 22 March 2023.

⁴⁴ Khayyun A. Rahi and Todd Halihan, Salinity evolution of the Tigris River. Reg Environ Change 18, 2117–2127 (2018), <https://doi-org.gate3.library.lse.ac.uk/10.1007/s10113-018-1344-4>

⁴⁵ Maryam Sinaiee, Iran’s Ex-Environment Chief Says Khuzestan Wetlands Dried For Oil, Iran International, 1 August 2021 <https://old.iranintl.com/en/iran/irans-ex-environment-chief-says-khuzestan-wetlands-dried-oil> .

⁴⁶ Telephone interview with author, 13 January 2023.

Iranian decision to build the barriers although the publicly-available information does not permit any ranking of their respective importance.

Iran's exploitation of these water resources appears to be driven primarily by the push for self-sufficiency in food – itself a manifestation of a desire for economic sovereignty that long pre-dates but which was adopted by the Islamic Revolution of 1979.⁴⁷ The imposition of Western sanctions has reinforced this belief in the value of self-sufficiency. As a consequence, 92% of the water used in Iran is consumed by irrigation.⁴⁸ This heavy agricultural consumption has been encouraged by large subsidies on water and on the energy used in pumping ground-water to the surface.⁴⁹ Moreover, more water is used per unit of crop produced than would be the case if more efficient irrigation techniques were used.⁵⁰

Another driver of Iran's development of water resources for use in agriculture has been a perceived need on the part of Iran's decision-makers for “populist development actions which produce immediate economic impacts. For example, the representative of a region in the parliament can pressure the water authorities to finance a dam construction project to help the farmers in his region. If the project is successful, it can boost the regional economy alongside the legitimization of the representative. Locals would then be willing to support the same person and send him to the parliament in the next round.”⁵¹ However, the fact that the turnover of members of the Majles is around a third suggests that these tactics are not very effective.

The Iranian water expert interviewed by the author said that such factors often led to the mis-management of Iranian dams. For instance, a provincial governor, in a desire to please the public in the short-term, could put pressure on dam managers to release water rather than retain it for the following year. The most striking example of such politically-driven mis-management was the shortages of water in Khuzestan in 2021, which followed two extremely wet years. (The lack of water also resulted from a sustained lack of investment in infrastructure.) These shortages exacerbated protests over other matters related to living conditions.⁵²

⁴⁷ Art. 43 of Chapter IV: Economy and Financial Affairs, of the Iranian Constitution, lists (as #8) the “Prevention of foreign economic domination over the country's economy” as one of the bases of the country's economy. Iran Chamber Society website: Iranian Laws and Society: The Constitution of Islamic Republic of Iran, last visited 28 February 2023 https://www.iranchamber.com/government/laws/constitution_ch04.php

⁴⁸ Tamer Badawi, The Impacts of Climate Change and Sanctions on Iran's Water-Food-Security Nexus, in Luigi Narbone (ed.), 2020, “Revisiting Natural Resources in the Middle East and North Africa”, European University Institute, Florence <https://middleeastdirections.eu/new-ebook-revisiting-natural-resources-in-the-middle-east-and-north-africa-edited-by-luigi-narbone/>, doi:10.2870/082270, ISBN:978-92-9084-953-7

⁴⁹ Mirzaei, A. et al., The Groundwater–Energy–Food Nexus in Iran's Agricultural Sector: Implications for Water Security. *Water* 2019, 11, 1835. <https://doi.org/10.3390/w11091835>

⁵⁰ Badawi, The Impacts of Climate Change and Sanctions, 2020

⁵¹ Kaveh Madani, Water management in Iran: what is causing the looming crisis? *J Environ Stud Sci* 4, 315–328 (2014). <https://doi.org/10.1007/s13412-014-0182-z> An FCDO official familiar with the region made similar points in a conversation with the author in November 2022.

⁵² Telephone interview with author, 13 January 2023

A third driver has been the opportunities for profit presented by dam-building. In the past three decades, most dams have been built by IRGC-affiliated companies with the support and approval of the governments of the time.⁵³

A fourth driver was an administrative change introduced by Ahmadinejad (president from 2005 to 2013), who changed the management of water boundaries from the central government to the provinces. Instead of watersheds being managed as units, they were often divided among provincial authorities. This introduced an element of competition among them, with each provincial authority now having an incentive to build dams before other authorities with which it shared rivers.⁵⁴ “These reforms have simply increased the number of stakeholders and promoted the ‘tragedy of the commons’ (Hardin, 1968) in different watersheds.”⁵⁵ Iran suffers from “disintegrated” water management.⁵⁶

These points apply to water management (or mismanagement) across Iran. They apply particularly strongly to the watersheds of the Tigris tributaries and the Karun, though, as these are the areas of the country with the greatest concentrations of water resources and fertile land. “The bulk of Iran’s agriculturally productive provinces lie in its western part, bordering Iraq [especially Khuzestan and W Azerbaijan]. Other Iranian provinces adjacent to Iraq that are important in terms of agricultural production are Kermanshah and Kurdistan.”⁵⁷ According to the same report, “the five Iranian provinces bordering Iraq, which are Khuzestan, western Azerbaijan, Kermanshah, Kurdistan, and Ilam, altogether constitute approximately 29.2 percent of Iran’s total crop production.”⁵⁸

Now that both the Tigris and Euphrates and their tributaries are highly regulated, their natural seasonal flow regimes are of much less significance: what matters more is the way in which countries upstream of Iraq operate their large dams and the purposes to which the water stored behind these dams is put. Water used to generate HP is not lost to downstream users (although the pattern of its flow is likely to be changed) because electricity cannot be generated unless water is allowed to flow through the turbines installed at the dams in question. Much of the water diverted to irrigate crops may be largely lost to downstream users through evapotranspiration from those crops; some of this water may return as drainage to the rivers from which it has been diverted (or to the water table) but it may be polluted with agricultural chemicals.

However, how much precipitation falls in the TERS in any given year is a key determinant of flows into Iraq. This is because the volume of water in the rivers which form the watershed will

⁵³ Cornelius Adebahr and Olivia Lazard, A Wilting World: Why water scarcity in Iran is a source of domestic and regional instability, Diwan, Carnegie Middle East Center, 6 September 2022 https://carnegie-mec.org/diwan/87818?utm_source=rssemail&utm_medium=email&mkt_tok=ODEzLVhZVS00MjIAAAGSxlxPSdjSml0YmC7qGLnfdOpTypXHjclGqxlczt52DPOBH1KiN3KLbdQyC5hBjs5R1KHA-PlkMk-xeahJryw4N_tw4wB8Oi3U4T8bHc

⁵⁴ Badawi, The Impacts of Climate Change and Sanctions, 2020

⁵⁵ Kaveh Madani, Water management in Iran: what is causing the looming crisis? J Environ Stud Sci 4, 315–328 (2014). <https://doi.org/10.1007/s13412-014-0182-z>

⁵⁶ Author’s telephone interview with a well-known Iranian water expert, 13 January 2023

⁵⁷ Badawi, The Impacts of Climate Change and Sanctions, 2020

⁵⁸ Badawi, The Impacts of Climate Change and Sanctions, 2020. The calculation is based on figures published by Iran’s Ministry of Agriculture Jihad.

be a major factor in the way in which Turkiye, Syria and Iran operate their dams and how much of the flow is abstracted for irrigation or retained for release to generate HP at a later date.

The impact of upstream use on water quality

The quality of the water reaching Iraq from its upstream neighbours is almost as important as its quantity. This is because water polluted beyond a certain point cannot be safely used – although that point varies according to the use to which the water is to be put. For example, some crops can tolerate higher degrees of salinity in irrigation water than others. Above 1,000 ppm (parts per million) of TDS (Total Dissolved Solids), water is not recommended for human consumption.⁵⁹ Above 2,000 ppm, there should be “severe restrictions” on the use of water for irrigation.⁶⁰

It should be noted that pollution of surface waters takes place in Iraq too, so users in the south of the country are receiving water that has been polluted by other Iraqi users as well as by users in countries upstream.

The quality of the water flowing down the Euphrates in Iraq is low and is continuing to decline. As a report on the Tigris and Euphrates produced for the EU notes:

“The water quality of the Euphrates entering Iraq is poorer than that of the Tigris due to agricultural return flows in Turkey and Syria, and is expected to get worse as more land comes under irrigation (Alwash et al., 2018). In addition to increasing salinity, intense agricultural activities and the dumping of untreated sewage in the Euphrates and its tributaries have polluted the rivers, with increasing nutrient levels and coliform bacteria counts in all three riparian countries. Natural characteristics of the Euphrates, such as high evaporation rates, strong climate variability, salt and sediment accumulation, poor drainage, and low soil quality in the river’s lower reaches, exacerbate the damaging effects of pollution from human activities (Bremer, 2013).”⁶¹

One academic study published in 2010 concludes that, “[d]ownstream from the city of Al Kufa [near Najaf], the Euphrates is, literally, used as a drain carrying the irrigation return from several agricultural areas ...”⁶² (Flows into the Euphrates from Lake Tharthar add to the level of salinity in the river.) Nothing appears to have changed since 2010 in a way that is positive for the quality of water in the Euphrates. Indeed, another, more recent academic study (published in 2020) asserts that the level of salinity in the Euphrates at Nasiriyah (Nassiriah, in southern Iraq, just

⁵⁹ Rahi and Halihan, Salinity evolution of the Tigris River (2018).

⁶⁰ R. S. Ayers and D. W. Westcot, FAO Irrigation and Drainage Paper, 29, Rev. 1 (1985), ISBN 92-5-102263-1, Table 1 <https://www.fao.org/3/T0234E/T0234E01.htm#ch1.4>

⁶¹ André Mueller et al., Climate change, water and future cooperation and development in the Euphrates-Tigris basin, EU Cascades, November 2021, p. 17-18 https://www.cascades.eu/wp-content/uploads/2021/11/Euphrates-Tigris-Report_Final.pdf

⁶² Rahi and Halihan, Changes in the salinity of the Euphrates River system in Iraq, Reg Environ Change 10, 27–35 (2010). <https://doi-org.gate3.library.lse.ac.uk/10.1007/s10113-009-0083-y>

above the confluence with the Tigris) is 4,000 ppm.⁶³ At this level of contamination, the water is effectively useless, unless treated – which at present it is not.

To date, the quality of water in the Tigris and its tributaries has been affected more by development in Iraq than by development upstream.⁶⁴ As with the Euphrates, the quality gets poorer downstream, “... with major pollution inflows from urban areas such as Baghdad due to sewage discharge.”⁶⁵ The level of salinity in the Tigris at Baghdad is 1,000 ppm; 150 kms downstream, it peaks at 2,250ppm.⁶⁶ As to the tributaries of the Tigris, the quality of water in the Derbendikhan reservoir (which is fed by tributaries of the Tigris that rise in Iran), while safe for irrigation and industrial purposes, is too poor for drinking.⁶⁷ Another factor is the reduction in average flows, due to reduced precipitation across the catchment in recent years (possibly an effect of climate change): as flows decline, so the concentration of any given quantity of pollutants increases.⁶⁸

As is the case with the Euphrates, Lake Tharthar contributes strongly to salinity levels of the Tigris in central and southern Iraq: “The increase in salinity at Baghdad and further downstream is affected by Lake Tharthar. The use of the lake as water storage adds significant salinity to the river at Baghdad and downstream.”⁶⁹ This is partly due to the fact that some of the water diverted from the Tigris to Lake Tharthar goes from there to the Euphrates rather than back into the Tigris. It is also due to high rates of evaporation from the Lake: at 2.86 bcm/a, this is more than twice the amount of water needed for the city of Baghdad (1.28 bcm/a). A further cause of the high salinity of water leaving the Lake is the dissolving of lake-bed deposits of gypsum and other minerals. The salinity of the Tigris in Amara (in southern Iraq) and downstream is above the accepted limits for human consumption.⁷⁰

As far as the Shatt is concerned, the Upper Gotvand Dam on the Karun has increased the levels of salinity. This is partly because it has reduced the flow of the river into the Shatt but also because the reservoir it impounds lies on salt beds.⁷¹ A more recent academic study (2020)

⁶³ Nasrat Adamo et al., How Dams Can Affect Freshwater Issues in the Euphrates-Tigris Basins, *Journal of Earth Sciences and Geotechnical Engineering*, Vol.10, No. 1, 2020, 43-76 ISSN: 1792-9040 (print version), 1792-9660 (online) <http://www.diva-portal.org/smash/get/diva2:1379429/FULLTEXT02.pdf> . The article does not cite a source for the figure.

⁶⁴ Rahi and Halihan, *Salinity evolution of the Tigris River* (2018).

⁶⁵ Mueller et al., *Climate change, water and future cooperation and development* (2021).

⁶⁶ Adamo, *How Dams Can Affect Freshwater Issues in the Euphrates-Tigris Basins* (2020). The article does not cite a source for the figure.

⁶⁷ Basim Shakir Al-Obaidi and Abdulmutalib Raafat Sarhat (2022) *IOP Conf. Ser.: Earth Environ. Sci.* 1120 012014 <https://iopscience.iop.org/article/10.1088/1755-1315/1120/1/012014/pdf> The article does not speculate as to the origin of the pollution. However, it seems likely that at least some of it has its source in Iran.

⁶⁸ Al-Sekar and Al-Dabbas, *The Influence of the Tigris River Discharge on the Hydrochemistry with Time* (2022).

⁶⁹ Rahi and Halihan, *Salinity evolution of the Tigris River* (2018).

⁷⁰ Rahi and Halihan, *Salinity evolution of the Tigris River* (2018).

⁷¹ *Financial Tribune*, *Solution to Controversial Gotvand Dam Scheme Costly*, 14 May 2016

<https://financialtribune.com/articles/people-environment/41454/solution-to-controversial-gotvand-dam-scheme-costly> This report is from 2016: the problem of salinity deriving from the location of the Gotvand reservoir might

concludes that “[t]he various sources of pollution have endangered aquatic life in the basin and rendered Shatt Al-Arab water unusable for both human consumption and Irrigation.”⁷²

HOW MUCH WATER DOES IRAQ HAVE AND HOW DOES IT USE IT?

Determinants of the volume of water available to Iraq

Most of Iraq receives very little precipitation. The main exception is the Kurdistan Region (KRI) and adjacent parts of “Arab” Iraq where rain-fed (that is, un-irrigated) agriculture is possible and where precipitation feeds the tributaries of the Tigris.⁷³ Otherwise, how much water reaches Iraq down the Euphrates and the Tigris (and its tributaries) from Turkiye, Syria and Iran depends on two factors, which also apply to the volume of water reaching the Shatt from the Karun in Iran. The first is how much precipitation falls in the Euphrates, Tigris and Karun catchments in these upstream countries. The second is how much water they take for their own use.

Because the Iranian regime deliberately withholds data on water, it is impossible to say with any confidence how much water Iran has and how much of that water is used for each of the purposes to which it is put.⁷⁴ However, it is clear that Iran’s developmental aspirations greatly exceed its available water resources: in effect, as Kaveh Madani has put it, the country generally is in a state of “water bankruptcy”.⁷⁵

This situation appears to be particularly severe in those provinces of Iran which border Iraq. Given the pressure on water resources there, it is hardly surprising that there is little left for Iraq. According to Dr. Shukri Al Hassen, a Basrah University academic and environmentalist, “the amount of water flowing from Iran into the rivers of Iraq is now almost zero, since Iran has diverted 42 tributaries in the last 20 years.”⁷⁶ (Al Hassen is apparently including in his count the dams in the Karkheh and Karun basins.) Dr. Dhurgham al-Ajwady, the Deputy Governor of Basra, has made similar comments, noting “that until the dams along the Karun river were built, 75 percent of Basra’s water consumption came from water originating from the Karun and flowing into the Shatt al-Arab.”⁷⁷

have been rectified but has probably not been, as it is referenced in a December 2021 piece by Kaveh Madani, Explainer: Iran's "Water Bankruptcy" USIP (United States Institute of Peace), 5 December 2021

<https://iranprimer.usip.org/blog/2021/dec/05/explainer-irans-water-bankruptcy>

⁷² Adamo et al., How Dams Can Affect Freshwater Issues in the Euphrates-Tigris Basins (2020).

