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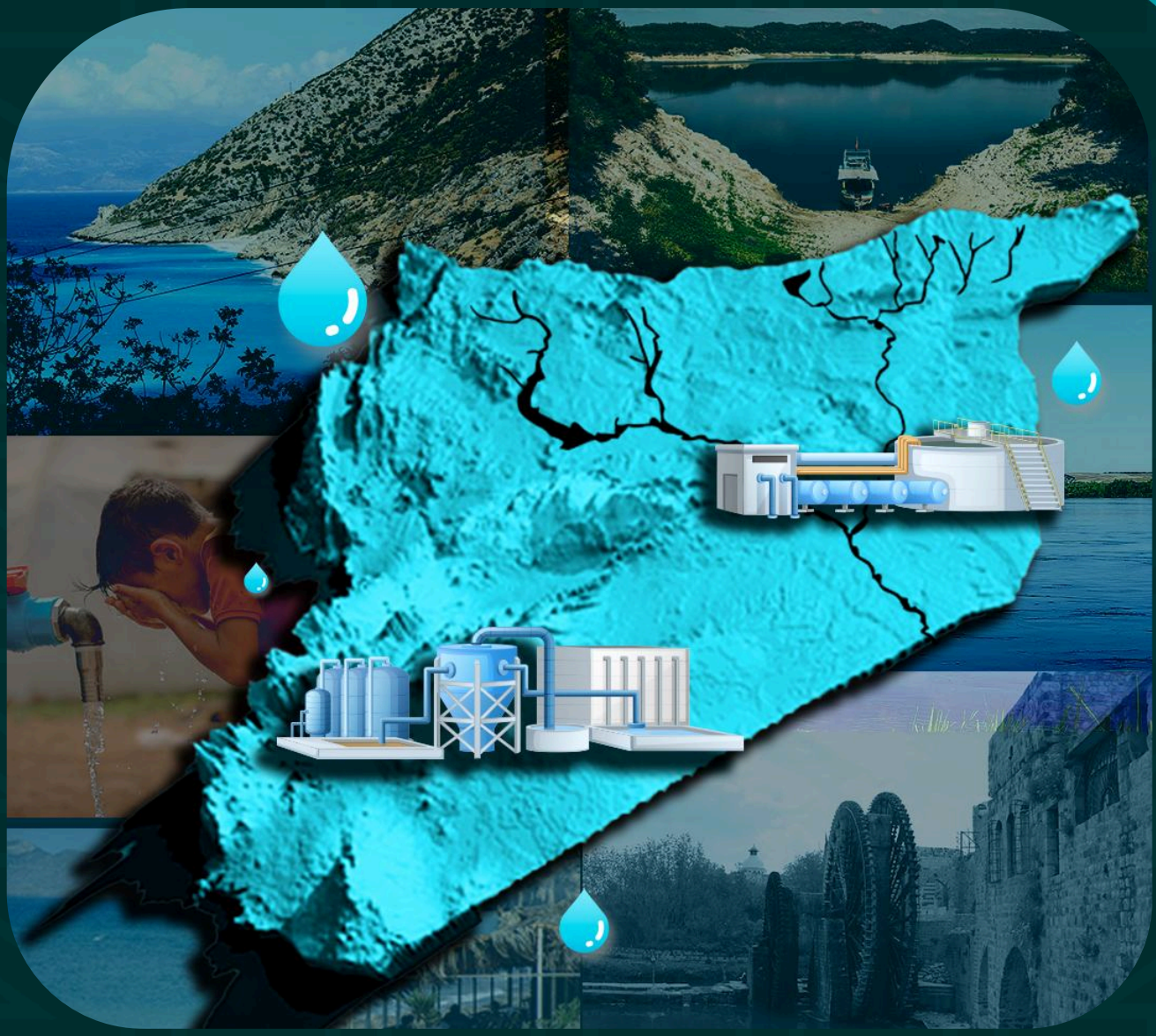

Article Title

# From Abundance to Deficit: a Historical and Strategic Review of Syria's Water Security (1970 - 2024)

Paradigm, 2025

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## introduction

Water scarcity is a defining challenge in the Middle East, one that has been exacerbated by climate change over recent decades. The region's arid and semi-arid climates naturally limit freshwater availability, and rising temperatures along with shifting precipitation patterns are intensifying the strain[1]. Syria exemplifies these dynamics. Since the 1970s, Syria has experienced a long-term decline in rainfall and more frequent multi-year droughts, trends which scientists have linked to anthropogenic climate change[2]. Notably, a severe drought from 2007 to 2010 – the worst in the recorded history of the Fertile Crescent (According to the data presented by Kelley et al. (2015), the Fertile Crescent region as a whole in 2007/08 was indeed the driest year in the instrumental record, with precipitation 35% below the 1961–90 average)[3] – devastated Syrian agriculture and displaced hundreds of thousands of rural inhabitants. Research shows that human-induced climate warming made an extreme drought of this magnitude two to three times more likely than natural variability alone[4]. In general, droughts in Syria and the broader Mediterranean have become longer and more severe, a trend projected to continue in coming decades[5]. These climatic pressures add to an already precarious water situation.

Syria's water crisis cannot be attributed to climate change alone; it has been compounded by decades of mismanagement, rapid population growth, and, since 2011, a devastating conflict. However, climate stress acts as a "threat multiplier" that aggravates existing vulnerabilities. By the late 2000s, millions of Syrians were facing acute water shortages as wells went dry and crop failures spread. This environmental desperation is believed to have contributed to social unrest on the eve of Syria's 2011 uprising[6]. The war that followed has further decimated water infrastructure and governance, creating a

[1] Syria's Water Crisis - Fanack & Resolving long-standing water dispute with Syria now 'highly urgent', given northern neighbour's new power shift– experts | Jordan Times

[2] Climate change in the Fertile Crescent and implications of the recent Syrian drought | PNAS

[3] Climate change and the Syrian civil war revisited

[4] Climate change in the Fertile Crescent and implications of the recent Syrian drought | PNAS

[5] Resolving long-standing water dispute with Syria now 'highly urgent', given northern neighbour's new power shift– experts | Jordan Times

[6] (Climate change in the Fertile Crescent and implications of the recent Syrian drought | PNAS)

complex humanitarian emergency in which water scarcity and conflict reinforce one another. believed to have contributed to social unrest on the eve of Syria's 2011 uprising[6]. The war that followed has further decimated water infrastructure and governance, creating a complex humanitarian emergency in which water scarcity and conflict reinforce one another. Today, after over a decade of war, only about half of Syria's water and sanitation infrastructure functions properly, leaving millions without reliable access to safe water. The United Nations now ranks Syria as the most drought-prone country in the Mediterranean, warning that climate change will continue to place enormous strain on its water resources[7].