⁷³ UN ESCWA/BGR, Chapter 3, p. 109, Fig. 4

⁷⁴ Adebahr and Lazard, How the EU Can Help Iran Tackle Water Scarcity (2022)

⁷⁵ Kaveh Madani, Explainer: Iran's "Water Bankruptcy" USIP (United States Institute of Peace), 5 December 2021

<https://iranprimer.usip.org/blog/2021/dec/05/explainer-irans-water-bankruptcy>

⁷⁶ Tessa Fox, Desertification in an Iraqi Bread Basket, New Lines Magazine, 18 August 2022

<https://newlinesmag.com/photo-essays/desertification-in-an-iraqi-bread-basket/>

⁷⁷ Human Rights Watch, “Basra is Thirsty: Iraq’s Failure to Manage the Water Crisis”, July 2019

<https://www.hrw.org/report/2019/07/22/basra-thirsty/irags-failure-manage-water-crisis>

While Turkiye has demonstrated some willingness to respond to Iraqi requests for more water on a case-by-case basis, Iran has not. In these circumstances, how much water reaches Iraq from Iran depends on whether there is more water in the transboundary tributaries of the Tigris than Iran needs to satisfy its own consumers. If there is none, then none flows into Iraq. Iraq does not appear to have made any such requests to Syria – presumably because the Tabqa Dam, the country’s largest water installation, is not under regime control and has not been since 2014.⁷⁸

Loss of water to evaporation

Whatever water is available to Iraq is severely depleted by evaporation from Lake Tharthar, other lakes and reservoirs and the canals used to transport water in southern Iraq. Azzam Alwash, one of Iraq’s leading environmental experts, puts this loss at around three trillion gallons a year (~13.7 bcm/a).⁷⁹ According to a calculation made by the Iraq Energy Institute in 2018, “... evaporation from Iraq’s reservoirs decreases the country’s total water supply by more than 10% each year ...”.⁸⁰

Lack of maintenance and other failings mean huge losses of water within Iraq

Lack of maintenance is also a feature of Iraq’s water sector. Together with the illegal extraction of water and excessive evaporation from lakes, reservoirs and canals (already noted), this shortcoming means that only about a third of treated water actually reaches customers: system losses total about 68%.⁸¹

The contamination of Basra’s water supply which led to riots in 2018 provides a dramatic illustration of this problem. Basra’s domestic water supply is supposed to come from the Bada’a Canal but water equating to up to two-thirds of the capacity of the Canal is regularly lost through “a combination of evaporation, embankment failures, illegal water extraction and the rampant growth of aquatic plants which clog up pumps and filters.” To address this situation, the authorities adopted a rationing system among city districts, whereby supply was alternated for two days at a time between water from the Canal and water from the Shatt, which was saline and polluted in other ways (e.g., by industry).⁸²

How does Iraq use what water is left?

⁷⁸ The dam, under the control of ISIL from 2014 to 2017, is currently under the control of the SDF, which is dominated by Syrian Kurds: “New Agreement Between SDF and Syrian Regime on Oil Supply”, 26 July 2022 by BALADI NEWS (opposition website), quoted by Syrian Observer <https://syrianobserver.com/news/77687/new-agreement-between-sdf-and-syrian-regime-on-oil-supply.html>

⁷⁹ Fox, Desertification in an Iraqi Bread Basket (2022)

⁸⁰ Save the Tigris, Into Thin Air: Evaporation Losses From Dam Reservoirs In Iraq, October 2021 <https://www.savethetigris.org/wp-content/uploads/2021/11/Save-the-Tigris-Into-Thin-Air-Report-2021-1.pdf>

⁸¹ Azzam Alwash et al. (eds), Towards Sustainable Water Resources Management In Iraq, Iraq Energy Institute, Publication Number: IEI 30081830, August 2018 <https://iragenergy.org/wp-content/uploads/2022/11/Water-Report.pdf> The figure cited is contained in a World Bank report published in 2006. There is no reason to believe, however, that the situation has improved since then; it may well have deteriorated.

⁸² Michael Mason, “Infrastructure under pressure: Water management and state-making in southern Iraq”, *Geoforum* 132 (2022), pp 52-61, <https://doi.org/10.1016/j.geoforum.2022.04.006>

According to the World Bank, agriculture is responsible for about 79% of fresh-water withdrawals.⁸³ The rest is used by industrial, commercial and domestic consumers. HP provides only 3% of Iraq's electricity,⁸⁴ and in any case does not consume water, apart from evaporation of water stored in reservoirs.

Iraqi agricultural policies and practices

Crop production in Iraq relies on irrigation because of the low productivity of rain-fed farming: in 2016, around 91% of the cropped area was irrigated⁸⁵ and 94% of the country's production of crops came from irrigated areas.⁸⁶ However, Iraqi agriculture "is in a very bad shape – outdated, damaged and inefficient."⁸⁷ Irrigation practices in Iraq are very wasteful: Iraqi farmers use old, open-channel irrigation techniques.⁸⁸ Azzam Alwash describes these techniques as "Sumerian".⁸⁹ (In 2017, about 817 mcm/a were used just to irrigate paddy rice-growing areas across Iraq.⁹⁰) Iraqi farmers complain that "There's no planning, no support for the farmers."⁹¹ According to ESCWA (quoted by France24), 'On a national level, Iraq provides "no incentives to encourage the use of modern irrigation technologies."⁹²

The Iraqi MOWR prioritises public water supply, which means that part of the demand for irrigation water often goes unmet.⁹³ A lack of water in the marshlands of southern Iraq has driven many to leave farming and move to the towns, or join militias.⁹⁴

⁸³ World Bank, Iraq: Country Climate and Development Report (2022), p. 15, citing the SWLRI. <https://documents1.worldbank.org/curated/en/099005012092241290/pdf/P1776390cfceae0d908ff8073b7e041bea6.pdf>

⁸⁴ Iraq Energy Information, Enerdata website, last visited 15 March 2023.

[https://www.enerdata.net/estore/energy-market/iraq/#:~:text=Oil%20accounts%20for%20most%20of,%25\)%20and%20hydropower%20\(3%25](https://www.enerdata.net/estore/energy-market/iraq/#:~:text=Oil%20accounts%20for%20most%20of,%25)%20and%20hydropower%20(3%25)

⁸⁵ World Bank, Iraq: Country Climate and Development Report (2022), Executive Summary, p. xii

⁸⁶ World Bank, Iraq: Country Climate and Development Report (2022), p. 15

⁸⁷ WPS and Clingendael, Water Governance in Iraq: Enabling a Gamechanger, Sep 2022

<https://waterpeacesecurity.org/files/245>, p. 8

⁸⁸ Simona Foltyn, 'The green land is a barren desert': water scarcity hits Iraq's Fertile Crescent, 7 September 2022

<https://www.theguardian.com/global-development/2022/sep/07/water-scarcity-hits-iraq-fertile-crescent-drought-farming>

⁸⁹ Azzam Alwash, telephone interview with author, 15 February 2023.

⁹⁰ Salam Hussein Ewaid et al., Water Footprint of Rice in Iraq, IOP Conference Series: Earth and Environmental Science, Volume 722, 1st International Virtual Conference of Environmental Sciences (IVCES 2020), 15-16 Dec, 2020, Babylon Province, Al-Qasim District 8, 51013, Iraq, p. 20

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DOI 10.1088/1755-1315/722/1/012008

⁹¹ Foltyn, 'The green land is a barren desert': water scarcity hits Iraq's Fertile Crescent (2022)

⁹² France24, For water-stressed Iraq, wells threaten race to the bottom, 30 October 2022

<https://www.france24.com/en/live-news/20221030-for-water-stressed-iraq-wells-threaten-race-to-the-bottom>

⁹³ IOM (Institute for Migration), Water Quantity and Water Quality in Central and South Iraq: a Preliminary Assessment in the Context of Displacement Risk, IOM (International Organisation for Migration), (2020), p. 9

<https://iraqrecovery.iom.int/iraqwatercrisis/files/Water-quantity-and-water-quality-in-central-and-south-iraq-Final.pdf>

⁹⁴ Peter Schwartzstein, Climate, Water and Militias: a Field Study from Southern Iraq, Center for Climate and Security: Council for Strategic Risks, 11 January 2023 <https://councilonstrategicrisks.org/wp-content/uploads/2023/01/39-WaterMilitiasSouthernIraq.pdf>

Wasteful practices, as well as the decline in surface flows from Turkiye, Syria and Iran, have compelled the Iraqi agricultural sector to turn to ground-water. However, depletion rates are very high. According to the UN, groundwater provides 14% of Iraq's water consumption, well above the sustainable level of 6.5% as calculated by the SWLRI.⁹⁵ This conclusion is supported by a study of groundwater withdrawals in the Bahr al-Najaf basin in southern Iraq.⁹⁶ If this over-exploitation continues, ground-water will not be able to fulfil its "buffer" function, acting as a source of irrigation water when surface flows are low.⁹⁷

Oil industry use

The Iraqi oil sector is injecting freshwater into oilfields, especially those in the south, in order to maintain the pressure necessary to extract oil. A project designed to replace freshwater could, in its initial phase, supply around 348 mcm/a of sea-water from the Gulf.⁹⁸ At the moment, the project appears stalled because of concerns about the cost and the difficulty of protecting it from corruption.⁹⁹

Governance of the water sector in Iraq: strategy and institutions

Iraq's MOWR has made "some progress" in adopting the recommendations of the Strategy for Water and Land Resources of Iraq (SWLRI) which was prepared for it by an Italian consulting company in 2014.¹⁰⁰ The authorities have this strategy: for example, it is used as a framework within which requests from Provincial Governments for water allocation, infrastructure and projects are considered. However, "it is not yet fully implemented and glaring shortcomings, inconsistencies and contradictions pervade the current system of water governance." There is no national, long-term vision at the national level on the governance, management and use of the country's shrinking water resources.

Moreover, Iraqi water-management institutions are "fragmented".¹⁰¹ Issues include insufficient capacity and resources, a lack of horizontal and vertical coordination between

⁹⁵ UN Iraq, Rainwater harvesting now to preserve groundwater for tomorrow, 22 March 2022 <https://iraq.un.org/en/175462-rainwater-harvesting-now-preserve-groundwater-tomorrow>

⁹⁶ Ali A. Obeed Al-Azawi & Frank A. Ward (2017) Groundwater use and policy options for sustainable management in Southern Iraq, International Journal of Water Resources Development, 33:4, 628-648, DOI: 10.1080/07900627.2016.1213705 <https://www.tandfonline.com/gate3.library.lse.ac.uk/doi/full/10.1080/07900627.2016.1213705> The data used relates to 2006-11 but there is no reason to think that withdrawals have declined since then.

⁹⁷ Famiglietti, J. S. (2014). The global groundwater crisis. Nature Climate Change, 4(11), 945-948

⁹⁸ Editor OilPrice.com, Are Iraq's Ambitious Oil Production Goals Feasible? 17 August 2022 https://finance.yahoo.com/news/iraq-ambitious-oil-production-goals-230000743.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAAEAy_3Y2BHQRuffwvm1-X5jZn2qx80W3McEW_c2q8N7p_9BpmN8rTolJ1ifmHp8P4g2zjFHA9QWCPR3zFNqDIWavM4OrcUk0xTWbSrfLCCHSOmN9T7aSdk-GBF5oYL0YC8U5K01I5kFSsb2kwhHa1jlyoagFqT4y2m-Aqzq4VBa The article quotes a figure of six million bpd, which equates approximately to 348 mcm/a.

⁹⁹ Telephone interview with oil industry source who preferred to remain anonymous, 14 December 2022.

¹⁰⁰ WPS and Clingendael, Water Governance in Iraq (2022), p. 4

¹⁰¹ Dr Hassan Janabi, Iraqi Minister of Water Resources 2016-18, speaking at the Chatham House Iraq Initiative Conference, 14 November 2022

different ministries or agencies (including those responsible for water resources and climate adaptation), and poor data management and sharing between different ministries and with the public. Allocation of central government funds to water is low: the MOWR gets “less than 1% of the total national budget”.¹⁰²

“[G]overnment institutions that are tasked with water management (...) are indebted and partly dysfunctional and corrupt (...)”¹⁰³ The capacity deficit in Iraq is exacerbated by brain-drain¹⁰⁴ and the loss to retirement of many skilled and experienced engineers.¹⁰⁵ According to a former Minister of Water Resources, officials in government do not have the requisite background.¹⁰⁶ This is not just in central government: “... appointed authorities and staff within governorates do not always have sufficient experience and skills to carry out their responsibilities and plan effective and efficient water management.”¹⁰⁷ This view is shared by Nadhir al-Ansari, an Iraqi water engineer and professor at Sweden’s Luleå University. “The people who have taken over the water ministry have no expertise.”¹⁰⁸ In some cases, the personal interests of officials may distort decision-making in respect of water.¹⁰⁹ There is also a challenge posed by the lack of an authority to adjudicate in cases in which some water users feel others are getting disproportionate access to water.¹¹⁰

Another problem is what could be called Iraqi water-management culture. Today’s senior Iraqi water engineers were conditioned in the early stages of their careers to deal with excessive water (floods) rather than too little.¹¹¹

There is a lack of coherence across central government in Baghdad. For example, the threat in 2021 to take Iran to the ICJ was made by the then Minister of Water without consulting other ministers. According to one academic analyst, the Iraqi state is made up of “nodes of power” whose relationships are characterized by “contradictions, antagonisms, and outright enmity”.¹¹² Different ministries are held by different political parties that see no reason to cooperate in the national interest. Moreover, even if the ministers are independent technocrats, the senior civil servants in their ministries are usually political figures appointed

¹⁰² WPS and Clingendael, *Water Governance in Iraq* (2022), p. 5

¹⁰³ André Mueller et al., *Climate change, water and future cooperation and development* (2021), p. 57, citing Georgia Cooke et al., (2020), *Same Old Politics Will Not Solve Iraq Water Crisis*. Chatham House. <https://www.chathamhouse.org/2020/04/same-old-politics-will-not-solve-iraq-water-crisis>

¹⁰⁴ Mueller et al., *Climate change, water and future cooperation and development* (2021), p. 57

¹⁰⁵ Prof Nadhir Al-Ansari, telephone interview with author, 24 April 2023.

¹⁰⁶ Dr Hassan Janabi, Iraqi Minister of Water Resources 2016-18, speaking at the Chatham House Iraq Initiative Conference, 14 November 2022

¹⁰⁷ WPS and Clingendael, *Water Governance in Iraq* (2022), p. 8

¹⁰⁸ Foltyn, ‘The green land is a barren desert’: water scarcity hits Iraq’s Fertile Crescent (2022)

¹⁰⁹ Independent, Iraq’s ‘pearl of the south’ Lake Sawa dry amid water crisis, 13 June 2022

<https://www.independent.co.uk/news/ap-iraq-baghdad-muhammad-saddam-hussein-b2099492.html>

¹¹⁰ Foltyn, ‘The green land is a barren desert’: water scarcity hits Iraq’s Fertile Crescent (2022)

¹¹¹ Azzam Alwash, speaking at a 2021 Chatham House workshop on the impact of climate change on the Tigris and Euphrates, part of the process of preparing the EU Cascades paper by Mueller et al.