In this context, this report provides a comprehensive examination of Syria's water security from the 1970s to the present, situating it within regional climate and water scarcity trends. Beginning by Syria's water resources and river basins, establishing the baseline of available surface and groundwater. then analyze the major challenges to water security in Syria, including mismanagement of resources, recurrent droughts, population pressures, unsustainable agricultural practices, and infrastructure degradation during the conflict. The role of external actors and humanitarian organizations is also scrutinized, with a focus on non-sustainable water practices by NGOs during the war, such as over-extraction of groundwater in refugee camps and other practices that resulted in water contamination. Subsequently, we broaden the scope to geopolitical dimensions, discussing Syria's transboundary water disputes with Turkey, Lebanon, and Israel. Given the importance of shared rivers like the Euphrates, Orontes, and Yarmouk, regional politics have a profound impact on Syria's water situation. Additionally the paper devotes particular attention to Israel's water security strategies, including its control of the Golan Heights and adaptation to chronic water deficits, to understand how water considerations factor into the Syria-Israel shared water resources. Adding to this, the paper examines the Yarmouk River basin as a case study of protracted conflict involving Syria, Jordan, and Israel, and considers whether Israel's actions in southern Syria since 2011—amid border escalations and

[6] (Climate change in the Fertile Crescent and implications of the recent Syrian drought | PNAS)

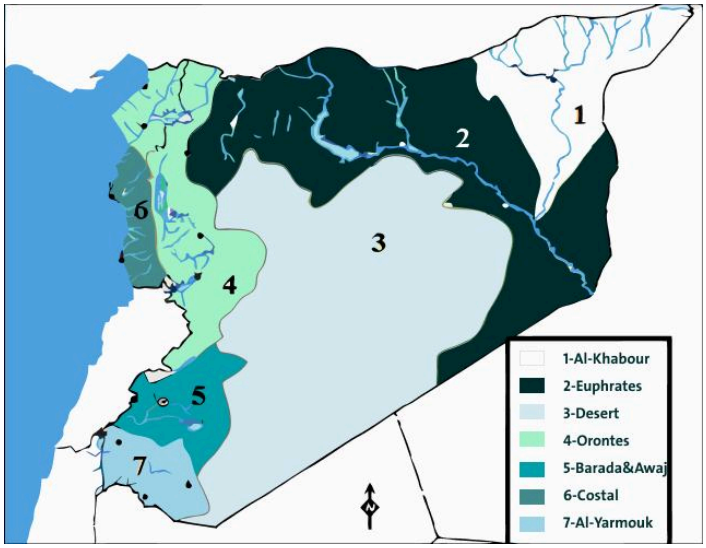
[7] SSyria's Water Crisis - Fanack Water

instability—have any linkage to water resource concerns. Through this detailed analysi Through this detailed analysis, drawing on data from institutions like the FAO, UNDP, World Bank, and peer-reviewed research, the report aims to elucidate how water scarcity in Syria has evolved over the past half-century. The goal is to highlight both the internal governance issues and the external geopolitical forces that shape Syria's water security. In doing so, we can better understand the interplay between climate change, conflict, and water resources in the Middle East, and the urgent need for sustainable water management and cooperative solutions in this volatile region.

## 1. Syria's Water Resources and Basins

Syria's natural water endowment is modest and unevenly distributed. The country lies in a semi-arid zone bridging the wetter eastern Mediterranean and the arid Arabian desert. Average annual precipitation is only 298.16 mm (an average from 1901 to 2023, experiencing intense fluctuations in the past ten years)[8]. The average annual precipitation in Syria ranges from over 1,000 mm in the coastal mountains to less than 100 mm in eastern deserts. Most rain falls in the winter, and year-to-year variability is high. These climatic conditions divide Syria into distinct hydrological regions. The government recognizes seven major water basins: **(1) the Tigris and Khabour basin in the northeast (sometimes grouped as part of "Al Jazeera"), (2) the Euphrates and Aleppo basin (including the Euphrates River and tributaries like the Khabour), (3) the Al Badia or desert basin in the interior, (4) the Asi-Orontes basin in the west, (5) the Barada and Awaj basin (around Damascus), (6) the Coastal basin (Al Sahel) along the Mediterranean and (7) the Al-Yarmouk basin in the south, .** Each basin has different water availability profiles. For example, the Coastal and Orontes basins benefit from higher rainfall and perennial streams, whereas the Euphrates and northeast basins rely heavily on river inflows from neighboring countries.

Figure: Map of Syria seven main basins,




[8] https://tradingeconomics.com/syria/precipitation

## 1.1 Surface water resources:

Syria's most significant river is the Euphrates (Al-Furat), which enters from Turkey in the north and flows southeast into Iraq. The Euphrates is Syria's lifeline, historically providing the bulk of its surface water. Of the river's total length of 2,330 km, about 680 km flow through Syria. Agreements between Syria and Turkey specify the minimum average flow of water from the Euphrates at the Syrian-Turkish border[9]. According to the 1987 agreement between Damascus and Ankara, Syria should get 500 cubic meters of water per second from Turkey[10]. However, in 2021, Turkey deprived Syrians of their share of water from the Euphrates. Currently, the river is only supplying 200 cubic meters per second[11]. Other important rivers include the Tigris, which forms part of Syria's northeast border (though only a small section, contributing little usable water to Syria – on the order of 1.2 BCM/year entering from Turkey under one estimate), and the Orontes (Asi), which flows north from Lebanon through western Syria into Turkey. The Orontes has an annual flow of around 2.5–2.8 BCM, though Syria can use only a portion of this after sharing with Lebanon and as it exits to Turkey[12]. The Yarmouk River in the south is another notable transboundary river – rising from springs in Syria and Jordan, it forms the Syria-Jordan border and eventually joins the Jordan River. Smaller coastal rivers such as the Nahr al-Kabir al-Janoubi mark the border with Lebanon in the northwest. In the interior, seasonal wadis are common but carry little reliable water.

Crucially, Syria is highly dependent on water that originates outside its borders. The FAO reports a dependency ratio of over 72%, meaning nearly three-quarters of Syria's renewable water resources come from upstream countries. Most of this is via the Euphrates (from Turkey) and, to a lesser extent, the Tigris (from Turkey) and the Orontes (from Lebanon). By contrast, water generated internally from rainfall within Syria averages only about 7.1 BCM per year. This internal renewable water includes roughly 4.3 BCM of surface runoff in Syrian rivers and 4.8 BCM of groundwater recharge, with an overlap of about 2 BCM (springflow that counts in both). Thus, Syria's total actual renewable freshwater supply (combining internal resources and incoming flows under present conditions) is estimated around 16.8 BCM per year. In per capita terms, this amounted to

[9] Agreements between Syria and Turkey

[10] the 1987 agreement

[11] Euphrates river water Level comparison in the same spot 2021 vs 2022

[12] The Asi River and the Turkey-Syria Friendship Dam - Fanack Water

about 882 cubic meters per person per year in 2005, below the commonly used water scarcity threshold of 1,000 $m^3$/person/year[13]. Notably, per capita availability has declined drastically from the 1970s due to population growth (as discussed later) – and was projected to further halve by 2025 according to FAO projections[14]. Syria crossed into the zone of chronic water scarcity well before the outbreak of the war.

1.2 Groundwater resources: Beneath the surface, Syria has several important aquifer systems, though these too are limited and have been heavily exploited. Major aquifers are associated with the limestone massifs of the Anti-Lebanon and Aleppo regions, and the extensive alluvial plains of the northeast. A notable groundwater system is that of the Damascus basin (Barada-Awaj), fed by springs in the Anti-Lebanon mountains. Two famous springs in the Golan/Anti-Lebanon region – the Banias and the Dan – contribute to the upper Jordan River, illustrating how groundwater in southwest Syria connects to regional surface water systems[15]. In the northeast, the Euphrates and Khabour plains overlie sedimentary aquifers that stored substantial reserves, but have seen declining water tables. Aquifer recharge rates vary; for instance, in Syria's coastal and highland karstic aquifers, recharge from rainfall is relatively high (rain infiltrates fractured rock), whereas in the eastern desert, meaningful recharge is minimal. By the 2000s, total sustainable groundwater yield was estimated to be on the order of only a few BCM per year. Overuse has been a serious issue – as will be discussed, by 2010 Syria was extracting far more groundwater than could be naturally replenished[16]

## 1. Challenges of Water in Syria: Mismanagement, Drought, and Conflict

### 2.1 Unsustainable Water Management and Agricultural Pressure

Long before the outbreak of the Syrian revolution,, Syria's water resources were stressed by mismanagement and unsustainable policies. From the 1970s onward, the government pursued aggressive agricultural development and food self-sufficiency goals that significantly increased water withdrawals. Large state irrigation schemes were established, and farmers were encouraged to replace traditional rainfed crops with water-intensive irrigated crops like cotton and wheat. This was facilitated by subsidies for

[13] (FAO, 2008)
[14] Water Status in the Syrian Water Basins
[15] FAO, 2008
[16] Unsustainable water pumping in Syria's northwest spells trouble for coming generations

fuel and pumping, which made groundwater extraction cheap for farmers. The result was a dramatic rise in well drilling: the number of wells in Syria skyrocketed from about 53,000 in 1988 to 124,000 by 1994. the numbers of wells kept increasing to more than 230.000 wells in 2010, while the number kept increasing during the conflict (2011 - 2024) as a result of Assad's strategy to support farmers and the agricultural economy. Much of this expansion was unregulated, and groundwater began to be depleted at rates far beyond natural recharge. By the early 2000s, reports of falling water tables, drying springs, and wells going dry had become common across Syria's farming regions.

Water-intensive strategic crops, particularly cotton in the northeast and wheat in many areas, were prioritized by the government's agricultural policies. These crops provided economic returns and domestic food security but at the cost of unsustainable water use. Irrigation efficiency remained low, with most farms using flood or furrow irrigation methods that lost substantial water to evaporation and runoff. By 2003, agriculture (including irrigation and livestock) consumed approximately 87.9% of Syria's total water withdrawals, leaving less than 12% for domestic and industrial use[17]. This volume of use was nearly equivalent to the total renewable supply in a normal year, indicating Syria was effectively using all available water and tapping into non-renewable reserves. Groundwater in particular was overdrawn: it supplied more than half of irrigation needs before the war, even though aquifers were not naturally recharged at that rate . In some areas (such as parts of the north and northeast), groundwater extraction reached almost three times the aquifer recharge rate, a clearly unsustainable situation[18].

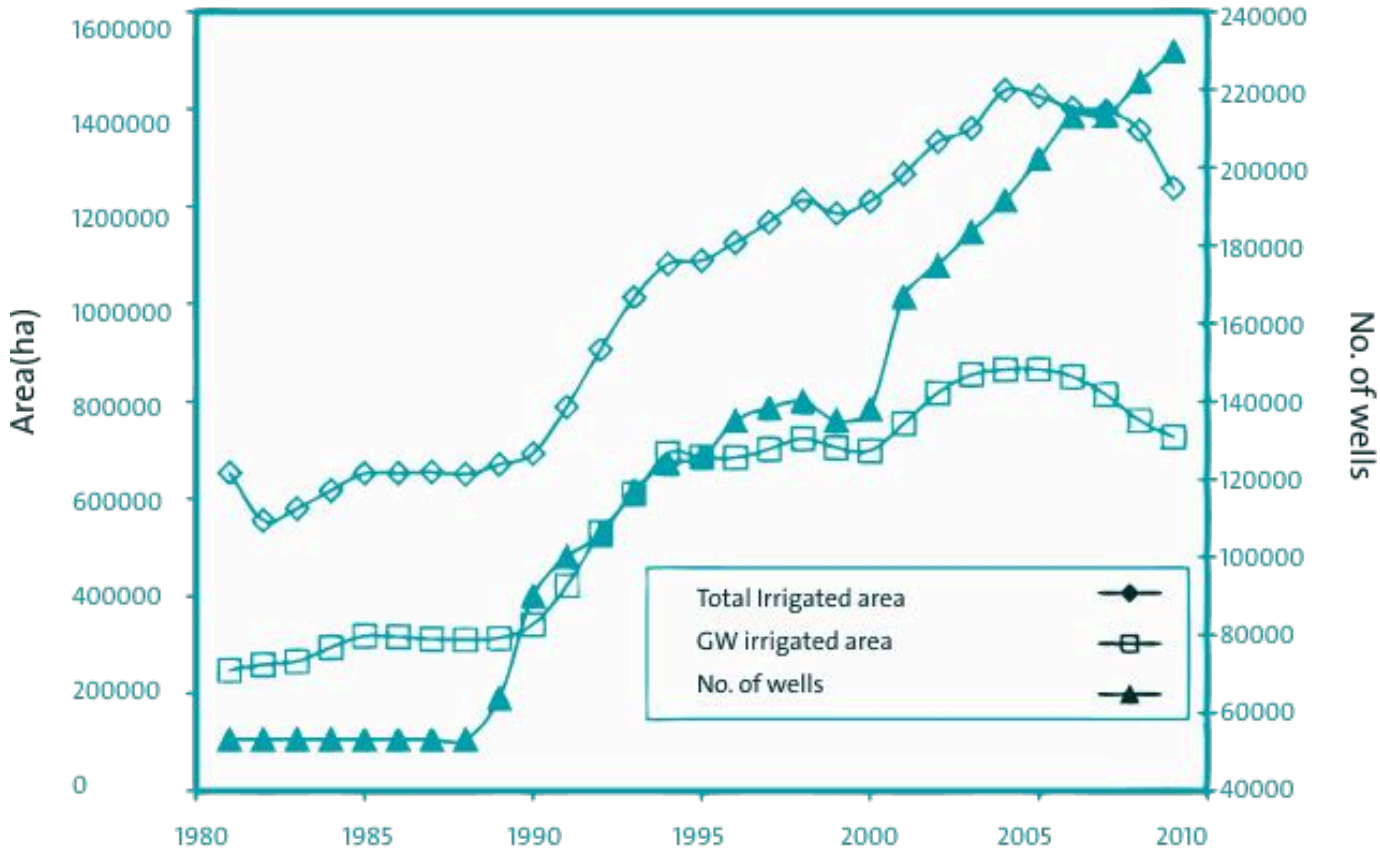
Institutional weaknesses compounded the problem. Syria lacked effective groundwater regulation – permits were required on paper for new wells, but enforcement was lax or subject to corruption. Many farmers drilled illegal wells or exceeded extraction quotas with little consequence. A 2005 water law sought to ban unauthorized well drilling, yet by then the damage was largely done: tens of thousands of illegal wells existed, and powerful interest groups resisted enforcement[19]. Meanwhile, large-scale irrigation schemes often suffered from poor maintenance and high conveyance losses. Water-intensive state farms and inefficient irrigation networks in areas like the Euphrates valley

[17] FAO, 2008

[18] Approaching summer and Syrian refugee influx add to Jordan's

[19] Unsustainable water pumping in Syria's northwest spells trouble for coming generations

led to problems of waterlogging and soil salinity, wasting water even as other regions went dry. In essence, Syria's water management prior to the war was characterized by over-expansion and lack of sustainability, trading short-term agricultural gains for long-term resource depletion. As analysts observed, by the 2000s Syria was facing "economic and physical water scarcity" simultaneously – growing demand outstripping supply due to both policy choices and inherent aridity[20].




Sources: Authors' elaboration based on FAOSTAT (2013): MAAR (2010), the Annual Agricultural Statistical Abstract for year 2010. Syrian Ministry of Agriculture and Agrarian Reform, Damascus. Syria.

[20] Water Status in the Syrian Water Basins

## 2.2 Droughts and Climate Stress

Periodic droughts are a natural feature of Syria's climate, but their frequency and severity have increased in recent decades, greatly straining water resources. Major drought episodes were recorded in the late 1980s, the late 1990s, and especially the multi-year drought from 2006 to 2010, which was unprecedented in instrumental records. During that period, rainfall in much of Syria fell to less than half of normal levels for three consecutive winters. Crop yields collapsed – wheat production in Syria's breadbasket northeast fell by over 75% in 2008, and hundreds of thousands of livestock died as rangelands turned to dust. An estimated 1.3 to 1.5 million people – mostly farming families – were displaced by this drought, abandoning their villages to migrate to urban peripheries in search of livelihoods[21].