¹¹² Fanar Haddad, *Turbulent Times for the ‘New Iraq’*, *Current History* (2022) 121 (839): 331–337. <https://doi-org.gate3.library.lse.ac.uk/10.1525/curh.2022.121.839.331>

to protect the interests of their patrons. They may be effective in that respect but are often not competent in their official roles.¹¹³

THE IMPACT ON IRAQ OF DECLINING WATER VOLUMES AND QUALITY

The main impact of declining flows has been on agriculture: the prioritisation of public water supply has meant that farmers have sometimes not received all the water they needed or been allowed to plant all the crops they wanted to grow. In particular, restrictions have been placed on the area that could be planted to “thirsty” crops like rice. “In early May [2022], officials limited total rice crop areas to 1,000 hectares (2,471 acres), in Najaf and Diwaniyah [Governorates/Provinces] only, according to the agriculture ministry. The normal quota is 35 times that.”¹¹⁴

Diyala Province, which borders Iran, is a notably productive area in terms of agriculture. It is known for its dates and citrus fruit but also for grain and livestock-rearing. As long ago as 2014, it seemed clear that supplies of water for irrigation and for drinking in the province’s urban areas were being reduced by Iran’s works upstream on the Sirwan and Alwand.¹¹⁵ The near-total lack of flow in the Diyala near its confluence with the Tigris was observed at first hand by the traveller Leon McCarron, who visited the location in the early summer of 2021.¹¹⁶

In one sense, a declining agricultural sector may not matter greatly. Despite the fact that it uses by far the largest part of the Iraqi water budget, agriculture only produces 30% of Iraq’s food.¹¹⁷ The rest of Iraq’s food supply is grown with “virtual water”, that is, it is imported from countries that have used their water supplies to grow it. Given Iraq’s substantial forex revenues from the export of oil and gas, this is not a problem. Nor should it be one, until these revenues decline with the global energy transition – although supply problems can occur, as they did in 2022.¹¹⁸ Moreover, agriculture is not of great importance to the Iraqi economy, contributing less than 4% to GDP.¹¹⁹

¹¹³ Robert Tollast and Sinan Mahmoud, Iraq's lost battle against corruption: from early failures to the 'heist of the century', The National, 30 December 2022 <https://www.thenationalnews.com/world/2022/12/30/iraqs-lost-battle-against-corruption-from-early-failures-to-the-heist-of-the-century/>

¹¹⁴ Salam Faraj, Iraq's prized rice crop threatened by drought, Phys.org, 15 May 2022 <https://phys.org/news/2022-05-iraq-prized-rice-crop-threatened.html>

¹¹⁵ Sean Ventura, Transnational Rivers and Water Security: Regional Review of the Diyala River Basin, University of Washington Jackson School Journal (2014), [https://www.academia.edu/8351273/Transnational Rivers and Water Security Regional Review of the Diyala River Basin](https://www.academia.edu/8351273/Transnational_Rivers_and_Water_Security_Regional_Review_of_the_Diyala_River_Basin)

¹¹⁶ Leon McCarron, *The Wounded Tigris* (2023), Chapter 25, p. 244, Little, Brown Book Group ISBN: 9781472156235

¹¹⁷ Dr Hassan Janabi, Iraqi Minister of Water Resources 2016-18, speaking at the Chatham House Iraq Initiative Conference, 14 November 2022

¹¹⁸ Greg Shapland (2022), How virtual water saved the Middle East from water wars, *Water International*, 47:6, 905-908, DOI: 10.1080/02508060.2022.2118362

¹¹⁹ Trading Economics, Iraq - Agriculture, Value Added (% Of GDP). (The figure is for 2021.) <https://tradingeconomics.com/iraq/agriculture-value-added-percent-of-gdp-wb-data.html#:~:text=Agriculture%2C%20forestry%2C%20and%20fishing%2C,compiled%20from%20officially%20recognized%20sources>

In terms of employment, however, agriculture (including forestry and fishing) is a good deal more important. According to the World Bank, 9% of employed Iraqis worked in the sector; the proportion is much higher for women: 30% of women nationally and 40% of women in rural areas.¹²⁰ Maintaining a healthy agricultural sector is also crucial to slowing the rate of migration from the countryside to urban areas.^{121, 122}

THE FUTURE: HOW MUCH WATER (AND OF WHAT QUALITY) WILL IRAQ HAVE?

In all four states of the TERS, population growth will increase the demand for water (see Table 1). The relationship is not a linear one: a 10% increase in a country's population does not necessarily equate to a 10% increase in water consumption, as domestic consumption is only a small proportion of overall consumption. However, there may be a closer correlation between population growth and overall water consumption if a country is striving for food self-sufficiency, as Iran is doing at present.

The introduction of more efficient water-management techniques may mitigate the increased demand for water consequent upon the growth of populations.

Table 1: Projected population growth in TERS countries, in millions (to nearest million). Source: "World Population Prospects, 2022", UN Population Division, Department of Economic and Social Affairs: median estimate.

	2022	2030	2040	2050
Turkiye	85	89	93	96
Syria	22	29	35	38
Iran	88	93	96	99
Iraq	44	52	63	74
Total	239	263	287	307

Likely water use by Turkiye: volume and pattern

Turkiye has not yet completed the GAP: 19 out of 22 large dams planned within the GAP framework have been constructed. The flow of the Euphrates and Tigris into Iraq can therefore be expected to decrease still further. However, a more important consideration is that the

¹²⁰ World Bank, Iraq: Country Climate and Development Report (2022), pp. 15 and 45

¹²¹ IOM (International Organization for Migration) and Social Inquiry, "Fragile Setting: Responding to Climate-Induced Informal Urbanization and Inequality in Basra", 22 October 2021: <https://reliefweb.int/sites/reliefweb.int/files/resources/IOM%20Iraq%20Migration%20into%20a%20Fragile%20Setting-Responding%20to%20Climate-Induced%20Informalization%20and%20Inequality%20in%20Basra.pdf>

¹²² IOM (International Organisation for Migration), Water Quantity and Water Quality in Central and South Iraq (2020), p. 6

irrigation component of the GAP has lagged: by 2017, only around 546,000 hectares out of a planned 1.8 million hectares of land had been supplied with water.¹²³ According to a 2022 DSI report, 91% of the energy projects but only 58% of the irrigation projects under GAP have been completed.¹²⁴ (The DSI is Turkiye's General Directorate of State Hydraulic Works.) The further development of irrigation could lead to substantial additional abstractions by Turkiye. The next major irrigation development in Turkiye will follow the completion of the Çizre Dam on the Tigris, which will divert water to irrigate about 100,000 hectares. In this sense, the Çizre Dam represents more of a threat to Iraq than the larger Ilisu Dam. It is recognised as such by Iraqi officials.¹²⁵,¹²⁶

According to Madhhachi *et al.* (2020), the operation of the two Turkish dams would (in a worst-case scenario) reduce the flow of the Tigris at the Mosul Dam to 22% of its present flow. The authors of this study state (without referencing their statement) that the only commitment which Turkiye has made in terms of the flow of the Tigris is to maintain it at at least 60 cusecs. In some months, the flow might be so low that the Mosul Dam would become "inoperable" in terms of generating HP, its main function.¹²⁷

Another academic article asserts that "On the basis of the figures published by the GAP authorities, Iraq calculates that the irrigation projects on the Tigris within the GAP will consume 5.8 BCM and reduce the flow of the Tigris River as it passes the border into Syria at Cizre by 66% from an annual discharge of annual 16.72BCM to 5.68BCM. Iraq estimates that it would receive 48% of the water it receives at present."¹²⁸ Since this assertion is not backed by any references to either Turkish or Iraqi sources, it is hard to assess its reliability. In any case, we must bear in mind that around 35% of the natural flow of the Tigris, as measured at Kut in southern Iraq, derives from Iran and Iraq and not from Turkiye.

The Çizre Dam will affect the quality of the water reaching Iraq, as well as its quantity, in two ways. First, the diversion of water for irrigation will reduce the flow of the river, leading to a higher concentration of dissolved solids (even without any increase in the absolute volume of the latter). Second, any irrigation water returning to the river will be contaminated with agricultural chemicals. At the time of writing, there do not seem to be any publicly-available projections (in English) of how severe the increase in the salinity of the Tigris will be, once the Çizre Dam and associated irrigation schemes are operational.

¹²³ Arda Bilgen, Turkey's Southeastern Anatolia Project (GAP): a qualitative review of the literature, *British Journal of Middle Eastern Studies* (2020), 47:4, 652-671, DOI: 10.1080/13530194.2018.1549978 <https://www.tandfonline.com/gate3.library.lse.ac.uk/doi/full/10.1080/13530194.2018.1549978>

¹²⁴ DSI. (2022). *2021 yılı faaliyet raporu*, cited by Arda Bilgen, *Surface Water Changes in the Euphrates-Tigris Basin since 1984 and their Governance Implications for Iraq: A Turkish perspective* (2023, forthcoming)

¹²⁵ North Press Agency, Baghdad Rejects New Turkish Water Project, 17 November 2021 <https://npasyria.com/en/67861/>

¹²⁶ ANF News, Samir Muxif Ciburi: Çizre Dam is a major threat to Iraq, 12 July 2022 <https://anfenglish.com/ecology/samir-muxif-ciburi-cizre-dam-is-a-major-threat-to-iraq-61154>

¹²⁷ Al-Madhhachi, A-S. T., et al., Hydrological Impact of Ilisu Dam on Mosul Dam; the River Tigris, *geosciences*, 27 March 2020

¹²⁸ Adamo et al., *How Dams Can Affect Freshwater Issues in the Euphrates-Tigris Basins* (2020). The article does not cite sources for the figures.

Likely water use by Syria: volume and pattern

Post-civil-war reconstruction, when it eventually takes place, will probably result in increased water use (although this may be mitigated by more efficient methods of irrigation and improved water infrastructure in all sectors). Reduced precipitation in northern Syria consequent on climate change will make rain-fed agriculture increasingly problematic, leading to more widespread use of irrigation. There are some signs of this already.¹²⁹

There are so many uncertainties about the reconstruction of the agricultural sector that it seems impossible to predict how much water Syria will take from the Euphrates in future. Reconstruction will also bring increased domestic, commercial and industrial demand for water but the same uncertainties apply.

A better relationship with Turkiye could lead to the construction of joint works on the Tigris that would allow Syria to make greater use of water from that river. However, this would probably be a low priority for the Syrian regime relative to other reconstruction needs. Any such works would probably be many years in the future, even after a peace settlement.

Likely water use by Iran: volume and pattern

Given the opacity of Iranian planning, it is difficult to ascertain how much more water Iran will take from the tributaries of the Tigris and from the Karun. According to the Iranian water expert interviewed by the author, there is still scope for Iran to build more dams and diversion works on these rivers. Iran likes supply-oriented approaches [rather than demand-management] and the limits to supply-side development have not yet been reached.¹³⁰

One academic attempt to quantify the impact of Iran's works on tributaries of the Diyala assesses that they will take 2.05 bcm each year that would otherwise flow into the Derbendikhan reservoir – which consequently would only receive water from Iran in years when the combined flow of these tributaries exceeded that volume.¹³¹ The same study concluded that the implementation of Iran's plans would mean that almost half (48.8%) of the Derbendikhan Dam's HP generation would be lost and that virtually no HP could be generated from June to September inclusive. The Derbendikhan reservoir also supplies water to the towns of Halabja, Sirwan and Saidaq but would not be able to do so in future "for extended periods", as the water level would be below the intake for the supply scheme. Moreover, the quality of the water in the reservoir would decline because the volume of water flowing into it would be reduced.

An attempted bottom line: how much water will Iraq have in future?

The MOWR's SWLRI predicted that, if the three upstream riparians fully developed the surface water resources they share with Iraq, then Iraq would receive 28.487 bcm/a from them in 2035. This would represent a fall of almost 35% from the existing inflow of 43.696 bcm/a. The volume

¹²⁹ Maha El Dahan, Exclusive: Climate change, conflict decimate Syria's grain crop, Reuters, 20 September 2020 <https://www.reuters.com/markets/commodities/exclusive-climate-change-conflict-decimate-syrias-grain-crop-un-fao-2022-09-20/>, apparently quoting FAO Syria rep.

¹³⁰ Telephone interview with author, 13 January 2023

¹³¹ Faraj et al., The impact of the Tropical Water Project (2022)

of surface water generated within Iraq would remain the same, at 21.919 bcm/a.¹³² However, the calculation does not appear to allow for possible reductions in flow across the TERS resulting from climate change.

The KRG's dam-building plans may affect the availability of water in the rest of Iraq

The water available to Iraq outside the KRI may be affected by the KRG's plans to have a Chinese company build four additional dams on tributaries of the Tigris. These four dams are the Dalkah Dam within the borders of Bashdr District and Khyota Dam, both in Sulaymaniyah, Mandawa Dam in Erbil, and Bakirman Dam in Dohuk.¹³³ The memorandum of understanding relating to these projects was signed without the knowledge of the federal Ministry of Water Resources (MOWR) in Baghdad, which asserts responsibility for water throughout the national territory.¹³⁴

Prof Al-Ansari of Lulea University in Sweden told the author that, if the KRG implemented all its planned projects, no water would flow from the KRI into the rest of Iraq.¹³⁵ However, given the KRG's lack of financial means (following the stoppage of its independent oil exports), it is hard to see how Erbil can proceed with these projects without Baghdad's agreement.¹³⁶

The projected impact of climate change to mid-century

According to UNEP, Iraq is the world's fifth most vulnerable country in terms of climate change.¹³⁷

This report looks ahead to mid-century. Beyond that, climate change projections are much less reliable and, for the purposes of ODA policy planning, there are many other uncertainties as well. Prominent among the latter are the ability (or otherwise) of Iraq to deal with the impact of climate change, an ability which may be influenced but not determined by ODA interventions.

One academic study (Osman et al., 2017) suggests that precipitation across Iraq itself will not change much on an annual basis in the near (2011-2030) and medium (2046-2065) terms (although it is projected to have declined by 2080-2099).¹³⁸ Given Iraq's dependence on flow from upstream riparians, however, it is more significant that another study projects that average annual levels of precipitation across the TERS as a whole are likely to decline over the next three

¹³² Republic of Iraq – Ministry of Water Resources, SWLRI (2014), Executive Summary, Table 1, p. 6.

¹³³ Save the Tigris, Building More Large Dams Threatens Southern Iraq and Increases Drought and Water Scarcity: No More False Solutions; 15 April 2022 <https://humatdijlah.org/en/statement-nomorefalsesolution/>

¹³⁴ Middle East Monitor, Iraq's Kurdistan to build 4 dams, 11 April 2022 <https://www.middleeastmonitor.com/20220411-iraqs-kurdistan-to-build-4-dams/>

¹³⁵ Prof Nadhir Al-Ansari, telephone interview with author, 24 April 2023.