Climate research indicates that this devastating drought was not an isolated event of natural variability. Rather, it occurred in the context of a long-term drying and warming trend in the Eastern Mediterranean, to which human-induced climate change has contributed. Since the 1970s, winter precipitation in Syria has trended downward while average temperatures have risen, leading to reduced soil moisture and higher evaporation. One study found that the 2007–2010 drought was made 2–3 times more likely by the regional climate changes attributable to greenhouse gas emissions. In other words, climate change has elevated the baseline risk of severe drought for Syria. The country's rainfall is highly variable, but the bad years are getting worse. The United Nations' climate assessments project continued increases in the frequency of droughts and heatwaves across the Levant, along with a possible decline in overall precipitation and a shift toward more sporadic, intense rainfall when it does occur[22]. This means Syria faces not just temporary drought crises, but an evolving chronic climate stress on its water systems.

The impacts of drought in Syria are magnified by the pre-existing mismanagement described above. When the rains fail, farmers turn further to groundwater – drilling new wells or pumping existing ones harder – which accelerates aquifer depletion. During the

[21] Climate change in the Fertile Crescent and implications of the recent Syrian drought | PNAS

[22] Syria's Water Crisis - Fanack Water), Resolving long-standing water dispute with Syria now 'highly urgent', given northern neighbour's new power shift– experts | Jordan Times

late 2000s drought, groundwater levels in parts of Aleppo, Idlib, and Hasakah provinces plummeted as desperate farmers tried to compensate for the lack of rain. Because Syria had no significant contingency planning (such as large-scale drought relief or water rationing strategies), the drought's effect was to essentially push the rural economy into collapse. Analysts have noted that while drought was a natural trigger, the Syrian government's inadequate response and years of unsustainable water use turned it into a humanitarian catastrophe[23]. In this way, drought and mismanagement acted in synergy: water governance problems made the country extremely vulnerable to climatic shocks, and the 2007–2010 drought in turn exacerbated economic and social tensions on the eve of the war.

During the war, Syria has seen additional drought years. Notably, 2021 was another extremely dry year regionally, contributing to sharp drops in the Euphrates River's flow[24]. By then, the nation's capacity to adapt was even lower – climate change and drought now unfold on a landscape fragmented by war, where water infrastructure is broken and institutions are weak. This combination of climate stress and state fragility makes Syria's water crisis particularly acute and difficult to resolve.

In 2021, the reduction of water availability has impacted the livelihoods of a significant number of Syrians especially in northern Syria. The total number of affected Syrians in the north is estimated around 709.279 Syrians[25].

### 2.3 Population Growth and Infrastructure Decay

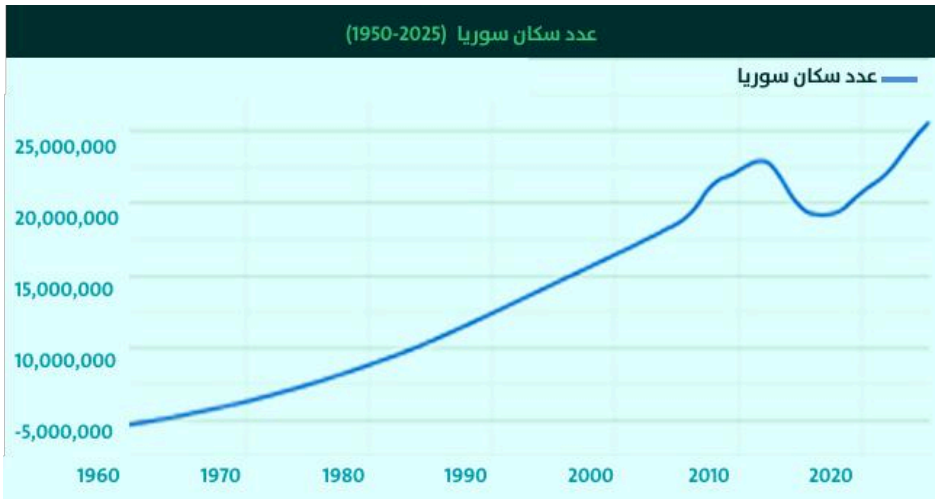
Demographic pressure is a further underlying challenge to Syria's water security. The Syrian population roughly tripled between the 1970s and 2010, from around 6 million to 21 million people. This rapid growth dramatically reduced per capita water availability. In 1970, renewable water per capita may have been on the order of a few thousand cubic meters; by 2000 it had dropped below 1,000 $m^3$, entering the range of water scarcity, and by 2010 was approaching 800 $m^3$ per person per year. Such a low figure indicates absolute scarcity, even without considering water quality. Population-driven demand increased municipal and industrial water needs (albeit these

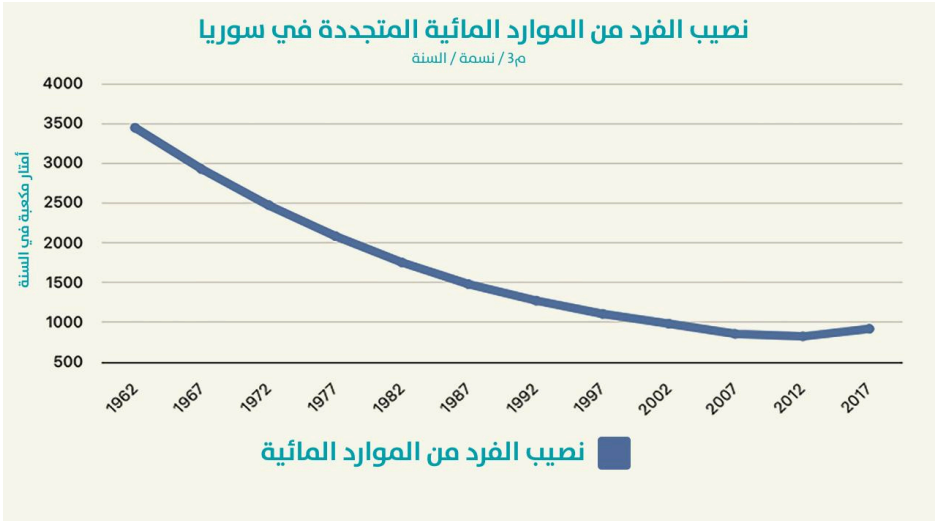
[23] PNAS

[24] Syria's Water Crisis - Fanack Water

[25] Center for Strategic & International Studies

remain asmall fraction of agricultural use), and also led to expansion of irrigated farming to feed the growing nation. The strain was already evident: by 2010, many Syrian cities and towns were experiencing intermittent water shortages, especially in summer, as supply systems struggled to keep up.




*@Figure data source: AQUASTAT, World Population Prospects: The 2019 Revision, United Nations Statistics Division and World Bank*

Table: Statistics presenting a comparison between population growth in Syria and the availability of renewable water resources per capita from the 1960s to the 2010s highlight the growing deficit over time.

From 2011 onward, the situation worsened due to the destruction and neglect of water infrastructure during the war. Syria's once relatively modern water supply network – which before the war provided 98% of urban residents and over 90% of rural residents with access to safe drinking water – has been severely impaired. High number of water treatment plants, pumping stations, pipelines, and power supplies have been damaged by fighting or lack of maintenance. By 2021, only an estimated 50% of water and sanitation infrastructure was still functioning properly[26].

The war has also seen water being used as a weapon and bargaining tool by various parties, further disrupting access. Armed groups have deliberately cut water supplies to besieged cities, and in some cases, contamination of water sources has been used to pressure communities. For instance, the Islamic State (IS) at times manipulated flows from dams it controlled, and other militias have sabotaged pipelines. One prominent example is the Alouk water station in the northeast: this station, which sources groundwater and supplies up to 460,000 people in Hasakah province, has been repeatedly shut down or restricted since coming under the control of Turkish-backed forces in 2019, depriving the areas under the control of the Syrian Democratic Forces of water.[27]. Each such incident forces communities to resort to emergency measures like trucking water over long distances. Overall, 13+ years of conflict have devastated Syria's water infrastructure and management capacity, leaving the population extremely vulnerable to scarcity. As of 2023, Syria has about 40% less drinking water available than in 2011, a statistic that underscores the dual impact of war and mismanagement on the country's water security[28].

**Syria's internal water challenges are multifaceted: inefficient and unsustainable use of resources, heightened climate variability, rapid population increase, and conflict-driven infrastructure collapse have combined into a severe national water crisis. This crisis is not happening in isolation, however. Syria's water woes are also tied to the actions of external actors – both humanitarian organizations responding to the crisis and neighboring countries that share water resources with Syria. The following sections examine these external dimensions, from the unintended consequences of emergency water relief to the geopolitical struggles over the rivers that cross Syria's borders.**

[26] Syria's Water Crisis - Fanack Water

[27 ] Syria's Water Crisis - Fanack Water

[28] Syria: Up to 40% less drinking water after 10 years of war - ICRC

## 3. Non-Sustainable Practices by NGOs During the Conflict

The humanitarian response to Syria's conflict, while crucial for survival, has at times led to non-sustainable water extraction and management practices. With the collapse of centralized services in many areas, both local communities and international NGOs have resorted to emergency measures to provide water to displaced populations and besieged towns. In the short term these measures save lives, but in the long term they can contribute to groundwater depletion and water quality problems.

One major issue has been the over-extraction of groundwater in "rebel-held" and besieged regions during the war. In large parts of northern Syria (Idlib and Aleppo provinces), millions of people came to depend on wells and boreholes as their primary water source after 2011. The pre-war public water networks in these areas ceased to function reliably due to war damage and fuel/electricity shortages. In response, NGOs, local councils, and private entrepreneurs drilled numerous new wells and installed portable pumps to supply camps and communities. This resulted in a "chaotic well-drilling" in the northwest. For example, as of 2022 in Idlib province, about 1,000 wells were officially registered with local authorities (the Idlib "Salvation Government"), but many more were drilled illegally without oversight. Hundreds of new wells have been added in recent years to meet the water needs of both farmers and the nearly 3 million internally displaced people were crowded into the region's camps[29].

Humanitarian organizations, by necessity, prioritized immediate water access over long-term sustainability during the height of the crisis. NGOs and UN agencies funded water trucking operations to deliver water to camps, and in some cases rehabilitated or drilled wells. While this ensured short-term supply, it sometimes meant extracting more water from an aquifer than was naturally replenished. In northeast Syria as well, for instance, when flows in the Euphrates River plummeted in 2021, communities and aid groups turned to groundwater and rainwater harvesting to make up the difference[30]. The primary water sources have remained the same despite unprecedented lows in surface water – meaning greater reliance on wells – which implies heavier stress on groundwater reserves[31].

[29] Unsustainable water pumping in Syria's northwest spells trouble for coming generations

[30] Syria's Water Crisis - Fanack Water

[31] Current Situation of the Water Crisis in Northeast Syria and its ...

In Jordan's Rukban camp on the Syria–Jordan border, water has to be trucked from Jordanian wells over long distances; boreholes on the Syrian side were attempted but the deep desert aquifer there is limited. These emergency solutions, while lifesaving, have not been coupled with robust management to prevent aquifer exhaustion.

Another concern has been water contamination and quality control issues in IDP camps and conflict zones. In the rush to provide water, some NGOs have had to source from whatever wells or surface supplies are available, which may be contaminated. Overcrowded camps often have makeshift sanitation, leading to seepage of waste into shallow groundwater. For example, informal camps in northeast Syria often rely on shallow "surface" wells (70–120m deep) that draw from recently infiltrated rainwater. These shallow aquifers are highly vulnerable to pollution from latrines and garbage pits. Testing by humanitarian WASH clusters found bacteriological contamination in many camp water points. In mid-2021, Save the Children reported tens of thousands of cases of acute diarrhea in northeast Syria, attributing it to the severely limited availability of clean water for drinking and hygiene in the camps. Diseases like hepatitis A, typhoid, and leishmaniasis have also surged in unhygienic camp conditions linked to water scarcity[32].

A stark illustration of the consequences came with the cholera outbreak of 2022. One major source of the outbreak was thought to be people drinking directly from the Euphrates River when other supplies failed[33]. Diminished river flow (partly due to upstream withholding and drought) meant the Euphrates water was stagnant and polluted in stretches, yet communities had little choice but to use it when wells ran dry. Humanitarian efforts to chlorinate water trucks and distribute purification tablets were implemented, but the scale of need outpaced these measures. Unsafe coping mechanisms, such as people digging their own crude wells or reusing irrigation water, became more common as funding shortfalls forced some NGOs to cut back water trucking services by 2022. In northwest Syria, media reports noted that as international aid budgets declined, some camps saw regular water deliveries reduced or stopped, pushing residents to fetch water from nearby rivers or puddles, again heightening contamination risks[34].

[32] Water crisis plagues tens of thousands in northeast Syria: NGOs | Water News | Al Jazeera

[33] IRC health workers deliver care in Syria amid a cholera outbreak

[34] Water shortages worsen as funding dries up for northwest Syria ...

There have also been environmental side-effects of the conflict that NGOs must navigate. The collapse of industry regulation led to activities like primitive oil refining in parts of eastern Syria, which generated toxic waste dumped into water bodies. A report on the "toxic footprint" of Syria's war described how chemicals from makeshift oil refineries and destroyed industrial sites have leached into soil and water, potentially contaminating groundwater aquifers[35].

Recently, and following the fall of the Syrian regime, Syrian refugee camps have faced a severe shortage of basic services—particularly in northern Syria—according to reports by the 'Campaign for Syria, 2025'. Many international organizations and civil society groups have ceased providing essential services, including the supply of drinking water, garbage collection, and waste management related to sanitation. This has led to a further deterioration of conditions in the refugee camps. It also reflects the unsustainable nature of international organizations' interventions, which rely on external funding rather than investing in the implementation of sustainable solutions.

**While humanitarian organizations and local providers stepped in to prevent mass dehydration – drilling emergency wells, trucking water, and installing storage tanks – these interventions were often stop-gap solutions that bypassed the peacetime water management system. In the absence of strong governance, over-extraction of groundwater went unchecked and water quality safeguards were weak. This is not to ascribe blame to relief efforts, which operated under crisis conditions, but rather to highlight the unintended legacy: in parts of Syria, the war's survival strategies have set the stage for longer-term water sustainability problems. Reversing this will require restoring governance and implementing managed aquifer recharge, water quality monitoring, and alternative water sources (e.g. expanded rainwater harvesting or desalination for coastal areas) once stability allows[36].**

[35] Toxic footprint of Syria's War - Syrian Arab Republic - ReliefWeb

[36] Water Status in the Syrian Water Basins

## 4. Geopolitical Challenges: Regional Water Conflicts Involving Turkey, Lebanon, and Israel

Syria's water security is intricately linked to its neighbors. Most of Syria's major rivers cross international borders, so upstream developments and bilateral agreements have a profound impact on water availability inside Syria. Over the past decades, Syria has engaged in protracted disputes and negotiations with Turkey, Lebanon, and Israel over shared water resources (Iraq and Jordan were not included in this report; further discussions on water issues with both countries will be elaborated in future papers). These geopolitical challenges have often limited Syria's access to water or created additional uncertainties, compounding the internal issues discussed above. This section examines each of these regional water relationships in turn.