¹³⁶ Shafaq News, Baghdad to allocate funds for public sector salaries in KRI, 16 April 2023 <https://shafaq.com/en/Iraq-News/Baghdad-to-allocate-funds-for-public-sector-salaries-in-KRI>

¹³⁷ UNEP, Iraq launches National Adaptation Plan process for climate change resilience, 21 September 2020 <https://www.unep.org/news-and-stories/press-release/iraq-launches-national-adaptation-plan-process-climate-change>

¹³⁸ Yassin Osman et al., Climate Change and Future Precipitation in an Arid Environment of the Middle East: Case Study of Iraq, Environmental Hydrology, vol. 25 (February 2017)

decades. “In particular, the northern part of the basin as well as the border area between Iraq and Iran could see declines in rainfall of up to 40mm per year”.¹³⁹

Other modelling gives broadly similar results. An Institute of Migration (IOM) report suggests that, under one scenario, climate change could, by 2050, cause a 20% decrease in the flow of rivers into Iraq from the three upstream riparians.¹⁴⁰

As far as the Tigris basin in Turkey is concerned, Şen (2019) calculates that, by 2041-50, flows at the Turkish-Syrian border could have declined by 30%.¹⁴¹ Another study (Dezfuli et al., 2022) concludes that the Tigris and Euphrates catchments in Turkey are “likely to see the most dramatic compound changes of any area in the Middle East, with rapid warming, increased interannual precipitation variability, and decreased precipitation.” Moreover, “the chance of occurrence of compound extreme events is projected to increase”.¹⁴² The Karkheh is projected to see a reduction in flow of up to 24% over the period 2020-2080.¹⁴³

The reduced availability of surface water in Iraq (as a result of the combination of lower river flows and higher evaporation) would lead to increased pressure on the country’s groundwater and a contraction in farm output. An academic study by Adamo et al., looking ahead to the end of the century, suggested that “productive land [in the Tigris and Euphrates basins] especially in Iraq will be reduced to a barren land with extensive deserts and only narrow strips of irrigated stretches along the two rivers.”¹⁴⁴ Moreover, reduced surface water volumes would lead to poorer water quality.

The impact on Iraq of any increased *variability* of precipitation in the TERS could be lessened by the existence of so many dams in the four riparian countries. Highly-engineered basins like the TERS have the capacity to retain water in years of high flow and to release it in drought years.¹⁴⁵ It seems reasonable to assume that, in the latter case, the upstream riparians will continue to release water in their own interests, to generate HP. However, this is an assumption and the reality may well turn out to be much more complicated – especially in years of low flow.

¹³⁹ Mueller et al., Climate change, water and future cooperation and development (2021), p. 28. According to the study, this decline is probable under both the RCP2.6 and RCP6.0 global emissions scenarios.

¹⁴⁰ IOM (International Organisation for Migration), Water Quantity and Water Quality in Central and South Iraq (2020), p. 14

¹⁴¹ Şen, Z. Climate change expectations in the upper Tigris River basin, Turkey. Theor Appl Climatol 137, 1569–1585 (2019). <https://doi-org.gate3.library.lse.ac.uk/10.1007/s00704-018-2694-z>

¹⁴² Amin Dezfuli, et al., Compound Effects of Climate Change on Future Transboundary Water Issues in the Middle East, Earth’s Future website, 2022 <https://doi.org/10.1029/2022EF002683>, last visited 12 January 2023.

¹⁴³ Richardson, K., et al., Climate risk report for the Middle East and North Africa region, Met Office, ODI, FCDO (2021), p. 47

https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/services/government/mena_climate_risk_report_finalversion_27102021.pdf

¹⁴⁴ Nasrat Adamo et al., Global Climate Change Impacts on Tigris-Euphrates Rivers Basins Journal of Earth Sciences and Geotechnical Engineering, Vol.10, No.1, 2020, 77-125, 1792-9660 (online), p. 118

http://www.sciencpress.com/Upload/GEO/Vol%2010_1_4.pdf

¹⁴⁵ Karem Abdelmohsen et al., Buffering the impacts of extreme climate variability in the highly engineered Tigris Euphrates river system. Sci Rep 12, 4178 (2022). <https://doi.org/10.1038/s41598-022-07891-0>

The seasonal pattern of flows in both the Euphrates and Tigris will change as higher temperatures in the mountains bring earlier melting of the snow cover. Peak flows of melt water will shift towards earlier in the year.¹⁴⁶ But how this earlier occurrence of peak flows will translate into the pattern of flows into Iraq will depend on how Turkey and Iran operate their dams in these changed circumstances – and this is far from clear.

Sea-level rise will combine with reduced flows in the Euphrates, Tigris, Karkheh and Karun to allow saline water from the Gulf (“the salt wedge”) to progress ever further up the Shatt al-Arab/Arvand Rud.¹⁴⁷ This would have a negative impact on Basra’s water supply and contaminate the groundwater reserves beneath the adjacent farmland.

As regards temperature, a report published in 2021 by the Meteorological Office projects, with “high confidence”, that temperatures in the 2050s in highland and lowland parts of Iraq will be 2-3°C and 2-4°C respectively above present averages. According to this projection, the biggest increases will come in the summer months.¹⁴⁸

Higher temperatures mean drier soils and higher rates of evapo-transpiration from plants and therefore higher water demand per unit of crop yield. They also mean higher rates of evaporation from reservoirs, lakes and open canals and therefore higher concentrations of pollutants (assuming the absolute volume of pollutants has not decreased).

Will future upstream consumption and climate change leave enough water for Iraq’s needs?

If the climate projections cited above are correct, then the short answer is “no” – unless there are radical changes in water management in Iraq (and even these may not be enough). According to the EU study previously mentioned, “Future drought episodes, heat waves, and other extreme events will further challenge agricultural systems in the basin.” There is “a high risk of crop failures in the southern part of the basin and along the Tigris. Agriculture in these areas has already been strongly affected by water shortages (especially through poor water quality) ...”¹⁴⁹

THE LEGAL REGIME GOVERNING THE USE OF WATER IN THE TERS

Only partial adherence to general principles of water use in shared basins

International law on transboundary watercourses is embodied in two UN conventions. These are the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (“the 1992 Convention”) and the UN Convention on the Law of the Non-

¹⁴⁶ Katharine Waha et al., Climate change impacts in the Middle East and Northern Africa (MENA) region and their implications for vulnerable population groups. *Reg Environ Change* 17, 1623–1638 (2017).

<https://link.springer.com/article/10.1007/s10113-017-1144-2>

¹⁴⁷ Tessler, Z. D. et al., (2015), Profiling risk and sustainability in coastal deltas of the world. *Science*, 349(6248), 638-643. How far the salt wedge extends upstream will vary from year to year and season to season, depending mainly on the volume of freshwater flowing into the Shatt. It can already reach as far as the city of Basra, 130 kms (81 miles) from the Gulf: Mohammed Faisal Al-Fuady and Riyadh Zuhair Azzubaidi (2021) IOP Conf. Ser.: Earth Environ. Sci. 779 012079 <https://iopscience.iop.org/article/10.1088/1755-1315/779/1/012079/pdf>

¹⁴⁸ Katy Richardson et al., (2021), Climate risk report for the Middle East and North Africa region, p. 7

¹⁴⁹ Mueller et al., Climate change, water and future cooperation and development (2021), p. 34

Navigational Uses of International Watercourses (“the 1997 Convention”). These conventions deal with surface water and associated groundwater.¹⁵⁰

The cornerstone of the law of international watercourses, as embodied in these two conventions, is that states must use an international watercourse in an “equitable and reasonable” manner.¹⁵¹ At the same time, they should minimise the impact on other states with which it shares those watercourses (1992 Convention) or not cause them “significant harm” (1997 Convention).¹⁵²

The 1992 Convention entered into force in 1996. Iraq became a party to the Convention in March 2023.¹⁵³ None of Iraq’s fellow riparians in the TERS has joined.

The 1997 Convention entered into force in 2014. Syria ratified it in 1998; Iraq did the same in 2001.¹⁵⁴ Neither Iran nor Türkiye has signed or ratified the Convention.¹⁵⁵ Indeed, Türkiye was one of only three countries that voted against the adoption of the 1997 Convention. It has since made several public statements expressing its reservations about various important provisions of the Convention.¹⁵⁶

Although (apart from Syria in respect of the 1997 Convention), none of Iraq’s upstream neighbours has signed or ratified these agreements, they can still be said to represent universally-applicable codifications of international law. They could be used as a framework for basin-wide negotiation or cooperation. At the moment, neither Iran nor Turkey (nor Syria) shows any willingness to use them in this way. In geopolitical rather than legal terms, that would mean accepting limits on their control of transboundary rivers without gaining anything of equivalent value in return.

¹⁵⁰ They do not cover groundwater not associated with surface flows: the UN General Assembly agreed in 2022 that a convention on the subject should be elaborated. UN General Assembly, Sixth Committee (Legal) — 77th session, 2022, The law of transboundary aquifers (Agenda item 86) https://www.un.org/en/ga/sixth/77/transboundary_aquifers.shtml

¹⁵¹ Alistair Rieu-Clarke, Overview of the 1992 Water Convention and the 1997 Watercourses Convention, UNECE (UN Economic Commission for Europe), 2081, Slide 14. https://unece.org/fileadmin/DAM/env/documents/2018/WAT/01Jan_25_Accra_Ghana/Overview_of_both_Conventions.pptx

¹⁵² Stephen McCaffrey, The UN Convention on the Law of the Non-Navigational Uses of International Watercourses: Prospects and Pitfalls, Ch. 2 in https://unece.org/fileadmin/DAM/env/water/cwc/legal/UNConvention_McCaffrey.pdf

¹⁵³ UNECE (UN Economic Commission for Europe), Iraq’s accession to UN Water Convention opens new opportunities to strengthen transboundary water cooperation in the Middle East, 24 March 2023 <https://unece.org/media/environment/Water-Convention/press/377056> The text is at <https://unece.org/DAM/env/water/pdf/watercon.pdf>

¹⁵⁴ United Nations Treaty Collection, 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&clang=en

¹⁵⁵ United Nations Treaty Collection, Convention on the Law of the Non-Navigational Uses of International Watercourses, 1997, Status as at 9 April 2023 https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-12&chapter=27&clang=en

¹⁵⁶ Aysegül Kibaroglu, Turkey’s Water Diplomacy: Analysis of Its Foundations, Challenges and Prospects. Anthem Press, 2021. <https://doi.org/10.2307/j.ctvwh8bgf>, Chapter 3, p. 63

In these circumstances, it is not clear how much practical benefit Iraq can derive from the existence of these conventions, including from its accession to the 1992 Convention. That could change if, for example, altered geopolitical circumstances meant that the regimes in the upstream countries changed their attitude to the conventions. At present, however, it is difficult to see what would bring about such a change.

A lack of any comprehensive agreements governing the use of water in the TERS

There is no overall legal regime governing the use of the surface waters of the TERS. Nor is there even any consensus on the nature of the Tigris and Euphrates. Iraq and Syria consider them to be internationally-shared rivers; Turkey considers them to be a single transboundary river basin. Viewing the two rivers as “transboundary” rather than “international” (that is, internationally-shared), Türkiye asserts that it has the sovereign right to use the water within its territory. At the same time, it espouses the principle that transboundary waters should be used in an equitable, reasonable, and *optimum* manner.¹⁵⁷

The principle that transboundary watercourses should be used in an “optimum” manner does not figure in the UN Conventions. It seems to reflect a long-standing Turkish belief that, for reasons of topography and evaporation rates, most water-regulation installations and the lion’s share of the irrigation schemes in the Tigris and Euphrates catchment should be in Türkiye rather than Syria or Iraq. In the mid-1990s, Türkiye declared itself ready to discuss its own plan “for the establishment of principles according to which we would allot the use of cross-border waters to our neighbours.”¹⁵⁸

Moreover, in contrast to the Iraqi and Syrian position, Türkiye deems the Tigris and Euphrates to be one river basin. Türkiye’s stance on this point enables it to assert that any reduction in flow in the Euphrates (in Iraq, at least) can be compensated for by flow in the Tigris, which has so far been less affected by Turkish developments than the Euphrates.¹⁵⁹ Moreover, outside governments contemplating diplomatic initiatives relating to the Tigris and Euphrates should be aware that Türkiye insists that “transboundary water issues should be addressed only among the riparian countries without interventions by the third parties.”¹⁶⁰

For its part, Iran does not appear to have taken a public position on the nature of the Tigris and its tributaries, or of the Karun – still less on the legality of its building of dams and diversion works on them. Iran has, however, objected to Türkiye’s construction of dams on the Aras (a river the two countries share), describing such actions as “not acceptable”, because they would “cause problems for our people in the country and the region”. Hossein Amir Abdollahian, Iran’s Foreign Minister, has asked Türkiye to agree to set up “a joint bilateral water committee to address [Iranian] concerns in this field.”¹⁶¹

¹⁵⁷ Kibaroglu, *Turkey’s Water Diplomacy* (2021), Chapter 2, p. 34

¹⁵⁸ Greg Shapland, *Rivers of Discord*, Hurst & Company, London 1997, p. 119

¹⁵⁹ UN ESCWA/BGR, Chapter 3, Box 3, p. 121.

¹⁶⁰ Ministry of Foreign Affairs, Türkiye, Türkiye’s Policy on Water Issues, https://www.mfa.gov.tr/turkiye_s-policy-on-water-issues.en.mfa, last visited 13 January 2023.

¹⁶¹ Middle East Monitor, Iran FM: Turkey’s construction of dams ‘unacceptable’, 11 May 2022

<https://www.middleeastmonitor.com/20220511-iran-fm-turkeys-construction-of-dams-unacceptable/>

Iran has shown no recognition of the inconsistency of its position in complaining about unilateral Turkish dam-building on the Aras and while itself unilaterally building dams on the Tigris tributaries and the Karun. Similarly, Iran has not sought the establishment of a joint bilateral water committee to consider Iraqi concerns about Iran's use of shared watercourses.

The situation in respect of another major river on which Iran is the downstream riparian, the Helmand, is different, in that there is a bilateral treaty with Afghanistan. The existence of this treaty, signed in 1973, has not prevented Iran from claiming that "a colonial plan" had unfairly deprived its citizens in the areas bordering Afghanistan of their rights to water. An agreement between Iran and Afghanistan in August 2022 seems to have resolved the problem, at least for the time being.¹⁶²

The Hari Rud (Herat River) is different again. While Iran and Turkmenistan are downstream of Afghanistan on the Hari Rud, the two downstream states (both oil exporters) have been able to use their wealth and Afghanistan's weakness to prevent Afghanistan from depriving them of water.¹⁶³

Bilateral agreements

Despite the absence of a multilateral agreement covering the whole TERS, the riparian states have signed a number of bilateral agreements (see Annex 2, p. 55). Some of these agreements have been very general. For example, in the 1923 Treaty of Lausanne, Türkiye and the Allied Powers agreed that the interests of riparian states would be safeguarded by agreements and, if agreement could not be reached, the dispute would go to arbitration.¹⁶⁴ Similarly, in the 1946 Treaty of Friendship and Good Neighbourliness (with Iraq), Türkiye undertook to inform Iraq of any plans for such works and allow Iraq to send survey teams to the proposed sites.¹⁶⁵

More precise agreements were required when actual dams were being built. One such agreement, one of the most significant regarding the Euphrates, was driven by the prospect of the filling of the reservoir impounded by the Atatürk Dam. Under the terms of the Türkiye/Syria Protocol of Economic Cooperation, signed in 1987, Türkiye undertook to release at least 500 cusecs, averaged over a year (= ~15.5 bcm/a). The agreement marked a "deviation" from Ankara's long-established position that any allocation agreement could only be reached after the completion of "joint objective studies" on the land and water resources of the TERS. It was driven through by Prime Minister Turgut Ozal, who tended to 'govern by

¹⁶² Middle East Monitor, Afghanistan: Taliban reaches agreement with Iran over Helmand River rights, 12 August 2022 <https://www.middleeastmonitor.com/20220812-afghanistan-taliban-reaches-agreement-with-iran-over-helmand-river-rights/>

¹⁶³ Najibullah Loodin and Jeroen Warner, A Review of Hydro-Hegemonic Dynamics on the Transboundary Harirud River Basin: 2001–Present, MDPI, [Water 2022, 14, 3442](https://doi.org/10.3390/w14213442) <https://doi.org/10.3390/w14213442>

¹⁶⁴ League of Nations Treaty Series (1924). Treaty of Peace, signed at Lausanne, July 24, 1923, p. 95 <https://www.mfa.gov.tr/data/Kutuphane/MultilateralConventions/lozan-baris-antlasmasi.pdf> 5

¹⁶⁵ Kibaroglu, A., Building a regime for the waters of the Euphrates-Tigris river basin. Kluwer Law International (2002), pp 222-223.

personal decisions and decrees'.¹⁶⁶ Ozal wanted to provide Syria with an incentive to sign a parallel (but formally separate) agreement on cooperation on terrorism.¹⁶⁷

The Protocol was intended to be temporary. It specified that it was to apply while the Ataturk reservoir was being filled “and until the final allocation of the waters of the Euphrates among the three riparian countries”. Despite further talks since 1987, no such final allocation has been agreed.