### 4.1 Turkey and the Euphrates – Tigris Basin

By far the most critical external water relationship for Syria is with Turkey, the upstream riparian on the Euphrates and Tigris rivers. Turkey controls the headwaters of both great rivers in the Anatolian highlands and has pursued ambitious dam and irrigation projects since the 1970s – notably the Southeastern Anatolia Project (GAP) – which involve the construction of dozens of dams and hydroelectric stations. From Syria's perspective, Turkish dams dramatically affect the flow of the Euphrates into Syria. The filling of Turkey's Keban Dam in the early 1970s and later the huge Atatürk Dam (completed 1992) each led to sharp temporary reductions in downstream flow, triggering crises with Syria and Iraq. When Turkey impounded water to fill Atatürk Dam in 1990, it shut off the Euphrates entirely for a month, causing Syria's reservoirs to drop and contributing to a near confrontation (Iraq at one point threatened to bomb the Turkish dam)[37].

Since the 1980s, Syria and Turkey have had to negotiate a modus vivendi for sharing the Euphrates. In 1987, they reached an informal agreement in which Turkey pledged to release a minimum of 500 cubic meters per second ($m^3/s$) of Euphrates water across the border – equivalent to about 15.75 BCM per year[38]. In practice, this was a unilateral assurance by Turkey rather than a binding treaty, but Syria relied on it as a guarantee of flow. Syria then

[37] FAO, 2008

[38] An analysis of Turkey's water diplomacy and its evolving position vis-à-vis international water law. Lorenz & Erickson, 2013

agreed in 1990 to pass on 58% of that flow to Iraq, keeping 42% for itself (around 6.6 BCM/year)[39]. While the 1987 arrangement helped avert outright conflict, Turkey retains tremendous leverage: it can regulate flows above the guaranteed minimum and has been accused of periodically squeezing the flow during droughts or conflicts. Syrian officials have accused Turkey of violating the 500 $m^3/s$ pledge at various times. Turkey, for its part, does not consider the Euphrates a fully international river (preferring to term it a "transboundary" river where each state uses water within its territory).[40]

During Syria's war, this vulnerability became evident as Turkey effectively weaponized the Euphrates' flow on multiple occasions. Turkey now controls an estimated 90% of the Euphrates' total flow (through its dams and diversion structures[41]. In recent years, amid regional drought, the Euphrates flow into Syria has dropped well below the agreed 500 $m^3/s$. In 2021, Syrian observers noted the river's level was the lowest in memory; by some accounts the flow was half of the normal volume, causing hydropower shortages and irrigation failures in northeast Syria. Ankara officially cited its own drought and need to prioritize Turkish farmers, but the timing often coincided with disputes with Kurdish forces in Syria. Turkey's control of water has thus been a potent tool. An open letter by 120 NGOs in 2021 criticized Turkey for exacerbating Syria's water crisis by restricting the Euphrates and called for flows to be normalized[42].

From the Turkish perspective, water issues are tied up with security and territorial considerations. For many years, Turkey's government linked progress on water-sharing with Syria's stance toward the Kurdistan Workers' Party (PKK). In 1998, when Syria was sheltering Kurdish PKK leader Abdullah Ocalan, Turkey threatened war, and one demand was that Syria cooperate on water and other issues. Only after Syria expelled Ocalan did relations thaw, leading to talks like the 2001 joint communique on water and even a plan for a "Friendship Dam" on the Orontes (Asi) River. These discussions emerged after Bashar al-Assad came to power, marking a shift from the earlier stance of his father, Hafez al-Assad, who consistently excluded Turkey from negotiations over the Orontes River. Hafez claimed that the river lay entirely within Syrian territory and that the Hatay region, currently in Turkey, rightfully belonged to Syria. Therefore, the 2001 agreements between

[39] FAO

[40] لماذا خفضت تركيا من مستوى مياه الفرات المتدفقة لسوريا؟

[41] Syria's Water Crisis - Fanack Water

[42] Syria's Water Crisis - Fanack Water

Syria and Turkey were widely interpreted as an indirect acknowledgment by the Syrian regime of Turkish sovereignty over Hatay, while Syria and Turkey signed trade agreements during the same period[43].

However, the outbreak of war in Syria in 2011 ended such cooperative projects. Today, Turkey continues its GAP development, and climate change is reducing overall runoff, so the pie is shrinking. Without a binding treaty, Syria remains at the mercy of upstream usage. The absence of a comprehensive, enforceable water agreement in the Euphrates–Tigris basin is a source of recurring tension.

In the meantime, the impact on Syria has been severe. By 2021–2022, low Euphrates flows contributed to Lake "Assad" shrinking by 6 meters in depth since 2020, drastically reducing hydropower output and cutting off drinking water for communities around the reservoir. Aid agencies warned of a looming disaster as millions in northeast Syria faced water and power cutoffs. Thus, Turkey's upstream management remains perhaps the single greatest external determinant of Syria's water fortunes. Any lasting solution would likely require a three-party Syria-Turkey-Iraq agreement on Euphrates and Tigris sharing, something repeatedly attempted without success. Recently, after the fall of the Assad regime and the rapprochement between Ankar and Damascus; such issues must be negotiated in future strategic partnership.

### 4.2 Lebanon: The Orontes and Nahr al-Kabir

Syria's water relations with Lebanon are complex but somewhat more cooperative, given the power asymmetry historically favoring Syria. Several rivers are shared by the two neighbors, primarily the Orontes in the north and the Nahr al-Kabir al-Janoubi along the coastal border. During the decades of Syrian military presence in Lebanon (1976–2005), Syria exerted strong influence and effectively had first claim on shared waters. However, formal agreements have been reached. In 1994, Syria and Lebanon signed a treaty on the Orontes River, which allocated 80 million cubic meters per year (MCM/year) of Orontes waters to Lebanon and the rest (about 335 MCM in an average year) to Syria[44]. This reflects the fact that the Orontes rises in Lebanon's Bekaa Valley but quickly flows into Syria for the majority of its course. The agreement allowed Lebanon to build a dam (the

[43] The Asi River and the Turkey-Syria Friendship Dam - Fanack Water

[44] FAO

Al-Assi dam in the Hermel region) to utilize its share. Syria, in turn, built several dams on the Orontes upstream of Homs and in the Ghab valley. Overall, the Orontes accord was a rare instance of Syria willingly formalizing water sharing – likely because Syrian dominance in Lebanon at the time ensured terms favorable to Syria.

Syria and Lebanon have occasionally sparred over the Wazzani Springs, which feed the Hasbani River in southern Lebanon (a tributary of the Jordan River). While not directly a Syria-Lebanon issue, it becomes one in the context of regional water – Syria historically considered Israel's over-use of Jordan headwaters as problematic and supported Lebanese rights to utilize the Hasbani. In 2002, when Lebanon began a project to pump water from Wazzani Springs for villages, Israel objected strongly, raising tensions. Syria backed Lebanon's right to use that water (Lebanon argued it was within its share under the 1955 Johnston Plan, an old U.S.-brokered but never ratified allocation for the Jordan basin). Ultimately, that dispute did not escalate to conflict, but it highlighted how water in Lebanon, Syria, and Israel is all interlinked.