Another prominent (but also provisional) agreement on the flow of the Euphrates followed the filling of the Ataturk reservoir in early 1990. This agreement, between Syria and Iraq, divided whatever volume of water flowed across the Turkish/Syrian border 42% to Syria and 58% to Iraq. Together with the 1987 Turkiye/Syria Protocol, Iraq is “guaranteed” around 9 bcm/a.

Neither of these agreements, important as they were, dealt with questions other than volumes of water. Among such questions are water quality, flood protection, responses to droughts, the preservation of ecosystems and the prevention of accidents.

In 2002, Syria and Iraq agreed bilaterally that Syria could install a pumping station on the Tigris to abstract water for irrigation. In 2009, Syria and Turkiye signed a memorandum of understanding (MoU) in which the latter accepted that Syria could indeed install such a pumping station and could use it to withdraw 1.25 bcm/a from the river (“when the flow of water is within the average”) for the irrigation of 150,000 hectares.¹⁶⁸ At the same time, Turkiye and Syria signed three other MoUs “relating to regional waters, namely the Euphrates, Tigris and Orontes” with Syria.¹⁶⁹ The breakdown of Turkish-Syria relations following the beginning of the civil war in Syria in 2011 put paid to any implementation of these MoUs.

Turkiye has signed separate MoUs on water with Iraq. In 2009, Iraq and Turkiye signed an MoU on water under the terms of which the two countries “agreed to exchange hydrological and meteorological information as well as exchanging expertise in these fields.” This MoU has not been implemented, as a result of “strained political relations”.¹⁷⁰

In July 2021, the Iraqi and Syrian ministers of water agreed on the sharing of information on the Euphrates and Tigris and the apportionment of any harms resulting from reductions in flow and from climate change.¹⁷¹ The report does not set out what was agreed regarding the apportioning of such harms.

¹⁶⁶ Şevket Pamuk, *Economic change in twentieth-century Turkey: Is the glass more than half full?*, p. 288, (pp. 266–301) In R. Kasaba (Ed.), *Turkey in the modern world*. Cambridge University Press.

¹⁶⁷ Aysegül Kibaroglu, *Turkey’s Water Diplomacy: Analysis of Its Foundations, Challenges and Prospects*, Ch. 1, Institutional Setting, p. 14, Anthem Press (2021) <https://doi.org/10.2307/j.ctvwh8bgf>

¹⁶⁸ Aysegul Kibaroglu, *Transboundary Water Governance in the Euphrates Tigris River Basin*, E-International Relations, 22 July 2015, p. 3 <https://www.e-ir.info/2015/07/22/transboundary-water-governance-in-the-euphrates-tigris-river-basin/>

¹⁶⁹ Kibaroglu, *Transboundary Water Governance* (2015), p. 3

¹⁷⁰ Kibaroglu, *Transboundary Water Governance* (2015), p. 3

¹⁷¹ Iraqi News Agency, “Iraqi/Syrian Agreement over Water”, 17 July 2021 (in Arabic) <https://www.ina.iq/130552--.html>

The bilateral agreements between Türkiye and Syria, Türkiye and Iraq and Syria and Iraq may be regarded as better than nothing. However, they “are mostly outdated and fail to respond to current needs and issues regarding usage and protection.”¹⁷² Moreover, there are no such agreements between Iran and Iraq.

MECHANISMS FOR COOPERATION BETWEEN BASIN STATES

There are plenty of existing mechanisms that Turkey, Syria, Iran and Iraq could use to prepare agreements that would be more comprehensive, permanent and more satisfactory than those reached to date. Some of these mechanisms are official; others are unofficial.

In 1980, Iraq and Türkiye established a Joint Technical Committee (JTC); Syria joined it in 1983. The JTC’s overall mandate was to determine “the methods and procedures, which would lead to a definition of a reasonable and appropriate amount of water that each country would need from both rivers.”¹⁷³ The actual items on the agenda of JTC meetings were much more modest, such as the exchange of data and of information on dams and irrigation schemes. However, the JTC became deadlocked over the question of whether the Euphrates and Tigris should be considered as a single river basin or whether the discussions should be limited to the Euphrates. The last meeting of the JTC was held 30 years ago, in 1993.

Since then, official exchanges between riparian states have been bilateral and, as noted above, have led to the signature of several agreements. With Syria preoccupied since 2011 with internal strife and with relations between Türkiye and Syria at a low ebb, these exchanges have been mainly between Iraq and Türkiye. There have also been some reported exchanges between Iraq and Iran.

In 2017, Türkiye and Iraq formed five working groups “to address various aspects of the water issue, including the prospect of joint dams at the border, water quality, desertification, dust and sand storms, measurement methods and water management training.” And in 2019, President Erdoğan appointed a special envoy to boost water cooperation with Iraq.¹⁷⁴ In early 2022, the Iraqi News Agency reported that a joint Iraqi/Turkish water centre, agreed in 2019 and to be located in Baghdad, was to go ahead, to serve as a vehicle for Iraqi and Turkish experts to exchange information.¹⁷⁵

Potentially valuable though these initiatives may be, they appear to have made no difference to the fundamentals of Iraq’s water position vis-à-vis Türkiye. Iraq still has to request more water when availability falls below a certain level, as it did in July 2022.¹⁷⁶ During his official visit to Türkiye in March 2023, Iraq’s prime minister, Mohammed Shia al-Sudani made a similar

¹⁷² Aysegul Kibaroglu, “Türkiye’s Water Security Policy: Energy, Agriculture, and Transboundary Issues”, *Insight Turkey*, Vol. 24, No. 2 (Spring 2022), pp. 69-88

¹⁷³ Kibaroglu, *Transboundary Water Governance* (2015), p. 3

¹⁷⁴ Tastekin, *Is a water crisis brewing between Turkey and Iran?* (2022)

¹⁷⁵ INA (Iraqi News Agency), *MOWR: A date to implement the researches of the Iraqi-Turkish Center*, 12 January 2022 <https://ina.ig/eng/16759-mowr-a-date-to-implement-the-researches-of-the-iraqi-turkish-center.html>

¹⁷⁶ Daily Sabah (Turkey), *Iraq asks Turkey to increase water flow along Tigris, Euphrates*, 16 July 2022 <https://www.dailysabah.com/world/mid-east/iraq-asks-turkey-to-increase-water-flow-along-tigris-euphrates>

request to President Erdoğan. The latter agreed to release more water down the Tigris “for a month, as much as possible”.¹⁷⁷

Iraq’s efforts to maintain contacts with Iran over water appear to have had less success than with Türkiye. According to UN ESCWA/BGR (2013), “Following Iran’s exploitation and diversion of shared rivers without prior notification (e.g., on the Karkheh River), the two states decided to form a joint technical committee in order to address issues of mutual concern. Iraq’s Ministry of Water Resources reports that this committee holds regular meetings and organizes technical exchange visits.”¹⁷⁸ It is not known whether this committee has continued to meet: there does not appear to have been any reporting of any activities on its part in the English-language media. If it has continued to meet, it does not seem to have done anything to improve the flow in the rivers down which Iraq receives water from Iran. During his visit to Tehran in late November 2022, Prime Minister Sudani was due to raise the question of “Iran cutting off the flow of water to Iraq” with Iranian leaders.¹⁷⁹ The present author is not aware of any results regarding water that may have materialised from this visit.

Iraq has endeavoured to engage its neighbours about water by organising water conferences in Baghdad in 2021 and 2022.¹⁸⁰ Turkey and Syria were represented at these conferences but (on the basis of media reporting) it appears that Iran was not. Nothing tangible appears to have resulted from these events.

One framework for possible cooperation between Iraq and Iran (and Türkiye and Syria too) on water is an initiative on environmental cooperation launched by Iran at a ministerial-level conference on “Environmental Cooperation for a Better Future” in July 2022. The declaration issued at the end of the conference called for the establishment of “an information exchange network for closer cooperation in studying the impact of climate change on economies, society and the environment.”¹⁸¹ Another possible framework is the West Asia Regional Master Plan to Combat Sand and Dust Storms, an Iranian initiative coordinated by the UN Environment Programme and the World Meteorological Organization’s regional office for West Asia, which is based in Iran.¹⁸² So far, the initiative has had no discernible impact.

¹⁷⁷ Hidropolitik Akademi (Türkiye), Türkiye will increase the amount of water released to Iraq, 22 March 2023 <https://www.hidropolitikakademi.org/en/news-detail/30064/turkiye-will-increase-the-amount-of-water-released-to-iraq>

¹⁷⁸ UN ESCWA/BGR, Chapter 3: Tigris River Basin, p. 121 https://waterinventory.org/sites/waterinventory.org/files/chapters/Chapter-03-Tigris_River-Basin-web_0.pdf

¹⁷⁹ Edward Yeranian, New Iraqi Prime Minister Tells Iran's Supreme Leader that Baghdad Will Stop Attacks Against It, VOA, 30 November 2022 <https://www.voanews.com/a/new-iraqi-prime-minister-tells-iran-s-supreme-leader-that-baghdad-will-stops-attacks-against-it/6857507.html>

¹⁸⁰ Cinzia Bianco, A new climate for peace: How Europe can promote environmental cooperation between the Gulf Arab states and Iran, ECFR Policy Brief, 11 October 2022 <https://ecfr.eu/publication/a-new-climate-for-peace-how-europe-can-promote-environmental-cooperation-between-the-gulf-arab-states-and-iran/>

¹⁸¹ Iran Front Page, Regional environment ministers issue declaration, calling for tackling sandstorms, 17 July 2022 <https://ifpnews.com/regional-environment-ministers-declaration-tackling-sandstorms> The environment ministers of Iran, Azerbaijan Republic, Armenia, Uzbekistan, the UAE, Turkmenistan, Turkey, Syria, Iraq, Oman and Qatar took part in the conference.

¹⁸² Bianco, A new climate for peace (2022)

Indeed, it is debatable whether Iran is sincerely interested in doing all it can to combat the effects of desertification and climate change or is merely trying to spread the blame for the increased frequency of sandstorms and dust-storms in Iran. (In recent years, Iranians – especially in Khuzestan Province – have protested about poor air quality as well as other environmental problems.^{183, 184}) For example, rather than increase the flow of the tributaries of the Tigris which rise on its territory (something that would mitigate the desiccation of soils in Iraq and hence the frequency of dust-storms), Iran has preferred to blame Turkiye.¹⁸⁵ (Iran has also blamed Turkiye for water shortages in Iraq.¹⁸⁶)

In situations in which governments are not yet ready to engage in official negotiations on sensitive issues, informal initiatives can be a useful way of exploring possible solutions. In 2005, a group of scholars and professionals from Turkey, Syria and Iraq came together to set up the Euphrates-Tigris Initiative for Cooperation (ETIC).¹⁸⁷ Among other activities, ETIC has organised capacity-building programmes, workshops and research projects in the three countries. It has, however, been “dormant” since its last workshop in the US in 2016. One of its co-founders, Prof Aysegül Kibaroglu, told the present author that she hopes to revitalize it.¹⁸⁸

It is not clear why such an apparently promising initiative, which has gained international standing, has fallen into this dormant state. According to one interlocutor who preferred to remain anonymous, Turkish officials discouraged the members of the initiative from continuing their efforts. In the view of this author, this is likely to be because the Turkish government does not want any process regarding the two rivers to be taking place outside its control, although there is no publicly-available evidence to support this contention.

Other non-official fora were provided by the CPET (Collaborative Programme Euphrates and Tigris) and the SFG (Strategic Foresight Group), a Mumbai think-tank. CPET brought together experts from Turkiye, Iran and Iraq who were, as of 2021, continuing to meet despite tensions among the governments concerned.¹⁸⁹ The SFG hosted dialogue meetings between Turkey and Iraq in 2013 and 2014, which were attended by “stakeholders” from both countries.^{190, 191} At

¹⁸³ Alex MacDonald, Protests over pollution in Iran's Khuzestan province 'a national threat', Middle East Eye, 18 February 2017, <https://www.middleeasteye.net/news/protests-over-pollution-irans-khuzestan-province-national-threat>

¹⁸⁴ Iran Strategic Focus, Will Anti-Government Protests Destabilise Iran's Political System? MENAS Associates, 27 May 2022 <https://menas.co.uk/blog/will-anti-government-protests-destabilise-irans-political-system>

¹⁸⁵ Nima Khorrami, Amid dust storms and drought, Turkey and Iran are at odds over transboundary water management, MEI, 13 June 2022 <https://www.mei.edu/publications/amid-dust-storms-and-drought-turkey-and-iran-are-odds-over-transboundary-water>

¹⁸⁶ Muhammad Jawad Adib, Iran, Iraq exchange accusations over water flow, Al-Monitor, 25 January 2022 <https://www.al-monitor.com/originals/2022/01/iran-iraq-exchange-accusations-over-water-flow>

¹⁸⁷ <https://euphratestigrisinitiativeforcooperation.wordpress.com/>

¹⁸⁸ Personal communication (email) from Prof Kibaroglu, 5 January 2023.

¹⁸⁹ Kibaroglu and Sayan, Water and ‘imperfect peace’ in the Euphrates–Tigris river basin (2021)

¹⁹⁰ Mueller et al., Climate change, water and future cooperation and development (2021), p. 45.

¹⁹¹ Aysegül Kibaroglu, Ramazan Caner Sayan, Water and ‘imperfect peace’ in the Euphrates–Tigris river basin, International Affairs, Volume 97, Issue 1, January 2021, Pages 139–155, <https://doi.org/10.1093/ia/iaa161>

the 2023 UN Water Conference, Türkiye referred approvingly to the SFG’s “Blue Peace in the Middle East Initiative” as a potential framework for dialogue and cooperation.¹⁹²

POLITICAL RELATIONSHIPS AMONG THE RIPARIAN STATES

One or more of the mechanisms described in the previous section, whether official or non-official, could be used to seek more comprehensive agreements on the water resources shared by Iraq and its neighbours than exist today. That these mechanisms have not been so used suggests that those riparians with a dominant position – Türkiye and Iran – are not prepared to relinquish control of the water resources in question. This is particularly the case with Iran, which has shown a marked reluctance to enter into any serious exchanges on water with Iraq.

For its part, Türkiye has always professed a willingness to discuss comprehensive agreements regarding the Euphrates and Tigris with Syria and Iraq – but on its own terms, which have never been acceptable to the two downstream states. Moreover, Türkiye’s success in developing the GAP infrastructure in the absence of such agreements has created facts which dictate that any eventual negotiations among the three riparians can no longer be about what Türkiye should build and where but rather about how that infrastructure is operated. That need not necessarily be to the disadvantage of Syria and Iraq: it may, for instance, make better sense to store water in Turkish reservoirs than in Syria and Iraq, where evaporation rates are higher. What is clear, however, is that Türkiye is now in full control of the Euphrates and in full control of the flow of the Tigris before it enters Iraq.

One reason for the dominant position of Iran and Türkiye in respect of Iraq is that they are upstream. (The same is true of Türkiye vis-à-vis Syria.) Another is that they are both militarily much more powerful than Iraq. During the course of 2022, both countries launched military attacks on Kurdish militant groups in Iraqi territory. In the case of one particular incident in July 2022 that Baghdad blamed on Türkiye and in which at least nine people died, Iraq took the case to the UN Security Council.¹⁹³ In contrast, Baghdad issued a verbal condemnation of an Iranian attack in November 2022 but took no further action.¹⁹⁴ Later in November, Prime Minister Sudani, visiting Tehran, discussed the attack with Iranian leaders. He told journalists in Tehran after meeting Khamenei, Iran’s Supreme Leader, that Iraq would not allow any attacks on its neighbour from inside its territory.¹⁹⁵

The difference in the Iraqi reactions to these events is instructive: Iraqi leaders are obviously much more reluctant to upset Iran than they are to upset Türkiye.¹⁹⁶ This is not because Iran is militarily more powerful than Türkiye, which it is not. Rather, it is because many Iraqi

¹⁹² UN 2023 Water Conference: Proposal of Türkiye for the Thematic Concept Papers: Water for Cooperation <https://sdgs.un.org/sites/default/files/2022-11/Turkey%20inputs.pdf>

¹⁹³ Commonsense.eu, UN to investigate deadly attack which Iraq blames on Turkey, 28 July 2022 <https://www.commonsense.eu/news/un-investigate-deadly-attack-which-iraq-blames-turkey>

¹⁹⁴ Al-Monitor, Iran says attacks on Iraqi Kurdistan will continue, 16 November 2022 <https://www.al-monitor.com/originals/2022/11/iran-says-attacks-iraqi-kurdistan-will-continue>

¹⁹⁵ Yeranian, New Iraqi Prime Minister, VOA, 30 November 2022

¹⁹⁶ Bilal Wahab, Saving Iraqi Sovereignty: Iran, Turkey and a Fractured Homeland, TWI, 27 November 2022 https://www.washingtoninstitute.org/policy-analysis/saving-iraqi-sovereignty-iran-turkey-and-fractured-homeland#utm_term

politicians and their militia allies are aligned with or beholden to Iran in various ways. According to Bilal Wahab, a respected analyst of Iraqi politics, “Iran has systematically invested in keeping Iraq weak and dependent.”¹⁹⁷

Commenting on Sudani’s visit to Tehran, Prof Khattar Abou Diab, who teaches political science at Paris Sud University, described Sudani as a political ally of Iran. He was going to Tehran, said Abou Diab, to give an account of his government's actions, following Iran’s success in securing his appointment as prime minister.¹⁹⁸

Sudani’s appointment certainly represents a success for the Shia Coordination Framework (SCF), which groups together Iraq’s main Iran-aligned political parties. (The SCF includes Nuri al-Maliki’s State of Law party, Hadi al-Amiri’s Fatah Alliance, Ammar al-Hakim’s Hikmah Movement and Haidar al-Abadi’s Nasr bloc.¹⁹⁹) Sudani’s room for manoeuvre as prime minister is very constrained: “Sudani is a general manager ... Militia leaders have stated that his authority will be limited to technocratic and bureaucratic matters, while they will dictate the country's strategic direction and security decisions.”²⁰⁰ Qais al-Khaz’ali, who heads Asa’ib Ahl al-Haqq, one of the most powerful Shia militias in Iraq, told an interviewer in November 2022 that the SCF had struck a deal with Sudani under which the latter would “refer to the Coordination Framework...for strategic decisions, whether political, economic, or security.”²⁰¹

In a situation in which Iran can act as king-maker in Iraq via its allies there, Baghdad’s ability to contest Iranian failure to take its water (or other) interests into account is extremely limited. According to Prof Abou Diab, Iraq has absolutely no leverage in its dealings with Iran and will have to accept whatever Iran decides [in all fields].²⁰² A senior Iraqi journalist told the author in August 2022 that, because of Iran’s grip on Iraqi politics, there was “no chance” of Iraq getting Iran to release more water. And Azzam Alwash dismissed the suggestion that Iraq could take Iran to the ICJ: “Even if Iraq won a judgment against Iran, you wouldn’t be able to enforce it ... because the Baghdad decision is controlled by Iran.”²⁰³

Not all Shia leaders in Iraq are in hock to Iran. The Sadrist Bloc, led by Muqtada al-Sadr, has adopted a stance in opposition to Iranian influence in Iraq – a position popular among many ordinary Iraqis. At the last elections for Iraq’s parliament, the Council of Representatives, the Bloc gained more seats than any other party but nowhere near enough to form a government on its own. Over the course of the next several months, Sadr was out-maneuvred, with

¹⁹⁷ Bilal Wahab, *Saving Iraqi Sovereignty*, 27 November 2022

¹⁹⁸ Yeranian, *New Iraqi Prime Minister*, VOA, 30 November 2022

¹⁹⁹ Amwaj Media, *Will attacks on foreign interests resume under Iraq’s new government?* 1 December 2022

<https://amwaj.media/article/will-attacks-on-foreign-interests-resume-under-iraq-s-new-government>

²⁰⁰ Hamdi Malik, “Sudani Is a General Manager”: How Militias View Iraq's New Prime Minister, TWI, 1 Dec 2022

https://www.washingtoninstitute.org/policy-analysis/sudani-general-manager-how-militias-view-iraqs-new-prime-minister#utm_

²⁰¹ Hamdi Malik, “Sudani Is a General Manager”: How Militias View Iraq's New Prime Minister, TWI, 1 Dec 2022

²⁰² Yeranian, *New Iraqi Prime Minister*, VOA, 30 November 2022

²⁰³ Fox, *Desertification in an Iraqi Bread Basket* (2022)

Iranian help, by the SCF parties and withdrew the Sadrist representatives from parliament, leaving the SCF free to choose Sudani as prime minister.

It is possible that the Sadrist movement, strengthened over time by the growing popular resentment of Iranian influence in Iraq, will at some point be able to form a government. However, according to a Chatham House paper published in October 2022, “the anticipated gains vis-à-vis Iran will be superficial and are likely to be traded away by Sadr if he consolidates a more dominant leadership position within the Shia Islamist bloc.” Nor would a Sadrist-led government be likely to tackle corruption.²⁰⁴ As one academic analyst put it, “Sadr’s ‘revolution’ against the corrupt political classes is less Eliot Ness going after Al Capone, and more Michael Corleone moving against rival families.”²⁰⁵

What can Iraq offer Turkiye and Iran in exchange for more water?

The main thing Turkey would like from Iraq is suppression of the PKK presence in the KRI. But this is not in Baghdad’s gift but rather in Erbil’s – and the KRI does not need more water from Turkiye: “The Kurdistan Region does not depend on the [Mosul] dam. Duhok draws some water from the Tigris River, but above the dam.”²⁰⁶ In any case, the political and military costs to Iraqi Kurdish leaders of suppressing their fellow Kurds would be unacceptably high.

Iran would also like to see the KRG suppress Kurdish dissidents operating in the KRI. Again, Iraqi Kurdish leaders are not likely to respond positively, even though more water from Iran would be valuable to their region. Moreover, Iran has shown that it has other means (both military and political) of keeping these dissidents in check.

Iraq could offer Turkiye oil and gas at lower-than-market rates. For example, Azzam Alwash has suggested that Iraq could encourage Turkiye to manage the Tigris dams in a cooperative fashion by offering discounted oil and gas.²⁰⁷ As an introductory “sweetener” to such a deal, Baghdad could offer to relinquish the award made against Ankara by the International Court of Arbitration regarding the export of oil from the KRI via Turkiye.²⁰⁸ To date, however, this possibility does not seem to have figured in exchanges between Iraq and Turkiye over water. If it has, it has not reached the public domain.

²⁰⁴ <https://www.chathamhouse.org/sites/default/files/2022-10/2022-10-28-sadrist-movement-iraq-mansour-robin-dcruz.pdf>, p. 6

²⁰⁵ Fanar Haddad, Turbulent Times for the ‘New Iraq’, *Current History* (2022) 121 (839): 331–337.

<https://doi-org.gate3.library.lse.ac.uk/10.1525/curh.2022.121.839.331>

²⁰⁶ <https://www.rudaw.net/english/kurdistan/290520183>

²⁰⁷ Azzam Alwash, The Mosul Dam: Turning a Potential Disaster into a Win-Win Solution. Wilson Center. Viewpoints No. 98 (2016)

https://www.wilsoncenter.org/sites/default/files/media/documents/publication/the_mosul_dam_turning_a_potential_disaster_into_a_win_solution.pdf

²⁰⁸ Bilal Wahab, Tipping Point of the Iraq-KRG Energy Dispute, TWI, 13 February 2023

https://www.washingtoninstitute.org/policy-analysis/tipping-point-iraq-krge-energy-dispute#utm_term AND Raya Jalabi and Adam Samson, Iraq wins landmark case against Turkey over Kurdish oil exports, *Financial Times*, 25 March 2023 <https://www.ft.com/content/b4837b44-a646-4d91-8f86-45a51612dad3>

THE CHALLENGE OF CORRUPTION

As well as the challenge of dealing with upstream riparians, the Iraqi water sector – like all sectors of the economy – faces the challenge of corruption. According to Sajad Jiyad, an Iraqi political scientist based in Baghdad, “Corruption is so entrenched in the current political system that it has become the system. Whether in health care, education, financial services, construction, or any other sector, the political elite use intermediaries to inflate costs, eliminate competition, increase hiring, extort, blackmail, extract kickbacks and concessions, defraud, steal, and embezzle to make billions of dollars per year.”²⁰⁹ Other observers agree: US journalist Robert F Worth describes Iraqi politics as “a consensual process in which Iraq’s oil money, funneled through the ministries, is divided up by oligarchs and the militias that protect them.”²¹⁰ It is hard to disagree with Worth’s judgement that Iraq has become a “kleptocracy”.²¹¹ A think-tank report produced in late 2022 assesses that “...a ministry that is allocated to a particular political party is treated as a private domain to be exploited for the benefit of the party not the country.”²¹²

Resigning in August 2022 in protest at what he had found since returning to Iraq to become minister of finance some two years before, Ali Allawi said that the state had been “effectively captured by political parties and special-interest groups.”²¹³ Even where ministries are headed by technocratic ministers, senior officials are often politicised: officials in the “special grades” ensure that the interests of their political patrons are protected.²¹⁴

Such strictures apply to the water sector as much as other sectors. According to Nadhir al-Ansari of Luleå University, “The people in charge aren’t looking at the country’s future. All they care about is how much they are benefiting from the positions they are holding.”²¹⁵

The vested interests of leaders and business people in Iraq stand in the way of good decision-making: e.g., private water suppliers (via tankers) have no interest in seeing water supplies become more regular and efficient. The temporary drying-up of Lake Sawa (near Samawa in southern Iraq) offers another example: “Enforcing the closure of illegal wells and additional protective measures would have reversed Lake Sawa’s decline, said Aoun Diab, an adviser to

²⁰⁹ Sajad Jiyad, Corruption Is Strangling Iraq, The Century Foundation, 14 December 2022

<https://tcf.org/content/report/corruption-is-strangling-iraq/>

²¹⁰ Robert F. Worth, The Most Stinging Resignation Letter Ever Written, The Atlantic, 22/9/2022

<https://www.theatlantic.com/international/archive/2022/09/ali-allawi-iraq-corruption-resignation-letter/671509/>

²¹¹ Robert F Worth, Inside the Iraqi Kleptocracy, New York Times, Published 29 July 2020; Updated 27 May 2021

<https://www.nytimes.com/2020/07/29/magazine/iraq-corruption.html>

²¹² Massaab Al-Aloosy, With Iraq’s Quota System, the New Government is More of the Same, The Arab Gulf States Institute in Washington, 15 November 2022 <https://agsiw.org/with-iraqs-quota-system-the-new-government-is-more-of-the-same/>

²¹³ Robert F. Worth, The Most Stinging Resignation Letter Ever Written, The Atlantic, 22/9/2022

²¹⁴ Dodge and Mansour, “Politically sanctioned corruption and barriers to reform in Iraq”, June 2021

²¹⁵ Foltyn, ‘The green land is a barren desert’, 7 September 2022,

the Water Resources Ministry. But these would have directly affected the economic interests of provincial officials.”²¹⁶

That corruption is an integral part of the Iraqi political system makes it difficult for outside agencies to fund the infrastructure necessary to improve the functioning of the Iraqi water sector. For example, the Great Basra Water Project has been delayed because “political parties and other special interests” have demanded “bribes and other illicit contract payments”.²¹⁷ A contract for a reverse-osmosis desalination plant at Al Hartha to process 200,000 cm/day of water from the Shatt, awarded in 2014, provides another example. The project has been delayed as a result of tribal disputes and alleged corrupt payments.²¹⁸

Prime Minister Sudani has said he will tackle corruption.²¹⁹ However, since he serves at the pleasure of the SCF parties and their militia allies, they can prevent him doing anything that would threaten their interests or those of their associates.

While Iraqi political parties and their associates compete energetically for the spoils of government, they are unified in their resistance to attempts to reform the status quo.²²⁰ Speakers at a Chatham House conference in November 2022 made it clear how difficult it would be to change the system. First, there is a general lack of appetite for public sector reform in general, on the part of both civil servants – who fear the loss of jobs – and the elite, who fear the loss of patronage (and presumably income).²²¹ Second, the system itself constrains reform as the present set-up rewards those parties which control ministries with big budgets: for example, the Ministry of Electricity is fiercely fought over because it is a “cash cow”.²²² (The under-funded MoWR does seem to be one of these cash cows but major infrastructure projects on water are, as noted above, vulnerable to corrupt practices.) Third, ministers are not appointed on merit. Rather, ministries are awarded according to the number of “points” each party has, which depends in turn on how many seats it has in the CoR.²²³

It is of course possible that, within the time-frame adopted for this report, Iraqis will find a way of reforming or replacing their political system with one that brings corruption down to manageable levels. Such processes tend to take a long time, however – as witness the many countries languishing for years (with Iraq) at the bottom end of the Transparency International Corruption Perceptions Index.²²⁴

²¹⁶ Independent, Iraq's 'pearl of the south' Lake Sawa dry amid water crisis, 13 June 2022 <https://www.independent.co.uk/news/ap-iraq-baghdad-muhammad-saddam-hussein-b2099492.html> Aoun Diab was appointed Minister of Water Resources in October 2022.

²¹⁷ Mason, Infrastructure, 2022

²¹⁸ Mason, Infrastructure, 2022

²¹⁹ Renad Mansour and Haider al-Shakeri, Can Iraq's new government reform the corrupt system? 30 November 2022 https://www.chathamhouse.org/2022/11/can-iraqs-new-government-reform-corrupt-system?utm_

²²⁰ Al-Aloosy, With Iraq's Quota System, the New Government is More of the Same, 15 November 2022

²²¹ Dr Marsin Alshamary, Chatham House Iraq Initiative Conference, 14 November 2022

²²² Prof Toby Dodge, Chatham House Iraq Initiative Conference, 14 November 2022

²²³ Dhia al-Asadi (Sadrist politician), Chatham House Iraq Initiative Conference, 14 November 2022

²²⁴ Corruption Perceptions Index 2022 (and earlier years), Transparency International website, last visited 15 March 2023. <https://www.transparency.org/en/cpi/2022>

LOW-PROBABILITY, HIGH-IMPACT DEVELOPMENTS THAT COULD CHANGE EXISTING DYNAMICS

There is space in this report only to list these possible developments rather than examine their consequences in detail. Such developments could include:

1. A change of regime in Iran, which might come about through a popular revolution: a new regime in Tehran might try to improve relations with its neighbours and with the international community more generally. A more cooperative attitude to shared water resources could be part of such an effort
2. The lifting of sanctions on Iran (e.g., through a return to the JCPOA), leading the regime to abandon its goal of self-sufficiency in food. This would allow Iran to devote less water to irrigation, leaving more to share with Iraq.
3. A complete change of political system in Iraq, perhaps as a result of a popular revolution: this could free Iraq from corruption and from undue Iranian influence.
4. A political breakthrough or change of regime in Syria: this might lead to earlier-than-expected reconstruction and so to increased consumption of water from the Euphrates and Tigris.
5. A dramatic deterioration of relations between Erbil and Baghdad: this could lead to the KRG withholding water from the rest of Iraq.
6. A global energy crisis affecting Turkiye's supplies of oil and gas: this could give Iraq (which could offer cheap oil and gas) some leverage over Turkish water policy. It would need to be a very severe crisis, as "[a]pproximately 54% of Turkey's electric power generation capacity comes from renewable energy, including hydroelectric, wind, solar, geothermal, and biomass power plants ..." ²²⁵ It could, however, coincide with a sustained drought in the Tigris and Euphrates basins, causing lower flows in the rivers and so reducing the output of HP plants.