Compared to Turkey or Israel, Lebanon is a smaller player, and Syria historically had the upper hand. Post-2011, with Syria weakened and Lebanon in economic turmoil, major water initiatives have stalled. For instance, the Orontes "Friendship Dam" that Turkey and Syria agreed on in 2010 was to be built on the Syria–Turkey border, but it's reservoir would have backed up into Lebanon, requiring coordination with Beirut[45]. The war halted this plan. Similarly, any revisiting of Orontes allocations may occur if climate change reduces flows; Lebanon, which uses only a fraction of the Orontes water, is already seeking a larger share for its needs.

**Syria-Lebanon water relations have been characterized by negotiated shares that favor Syria's larger demand, enabled by Syrian influence. While mostly peaceful, these arrangements would benefit from ongoing cooperation, especially as both countries face climate variability. Joint monitoring of the Orontes and Nahr al-Kabir flows and coordination on dam operations could help maximize the benefit and prepare for drought periods. Whether such cooperation can deepen may depend on broader political normalization between Beirut and Damascus.**

[45] The Asi River and the Turkey-Syria Friendship Dam - Fanack Water

### 4.3 Israel, the Golan Heights, and Transboundary Waters

Syria's confrontation with Israel has a significant water dimension, centering on the Golan Heights and the Jordan River basin. The Golan Heights, which Israel seized from Syria in the 1967 Six-Day War and unilaterally annexed in 1981 (not recognized internationally), are strategically important for water as well as military geography. The Heights receive relatively high rainfall (800–1,200 mm in parts) and are the source of several tributaries of the upper Jordan River. In particular, springs and streams from the Golan feed into the Sea of Galilee (Lake Tiberias) – Israel's main natural freshwater reservoir. In 2008, the FAO noted that the Golan Heights control the main water sources of the State of Israel,
with Israel's only major freshwater lake and about a third of Israel's occupied land's water supply fed by waters originating in the Golan[46]. One of these sources is the Banias River, which rises in the Golan foothills; together with the Hasbani (from Lebanon) and the Dan (from Israel's side of Mount Hermon), it forms the Jordan River's headwaters that flow into the Sea of Galilee. By holding the Golan, Israel ensured it had direct access to the Banias spring and full control over the northeastern shore of the Sea of Galilee, as well as overlooking the Yarmouk basin to the south.

Water was a key factor in past Syrian–Israeli hostilities. In the early 1960s, Syria (together with other Arab states) attempted to divert the headwaters of the Jordan River to prevent Israel from taking as much water for its National Water Carrier project. The so-called "Headwater Diversion Plan" aimed to route the Hasbani and Banias waters away from Israel's intake at the Sea of Galilee and towards the Yarmouk River inside Syria and Jordan[47]. This led to escalating military skirmishes known as the "War over Water" between 1964 and 1967. Israel launched airstrikes in 1965 and 1966 to stop Syrian construction crews working on the diversion canals. These water-related clashes were one of the contributing factors to the broader tensions that erupted into the Six-Day War. When Israel triumphed in 1967, it not only gained territory but also removed the immediate water threat by capturing the Golan Heights (and also occupying the West Bank, thereby controlling the Jordan's downstream as well)[48].

[46] FAO

[47] Timeline | The Six-Day War

[48] Arab Summit of January 1964

Since 1967, Israel has effectively controlled all the upper Jordan River system, and has incorporated the Golan's water into its national supply network. Syrian farmers were largely displaced from the Golan, and Israel developed dozens of agricultural settlements there, using the area's plentiful surface and groundwater for their needs. From Syria's perspective, Israel's occupation of Golan has meant a permanent loss of access to those water resources – one reason Syria has adamantly demanded the return of the Golan in all peace negotiations[49]. Any future peace deal would have to address water-sharing arrangements to replace the current status quo. Throughout intermittent Syrian–Israeli peace talks in the 1990s and 2000s, water was an important sub-topic; Israeli strategists have expressed concern about how to secure continued water flow from the Golan if it were returned. One idea was joint water management or buffer zones around key springs. However, with negotiations long stalled and Israel showing no intention to relinquish the Golan, the issue remains hypothetical.

Another shared water resource is the Yarmouk River. the Yarmouk forms the boundary between Syria and the Israeli-occupied Golan for a short stretch before flowing into Jordan and then along the Israel–Jordan border. Prior to 1967, Syria had plans (in cooperation with Jordan) to build a dam on the Yarmouk (the Maqarin dam) that also would have limited flow into Israel's portion of the Jordan River. After 1967, Israel gained some control at the confluence of the Yarmouk and Jordan. In the 1994 Israel–Jordan Peace Treaty, Israel acknowledged Jordan's rights to the Yarmouk's flows (as Jordan and Syria had earlier agreed) and arranged to share some of the waters. Syria was not party to that treaty, but its actions upstream (damming and pumping) directly affected how much water reaches Israel and Jordan. Thus, even without direct diplomatic relations, Syria and Israel were linked by the hydrology of the Yarmouk-Jordan system. However, following the recent collapse of the Assad regime in Syria, Israeli forces have taken control of strategic water resources in southern Syria. Specifically, the Israeli military has seized the Yarmouk riverbed and the Al-Wehda Dam (also known as the Maqarin Dam), a critical infrastructure that supplies water to Jordan for drinking and agriculture, and hydroelectric power to Syria. This development grants Israel control over one of the main water sources

[49] Managing water for peace in the Middle East - UNU Collections

in the region[50]. The Al-Wehda Dam, completed in 2005, is a 110-meter-high concrete gravity dam on the Yarmouk River, forming part of the border between Syria and Jordan. It has a storage capacity of 115 million cubic meters and was designed to provide water for human consumption and agriculture, particularly benefiting Jordan. The dam's construction was a joint project between Jordan and Syria, governed by agreements aimed at managing the Yarmouk River's resources. Israel's control over the Yarmouk Basin and the Al-Wehda Dam has significant implications for regional water security, especially for Jordan, which relies heavily on the Yarmouk River to meet its drinking and agricultural needs. Any alteration in the flow of this water could exacerbate Syria's and Jordan's existing water scarcity issues, affecting both living conditions and economic stability[51].

Israel's continued control of the Golan Heights is partially motivated by the terrain's water and strategic military value. As one Middle East observer noted, Israeli command of the Jordan headwaters since 1967 allowed it to implement its water plans without hindrance[52]. Conversely, Syria's inability to regain the Golan keeps it largely out of the Jordan basin equation for now. Another point of contention can be water pollution and environmental flow: the Jordan River south of the Sea of Galilee has been reduced to a trickle of saline and treated sewage water in recent decades due to over-extraction by Israel, Jordan, and Syria (via Yarmouk) upstream. Any future regional cooperation will need to address restoring some flow for ecological health and downstream users (like the Palestinian territories)[53].