PART III: CONCLUSIONS

Iraq's water security is already poor: in many years, it does not have enough water to supply all consumers with adequate volumes of water at acceptable levels of quality. The agricultural sector is often unable, for lack of water, to produce everything it otherwise could. Without action, the country's water security will deteriorate further.

For much of its surface water, Iraq is dependent on flows from Turkiye and Iran. These flows have been declining for several decades and will probably continue to do so, as a result of growing consumption by these upstream riparians. Reconstruction in Syria, though seemingly many years away, will at some point increase that country's demand for water too. The decline in flows will, together with increasing pollution in upstream countries and in Iraq itself, negatively affect water quality in Iraq.

²²⁵ US International Trade Administration website: Turkey – Country Commercial Guide, Electric Power – Renewables, Smart Grid, Energy Storage, Civil Nuclear, last visited 13 January 2023
<https://www.trade.gov/country-commercial-guides/turkey-electric-power-renewables-smart-grid-energy-storage-civil-nuclear>

Lower precipitation consequent upon climate change across the TERS is likely to reduce flows into Iraq (and within Iraq) still further. Moreover, higher temperatures will cause higher rates of evapo-transpiration from plants and evaporation from reservoirs, lakes and canals, meaning the loss of an even greater part of Iraq's water budget than is the case today. Whatever water Iraq does have available will not go as far as it does now.

Neither Türkiye nor Iran has shown any interest in a permanent commitment to allow fixed volumes of water or percentages of flow in the watercourses which they share with Iraq. (The 1987 Türkiye/Syria agreement represents a qualified exception.) Otherwise, Türkiye's posture is ostensibly quite forthcoming. It has espoused the desirability of cooperation and has professed itself willing to talk about permanent arrangements for the Tigris and Euphrates. It has released more water when Iraq requested it and, until 2018, shared data. However, it has not shown any real readiness to share control of the transboundary water resources which rise in its territory – at least, not on terms that would be acceptable to Iraq.

For its part, Iran has not been prepared to engage seriously with Iraq on water at all. It has shown no consideration of Iraqi water needs and has not even been prepared to share data. And the Syrian regime is in no position to engage with Iraq on the water resources they share.

The asymmetries of power between Iraq and Türkiye and Iraq and Iran mean that neither upstream riparian is under any pressure to be more forthcoming. (Within the time-horizon adopted by this report, these asymmetries could change but, for the foreseeable future, the probability of such change seems low.) For its part, Iran, through its influence on Iraq's political system, can prevent Iraq from doing anything that it would regard as damaging to its interests. Moreover, in its policy-making with respect to shared water resources, the Iranian regime is highly likely to put the interests of its own citizens and the vested interests of regime institutions before its relations with Iraq. The pressure on water resources in south-west Iran and Iranian behaviour to date in exploiting water with no regard for Iraqi interests support this conclusion, as do the remarks made by the Iranian water expert interviewed by the author (p. 14 above) about Iranian attitudes.

As well as being much weaker than both Türkiye and Iran, Iraq does not have much to offer either country to encourage a friendlier posture on water. What both upstream riparians appear to want most from Iraq (the suppression of Kurdish dissidents who have based themselves in the KRI) is in Erbil's gift rather than Baghdad's. And Erbil is not likely to comply.

It is tempting to think that diplomatic involvement by outside governments could help to improve the prospects of agreement on water between Iraq and its upstream neighbours. However, Türkiye (the big player in terms of Iraq's water supply) explicitly rejects the idea of third-party involvement.²²⁶ Moreover, the presently poor relationships between Western governments and the Iranian regime (and the strength of the latter's influence in Baghdad) would tell against any attempts to secure a more cooperative Iranian attitude to Iraq's water needs. The same poor relationships also hinder any action by Western governments with

²²⁶ Türkiye's Policy on Water Issues, Ministry of Foreign Affairs, Turkey https://www.mfa.gov.tr/turkiye_s-policy-on-water-issues.en.mfa, last visited 13 January 2023.

respect to Syria, with the additional complication that the Syrian regime is not in control of the Tabqa Dam, its largest water-regulation installation.

There seems to be little or nothing that Iraq can do to compel Iran or Turkey to adopt more accommodating attitudes. Moreover, it is difficult to identify any incentives – at least none that would not require concessions on major issues – that HMG and other governments could offer to Tehran and Ankara to induce them to change their positions. If third countries such as the UK felt they could offer such concessions, they would presumably be looking for reciprocal movement on questions of more direct importance to them, such as Ukraine. Encouraging more constructive attitudes on the part of Iran and Turkey with regard to Iraq's water security looks like a relatively low priority for the US, EU, UK and other governments.

International financial institutions might consider acting as high-level champions of transboundary cooperation. However, these institutions may have less leverage than one might expect. For instance, the decision by a consortium of European credit agencies not to provide finance for the Ilisu Dam delayed but did not halt the construction of the dam.²²⁷ Iran has similarly managed to pursue its dam-building programme using internal and Chinese funding and without access to Western financial institutions.²²⁸

These political circumstances are not immutable, especially when considered over a period of decades rather than years. And it is certainly possible to envisage the evolution of these circumstances in a positive direction. However, the UK and other outside governments needing to make aid policy now cannot count on the emergence of positive changes that would create opportunities not currently available.

Iraq's wasteful use of water, especially in irrigation, gives its upstream neighbours, particularly Turkiye, a pretext not to engage in negotiations over volumes of water. Iraq, they say, could manage with much less water than it consumes at present – and should not ask for more until it has got its own house in order. For example, "Ankara's ambassador to Iraq said in July [2022] that the drought had hit Turkey too, and that instead of asking for more water, Baghdad should manage its supplies more carefully."²²⁹ Iraq's Minister of Water Resources rejected the ambassador's remarks.²³⁰

²²⁷ Brett Walton, New Bank Loans Revive Controversial Ilisu Dam Project in Turkey, Circle of Blue, 13 January 2010 <https://www.circleofblue.org/2010/world/new-bank-loans-revive-controversial-ilisu-dam-project-in-turkey/>

²²⁸ On Chinese funding for water and other projects in Iran, see, for example, Mahua Mitra, Increased Credit Access in Iran Boosting Infrastructure Growth, 11 January 2018 <https://borgenproject.org/credit-access-in-iran/>

²²⁹ Amina Ismail and Maha El Dahan, Middle East's Fertile Crescent dries up as rains fail, Reuters, 14 November 2022 <https://www.reuters.com/investigates/special-report/climate-un-mideast-water/>

²³⁰ Julian Bechocha, Iraq hits back at Turkish claims of wasting water, Rudaw (news agency), 13 July 2022 <https://www.rudaw.net/english/middleeast/iraq/13072022>

PART IV: RECOMMENDATIONS

Numerous reports have considered the water resources of the TERS and offered recommendations.²³¹ Some of these recommendations concern things that the countries sharing the TERS could do to establish more cooperative relationships over water. Such moves could, in the view of those making the recommendations, produce outcomes that would enhance Iraq's water security without harming Turkish, Syrian or Iranian interests. For Iraq, initiatives of this nature make good sense. For the moment, however, the other three riparians exhibit little interest in such cooperation on terms acceptable to Iraq.

Other recommendations contained in studies on Iraq's water and agriculture sectors suggest steps such as:

- using water more efficiently, particularly in irrigation, mainly by replacing flood irrigation with drip irrigation or sprinklers;²³²
- conserving groundwater and promoting its most productive use by issuing transferable or tradable pumping permits;²³³
- concentrating the cultivation of rice (Iraq's thirstiest crop) in provinces in which the "water duty" (the volume of water required per ton of output) is lowest, e.g., Qadisiyah and Najaf, and substituting rice cultivation for vegetables (which are more profitable) in provinces in which the water duty is much higher, e.g., Muthanna and Maysan).²³⁴ (If this recommendation was adopted, Iraq might have to import more rice but should find itself importing fewer vegetables.)
- adapting in various ways to climate change, e.g., by introducing "climate-smart" agricultural practices such as the introduction of drought- and heat-resistant crop varieties.²³⁵

These recommendations, if implemented, could improve the prospects of the agricultural sector and hence maintain the viability of rural communities. This should have a beneficial effect on stability, by slowing migration from the countryside to the cities and hence the growth of a disadvantaged and discontented urban proletariat. In turn, this should discourage the creation of a pool of potential recruits to militias and terrorist groups. It should also serve to reduce emigration from Iraq to other countries on the part of those who had moved from the countryside to the cities with the aim of finding a better life there but whose hopes were dashed. One should be aware, however, that water shortages and other environmental factors are only one driver of displacement and migration, along with "political, demographic, economic and social factors".²³⁶

²³¹ For example, Mueller et al. (2021), Shamout and Lahn (2015), Von Lossow et al. (2022), World Bank (2022).

²³² See, for example, World Bank, Iraq: Country Climate and Development Report (2022), p. 51

²³³ Al-Azawi and Ward (2017), Groundwater use and policy options for sustainable management in Southern Iraq

²³⁴ Salam Hussein Ewaid et al., Water Footprint of Rice in Iraq (2020).

²³⁵ See, for example, World Bank, Iraq: Country Climate and Development Report (2022), p. 51

²³⁶ IOM (International Organisation for Migration), Water Quantity and Water Quality in Central and South Iraq (2020), p. 6

Of the reports which have made recommendations concerning Iraq's water sector, perhaps the most authoritative is the SWLRI strategy, which was prepared in 2014 for the MOWR.²³⁷ The SWLRI concluded that only through major reform of water use and allocation could Iraq avert a situation in which, by 2035, it would be unable to meet its water demand to the tune of almost 11 bcm/a. Put another way, the country would have only 85% of the water it needs, on the basis of projections of present consumption.²³⁸ The strategy suggests reforms that would enable Iraq to meet its water needs in full and improve its food security (despite a greatly increased population), even assuming "100% upstream development" in Turkiye, Syria and Iran. These reforms include:

- Modernising agriculture, including through the introduction of more efficient irrigation techniques. (The strategy admits that this would be hugely expensive but predicts that failing to do so would mean the end of agriculture in Iraq.)
- Abandoning the idea of building more large dams, which are not needed. (Former Minister of Water Resources Hassan Janabi, speaking at the Chatham House Iraq conference in November 2022, reiterated this recommendation – albeit without referring to the SWLRI.²³⁹)
- Ceasing to use Lakes Tharthar, Habbaniya and Razzaza for water storage, using them only for flood control at times of exceptionally high flow. The strategy makes it clear that water storage in these lakes will no longer be necessary because of reduced inflow into Iraq and changes in water resources management within Iraq.
- Constructing a new drainage network that would, together with the previous recommendation, mean a notable improvement in water quality.
- Reviewing the legal and institutional framework for land and water management and developing a strategy to reform this framework, which would lay the foundations for the implementation of the SWLRI Strategy recommendations.

At the same time, the strategy recommends that, although Iraq should plan for the worst, it should continue to strive for agreements with its upstream neighbours.²⁴⁰

Eight years after receiving the SWLRI, the MOWR has only implemented a small part of it.²⁴¹ The Mosul Dam has apparently been successfully rehabilitated.²⁴² But the institutional and policy reforms for which the strategy calls do not seem to have been made. There is no reason to suppose that similar recommendations regarding the reform of the water sector made by others would be implemented with greater alacrity – however much objective sense they might make and however elevated the international standing of those making the recommendations, such

²³⁷ Not all experts on the Iraqi water sector hold the SWLRI in high regard, however. Prof Nadhir Al-Ansari of Lulea University in Sweden told the author (interview, 24 April 2023) that some of the figures it used were "completely wrong": for example, when assessing Iraq's water-storage capacity, the SWLRI had failed to make any allowance for the impact of sedimentation.

²³⁸ Republic of Iraq – Ministry of Water Resources, SWLRI (2014), Executive Summary, Figure 1, p. 1.

²³⁹ Dr Hassan Janabi, Iraqi Minister of Water Resources, 2016-18, Chatham House Iraq Initiative Conference, 14 November 2022

²⁴⁰ Republic of Iraq – Ministry of Water Resources, SWLRI, 2014, Executive Summary, p. 5.

²⁴¹ WPS and Clingendael, Water Governance in Iraq (2022), p. 4 <https://waterpeacesecurity.org/files/245>

²⁴² Hydro Review, Mosul Dam rehab project wins award for work done deep in Iraq's conflict zone, 29 July 2022 <https://www.hydroreview.com/dams-and-civil-structures/mosul-dam-rehab-project-wins-award-for-work-done-deep-in-iraqs-conflict-zone/>

as the World Bank.²⁴³ Moreover, nothing in the Iraqi political system has changed enough to suggest that such recommendations would be sufficiently compelling to overcome the resistance of vested interests. These recommendations are therefore not examined here, especially as they largely concur with those contained in the SWLRI.

In terms of the better use of water within Iraq, this report has already identified two main obstacles to the implementation of the SWLRI recommendations, or any similar recommendations. These obstacles are endemic corruption and a lack of capacity on the part of officials. The former makes it very hard for outside agencies to fund large infrastructure projects, which are notably vulnerable to various forms of corruption and extortion. However, there may be ways of protecting large projects from such predation. With this goal in mind, it seems sensible for development officials in the FCDO to consult US counterparts to find out how they managed (assuming they did) to protect the Mosul Dam rehabilitation project from corruption. Similarly, it could be worth talking to other governments about this. For example, JICA (Japan) withdrew from a large-scale infrastructure project in southern Iraq because of corruption and could advise on the pitfalls.²⁴⁴

It might be possible for outside aid agencies to mitigate the risks of corruption if they can provide assistance on a small scale and in a dispersed fashion. (According to the World Bank (2022), “agriculture in Iraq is largely practiced on small farms.”²⁴⁵) The installation of modern irrigation systems at farm level could be an area worth examining. Farmers being provided with such equipment would need training as they seek to adapt to new irrigation technologies, to switch to less “thirsty” crops or to adopt more drought- and heat-resistant species.

The provision of equipment for monitoring water (surface flows and groundwater), in terms of both quantity and quality is another area in which donors could help. Information on Iraq’s groundwater reserves seems particularly poor.²⁴⁶ A related activity, entirely safe from corrupt Iraqi actors, would be the remote monitoring of groundwater reserves in Iraq, as done for Yemen by HR Wallingford (funded by the FCDO).²⁴⁷ It is worth remembering that “the use of modern technologies in monitoring and controlling groundwater aquifers” is one of the three primary adaptation actions in Iraq’s NDC (Nationally Determined Contribution) document.²⁴⁸ A joint statement following a meeting between the US Secretary of State and the Iraqi Foreign Minister in mid-February noted that “The delegations resolved to prioritize leveraging modern technologies in groundwater management (...).”²⁴⁹

²⁴³ World Bank, “Iraq: Country Climate and Development Report” (2022)

²⁴⁴ Mason, Infrastructure, 2022

²⁴⁵ World Bank, “Iraq: Country Climate and Development Report” (2022), p. 15

²⁴⁶ “The groundwater monitoring system infrastructure (including observation wells, periodical pumping test, water level monitoring, etc.), has suffered from deterioration over the last decades due to political crises facing the country.” Jafar Y. Al-Jawad et al., Decision-Making Challenges of Sustainable Groundwater Strategy (2019)

²⁴⁷ Yemen Groundwater Risk Assessment Website <https://www.yemen-groundwater-risk.org/>, last visited 2 March 2023.

²⁴⁸ World Bank, “Iraq: Country Climate and Development Report” (2022), p. 10

²⁴⁹ Joint statement by the US and Iraqi governments, 15 February 2023, Ministry of Foreign Affairs of Iraq website, last visited 15 March 2023 <https://mofa.gov.iq/newyork/language/en/the-following-statement-was-released-by-the-governments-of-the-united-states-of-america-and-the-republic-of-iraq/>

The second obstacle – the lack of capacity on the part of officials both in the MOWR and at provincial level – is, for outside aid agencies, an opportunity as well as an obstacle. Capacity-building can be delivered at relatively low cost, compared to large infrastructure projects, and is less vulnerable to predation. And public education programmes could, for a modest expenditure, make some dent in the consumption and pollution of water by Iraqi households.²⁵⁰

Along similar lines, although working with non-official interlocutors, would be support for local NGOs active in water and environmental matters.²⁵¹ Any action in this area would have to tackle security, logistical and accountability challenges but these are not inherently insuperable.

One issue that has emerged particularly starkly since the SWLRI was completed is that of water quality in Basrah Governorate. In this context, it is easier to identify what needs to be done than to find ways in which outside agencies could give practical assistance. However, the suggestion that there should be an independent review of water management in the Governorate represents a sound starting-point.²⁵² Assuring the independence of any such review would not be straightforward, however, given the dysfunctional and violent politics of the Governorate.

As far as reaching agreement with Iraq's upstream neighbours is concerned, the capacity of officials could be an issue here too. Iraq's negotiators might not at present be a match for those of their upstream riparians and would therefore benefit from capacity building.

The bigger problem, however, is that there are no negotiations in prospect. This is because neither Turkiye nor Iran sees it as being in their interests to agree to anything that would constrain their controlling positions. It is not clear how the UK or other third-parties can help in this regard. Of the three upstream riparians, two (Iran and Syria) have extremely poor relations with Western governments. And anything Syria might agree on shared water resources would be largely meaningless anyway, given the government's lack of control over the parts of the country that matter in this context.

One possible third-party intervention that could conceivably contribute to Iraq's water security could come through a dialogue between UK officials and the Iraqi government about ways in which the latter could most effectively engage with its neighbours on the subject. Such a dialogue could suggest to Baghdad that Iraq could benefit by seeking agreement with Turkiye regarding the latter's management of its dams on the Tigris and Euphrates. Baghdad might be able to reach some kind of agreement (possibly provisional) with Turkiye without compromising its position of principle regarding water shares.

²⁵⁰ Tobias von Lossow et al., Action Needed: Three Priorities for Iraq's Water Sector, Water, Peace and Security and Clingendael, June 2022, p. 12 <https://waterpeacesecurity.org/files/229>. Some public education in water use has taken place: the MOWR website records one such activity (but only one): MOWR, The Water Resources Directorate in Najaf holds an educational symposium to raise awareness of the importance of rationalizing consumption and optimal use of water, 7 December 2022 <https://mowr.gov.iq/en/2022/12/07/the-water-resources-directorate-in-najaf-holds-an-educational-symposium-to-raise-awareness-of-the-importance-of-rationalizing-consumption-and-optimal-use-of-water/>

²⁵¹ Schwartzstein, Climate, Water and Militias: a Field Study from Southern Iraq (2023)

²⁵² Azhar Al-Rubaie et al., Failing Flows: Water Management in Southern Iraq, LSE Middle East Centre Paper Series #52, July 2021 http://eprints.lse.ac.uk/110973/2/Failing_Flows_003_.pdf

A first step to building cooperation between Iraq and its upstream neighbours (which third parties might try to encourage) could come in the field of information exchanges. The legal basis for such exchanges between Iraq and Türkiye already exists, in the form of the 2009 MoU.²⁵³ Moreover, a proposed joint water centre, to be located in Baghdad and given the go-ahead in 2022, could serve as the vehicle.²⁵⁴ These exchanges would not necessarily require (initially, at least) the sharing of all available data. Rather, they could come in the form of the establishment of more partial arrangements, such as early-warning systems regarding drought and floods.

Such steps might seem excessively timid for those who can discern comprehensive solutions that would benefit all the riparian states. However, one should bear in mind that the Iranian regime has sufficient influence in Iraqi political life that it can frustrate any initiative that it regards as damaging to its interests in Iraq – and it might well see greater cooperation between Baghdad and Ankara over water as falling into that category. Over the coming decades, that power relationship could change, giving Baghdad and outside development agencies the opportunity to pursue more ambitious ideas. For the moment, however, all concerned are likely to have more success with modest initiatives.

To summarise, these initiatives might be:

1. Small-scale, dispersed assistance to farmers in the modernisation of their irrigation methods.
2. Assistance to farmers to help them switch from rice to other crops (e.g., vegetables) in vulnerable southern governorates.
3. Assistance to farmers to help them grow drought- and heat-resistant crops.
4. Capacity-building for officials (including engineers) both in the MOWR and at provincial level.
5. Technical support for an independent review of water management in Basrah Governorate.
6. The provision of equipment for monitoring water (both surface flows and groundwater), in terms of both quantity and quality.
7. The remote monitoring of groundwater reserves.
8. Support for local NGOs active in water and environmental matters.
9. Help with public education campaigns designed to increase awareness of the need to conserve water and protect its quality.
10. A UK-Iraqi dialogue aimed at identifying ways in which Iraq could best engage with its neighbours over shared water resources. In respect of Türkiye, this could be informed by UK diplomatic exchanges with Ankara to explore possibilities (although expectations should be realistic), perhaps in the area of the enhanced sharing of data.
11. Training for Iraqi water negotiators, should there seem to be a real prospect of negotiations with one or more of Iraq's riparians.

²⁵³ Kibaroglu, *Transboundary Water Governance* (2015), p. 3

²⁵⁴ INA (Iraqi News Agency), MOWR: A date to implement the researches of the Iraqi-Turkish Center, 12 January 2022 <https://ina.iq/eng/16759-mowr-a-date-to-implement-the-researches-of-the-iraqi-turkish-center.html>

ANNEX 1: THE MAIN DAMS IN THE TIGRIS-EUPHRATES RIVER SYSTEM (TERS)

Abbreviations FC: flood control; has: hectares; HP: hydro-power; I: irrigation; MW: megawatts; RR: re-regulation; WS: water supply

Table 1: The Main Dams in the Euphrates Catchment (in chronological order of completion)

Name of dam	Country location	River	Date of compl'n	Storage (mcm)	Purpose	Area (to be) irrigated, in has
Hindiya Barrage	Iraq	Euphrates	1989	Diversion only	HP, I	??
Ramadi Barrage	Iraq	Euphrates	1948	Diversion only	FC	64,150 ²⁵⁵
Keban	Turkiye	Euphrates	1974	31,000	HP, FC	
Tabqa/ Thawra	Syria	Euphrates	1975	14,000	HP, I	200,000 ²⁵⁶
Haditha/ Qadisiya	Iraq	Euphrates	1985	8,280	HP, I	??
Baath	Syria	Euphrates	1987	90	HP, FC, RR	
Karakaya	Turkiye	Euphrates	1987	9,580	HP	
Atatürk	Turkiye	Euphrates	1992	48,700	HP, I	200,000 (2013); 748,000 (projected) ²⁵⁷
Tishreen	Syria	Euphrates	1999	1,900	HP	
Karkamis	Turkiye	Euphrates	1999	160	HP, FC	
Birecik	Turkiye	Euphrates	2000	1,220	HP, I	92,700 (projected) ²⁵⁸

²⁵⁵ Mukhalad Abdullah et al., Irrigation Major Systems on Euphrates River within Mesopotamia, Journal of Earth Sciences and Geotechnical Engineering, Vol.10, No.4, 2020, 199-219 ISSN: 1792-9040 (print version), 1792-9660 (online) <http://www.diva-portal.org/smash/get/diva2:1416157/FULLTEXT01.pdf>

²⁵⁶ A. Alia, Bi-objective dynamic programming for trading off hydropower and irrigation: case of the Tabqa dam on Euphrates, Syria, Unesco-IHE (2007) <https://ihedelftrepository.contentdm.oclc.org/digital/collection/masters1/id/101213/rec/2171>

²⁵⁷ Ataturk Baraji (website), DSI <http://www.ataturkbaraji.com/en/30536/>, last visited 22 February 2023.

²⁵⁸ Cigdem Kurt, The impact of the Southeast Anatolia Project (GAP) on displaced families: Household livelihoods and gender relations, PhD thesis, 2013 <https://theses.ncl.ac.uk/jspui/bitstream/10443/2223/1/Kurt%2C%20C.%202013.pdf>

Table 2: The Main Dams in the Tigris Catchment (in order of completion)

For dams in the Karkheh and Karun catchments, see Table 3 below.

Name of dam	Country location	River (tributary and main)	Date of compl'n	Volume of storage (mcm)	Purpose(s)	Area in has (to be) irrigated
Kut Barrage	Iraq	Tigris	1939	Diversion only	I	111,500 ²⁵⁹
Samarra Barr	Iraq	Tigris	1954	Diversion only	FC, HP, I	115,500 ²⁶⁰
Dukan (Dokan)	Iraq	Lesser Zab, Tigris	1961	6,970 ²⁶¹	FC, HP, I	??
Derbendi-khan	Iraq	Diyala, Tigris	1962	3,000	FC, HP, I, WS	??
Hemrin	Iraq	Sirwan, Diyala/Tigris	1981	4,000	FC, HP, I	??
Mosul	Iraq	Tigris	1985	11,100 ²⁶²	FC, HP, I	116,000 ²⁶³
Tigris/Diçle	Turkiye	Tigris	1997	6,000	HP, I, WS	126,080 (proj'd)
Batman	Turkiye	Batman, Tigris	1999	1,200	FC, HP, I	37,774 (proj'd)
Garzan	Turkiye	Garzan, Tigris	2012	165	HP	40,000 ²⁶⁴
Gavoshan (Gavshan)	Iran	Gaveh, Diyala/Tigris	2004	550	HP, I, WS	31,000
Daryan ²⁶⁵	Iran	Sirwan	2015	316	HP, I	??
Sardasht	Iran	Lesser Zab	2017	380	HP, I(?)	
Ilisu	Turkiye	Tigris	2021	10,400 ²⁶⁶	HP	
Çizre	Turkiye	Tigris	Under constr'n	3,300	HP, I	~100,000 (proj'd)
Silvan	Turkiye	Batman, Tigris	Under constr'n	7,300	HP	245,000 (proj'd)

²⁵⁹ Figure calculated from figures in Mukhalad Abdullah et al., Water Resources Projects in Iraq: Irrigation Projects on Tigris, Journal of Earth Sciences and Geotechnical Engineering, Vol. 9, No. 4, 2019, 201-230 ISSN: 1792-9040 (print version), 1792-9660 (online).

²⁶⁰ Figure calculated from figures in Mukhalad Abdullah et al., Water Resources Projects in Iraq (2019).

²⁶¹ According to Prof Nadhir Al-Ansari (author's interview, 24 April 2023), the capacity of the reservoir has been reduced by 25% due to sedimentation.

²⁶² According to Prof Nadhir Al-Ansari (author's interview, 24 April 2023), the capacity of the reservoir is now, because of leakage, no more than four bcm (4,000 mcm).

²⁶³ Figure calculated from figures in Mukhalad Abdullah et al., Water Resources Projects in Iraq

²⁶⁴ Garzan Dam, Nina.az website https://www.wiki3-en-us.nina.az/Garzan_Dam.html, last visited 18 April 2023

²⁶⁵ Daryan Dam, Wikipedia https://en.wikipedia.org/wiki/Daryan_Dam, last visited 22 March 2023.

²⁶⁶ Ilisu Dam and Hydroelectric Power Plant, NS Energy (website), last visited 27 February 2023 <https://www.nsenergybusiness.com/projects/ilisu-dam-and-hydroelectric-power-plant/#:~:text=The%20Ilisu%20dam%20is%20a,cubic%20metres%20at%20maximum%20storage>

Table 3: The Main Dams in the Karkheh and Karun Catchments (in order of completion)

Name of dam	Country location	River (tributary and main)	Date of compl'n	Volume of storage (mcm)	Purpose(s)	Area in has (to be) irrigated
Hamidiyeh	Iran	Kharkeh	1957	Diversion only (?)	I	20,000
Dez	Iran	Dez, Karun	1962	3,340	HP, I, WS	16,000
Karun 1	Iran	Karun	1976	3,139	HP, I	??
Lower Gotvand	Iran	Karun	1977	Diversion only (?)	I	42,000
Karun 2 Masjed Soleyman (Godar e Landar)	Iran	Karun	2001	230	HP, I	??
Karkheh	Iran	Karkheh	2002	7,500	FC, HP, I	??
Karun 3	Iran	Karun	2004	2,000	FC, HP, I	??
Saymareh	Iran	Saymareh, Karkheh	2009	3,200	FC, HP	--
Karun 4	Iran	Karun	2010	2,190	HP	--
Upper Gotvand	Iran	Karun	2012	4,500 ²⁶⁷	HP	--

²⁶⁷ Arezoo Mirzakhani, Gotvand Dam: An Environmental Disaster, Iranwire, 16 July 2018
<https://iranwire.com/en/features/65407/>

ANNEX 2: THE MAIN WATER-RELATED AGREEMENTS BETWEEN TERS RIPARIANS

MoU: Memorandum of Understanding

Date	Name of agreement	Signatories	Main features	Implemented?
1923	Treaty of Lausanne	Iraq and Turkiye	Turkiye undertook to consult Iraq before carrying out any works on Tigris or Euphrates.	No
1946	Treaty of Friendship and Good Neighbourliness	Iraq and Turkiye	Turkiye undertook to inform Iraq of any plans for works on the Tigris or Euphrates.	No
1987	Protocol of Economic Cooperation	Syria and Turkiye	Turkiye agreed to allow a yearly average of at least 500 cusecs to flow down the Euphrates into Syria. The agreement was intended to be temporary.	Yes
1990	Syria-Iraq Protocol	Iraq and Syria	Divided whatever volume of water flowed across the Turkish/Syrian border 42% to Syria and 58% to Iraq.	Yes
2002	MoU	Iraq and Syria	Iraq agreed that Syria could install a pumping station on the Tigris to take irrigation water.	No
2009	MoU	Syria and Turkiye	Turkiye accepted that Syria could install the pumping station referred to in the 2002 Iraq/Syria agreement.	No
2009	Three MoUs	Syria and Turkiye	The MoUs dealt with regional waters, "namely the Euphrates, Tigris and Orontes".	No
2009	MoU	Iraq and Turkiye	Management of transboundary water resources, inc. exchange of hydrological & meteorological info & expertise.	No
2014	Minutes of the Bilateral Cooperation Mtg	Iraq and Turkiye	Exchange of information on filling of Ilisu reservoir; technical cooperation; training.	No (?)
2014	MoU	Iraq and Turkiye	Commitment to increased cooperation on Tigris and Euphrates.	No (?)
2021	Agreed minutes	Iraq and Syria	Sharing of information on the Euphrates and Tigris; apportionment of any harms due to reductions in flow and climate change.	??

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