**Syria's geopolitical struggle with Israel over water has centered on the Golan Heights and the broader Jordan-Yarmouk basin. Israel's domination of these waters since 1967 has been a strategic asset for it and a loss for Syria. While outright war over water between the two is unlikely under present conditions (the military and political balance discourages it), water rights would be a critical component of any peace settlement. Until then, the status quo – Israel's control and Syria's exclusion from these resources – persists. Meanwhile, Israel has moved toward water independence through desalination, which somewhat decouples its national water security from the Syrian issue. One might say that historically, "water wars" were a real aspect of the Syria-Israel conflict, but in the 21st century.**

[52] Water and Israel's Occupation Strategy - MERIP) (Water and Israel's Occupation Strategy - MERIP

[53] Water Resources in Israel

### 4.4 Projection of water in Syria between 2010 and 2050:

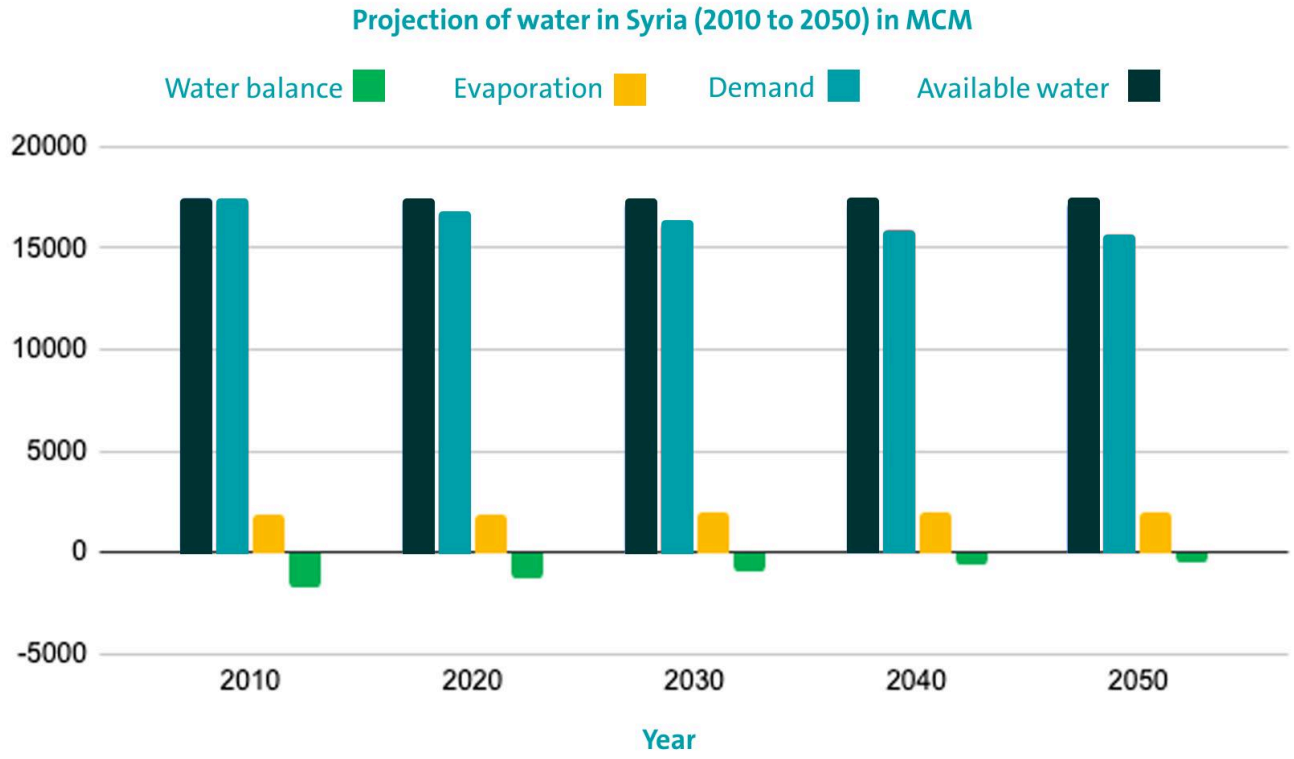
In their 2011 study, Syrian Water Resources between the Present and the Future, Mourad and Berndtsson analyze the key factors affecting Syria's water resources up to the year 2050. They project that the available water per capita (AWPC) is likely to be reduced by approximately 50% by mid-century. This decline is primarily attributed to climate change and population growth.

Mourad and Berndtsson (2011) also argue that a significant factor influencing future water demand is the anticipated reduction in Syria's population growth rate, largely driven by emigration associated with economic and political instability. Under normal circumstances, water demand would be expected to rise in line with population growth and socio-economic development. However, the protracted crisis in Syria has altered these dynamics. The authors contend that large-scale internal and international displacement will have a profound impact on population size and distribution. These demographic shifts are expected to suppress overall water demand, even if per capita consumption remains constant or increases slightly.

Their projections for the period between 2010 and 2050 indicate a relatively stable level of annual water availability in Syria, accompanied by a slight decline in both national water demand and the national water deficit. Notably, the projected reduction in national water demand by 2025 raises important questions about the underlying assumptions. According to Mourad and Berndtsson, the primary explanation for this trend is the expectation of continued emigration due to ongoing economic and security challenges, which would lead to a reduced population and thus lower national water requirements.

An additional consideration in their analysis is the modest decrease in Syria's projected annual water deficit by 2050. This improvement is partially based on the assumption of future peace agreements between Syria and Israel. As part of such agreements, Israel is expected to contribute to covering approximately 25% of Syria's water deficit through bilateral cooperation and resource sharing[54].

[54] Mourad, K. A., & Berndtsson, R. (2011). Syrian Water Resources between the Present and the Future. Air, Soil and Water Research, 4, ASWR.S8076




[54] Mourad, K. A., & Berndtsson, R. (2011). Syrian Water Resources between the Present and the Future. Air, Soil and Water Research, 4, ASWR.S8076

## Conclusion

1. The water crisis in Syria is one of the most prominent examples of the acute overlap between environmental degradation, governance failure, conflict, and geopolitical fragility in the Middle East in the 21st century. This report reviews the development of water scarcity in Syria from the 1970s to the present, placing the crisis within broader regional and international contexts linked to climate pressures, population dynamics, and political fragmentation.
2. The roots of water insecurity in Syria are not solely due to its arid climate and the increasing frequency of droughts—which have been significantly worsened by human-induced climate change—but also to decades of unsustainable water policies. Agricultural policies that prioritized water-intensive crops, in addition to a sharp rise in unregulated groundwater extraction and inefficient irrigation practices, contributed to the depletion of the country's limited freshwater resources years before the outbreak of conflict. Collectively, these factors left the country highly vulnerable to the 2007–2010 drought, which has been well-documented as contributing to rural displacement and increased public discontent, thereby helping ignite the 2011 uprising.
3. The ensuing conflict tragically exacerbated the crisis. Bombing and neglect led to the destruction of water infrastructure, and all military parties used water as a weapon. At the same time, although emergency humanitarian interventions were essential, they also encouraged in some cases unsustainable practices such as unregulated groundwater pumping and the use of contaminated sources. As a result, more than a decade after the conflict began, Syria's water system is operating at about half its pre-war capacity, many communities rely primarily on emergency aid, and repeated outbreaks of waterborne diseases caused by unsafe water are common.
4. Regional geopolitical challenges have hindered Syria's ability to access its main water sources. Turkey's control over the headwaters of the Euphrates and Tigris Rivers continues to undermine Syria's water sovereignty, while the Israeli occupation of the Golan Heights—and its recent incursion into southern Syria following the fall of Assad—has reinforced Israeli dominance over southern Syria's water resources. At the same time, water-sharing agreements with Lebanon, although cooperative in earlier periods, remain imbalanced and are increasingly strained by climate change and political instability.

5. It is important to emphasize that this complex crisis cannot be addressed through technical solutions alone. Achieving sustainable water recovery in Syria requires a multi-level approach that may include (but is not limited to):
   a. Restoring governance and the rule of law to regulate and monitor resource use;
   b. Implementing institutional reforms to transition toward efficient irrigation and climate-resilient agricultural practices;
   c. Reintegration of displaced populations into the frameworks of water resource planning and management;
   d. Investment in alternative sources such as rainwater harvesting and small-scale desalination in coastal areas;
   e. Activation of regional diplomacy to ensure fair agreements for the sharing of transboundary water resources.
6. International organizations must transition from emergency relief models toward sustainable water development, while being sensitive to the political context and long-term hydrological impacts.