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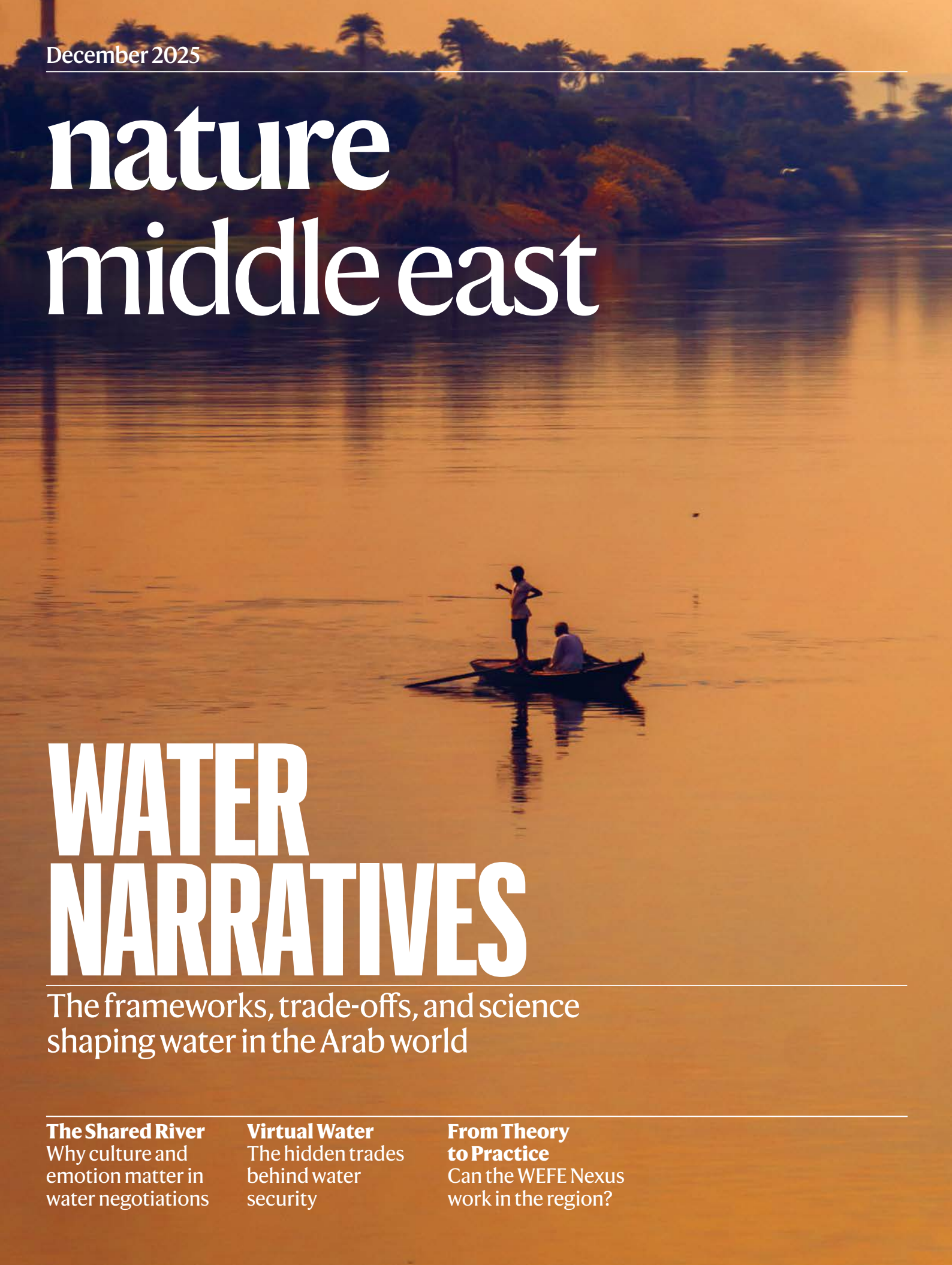

WATER NARRATIVES

The frameworks, trade-offs, and science shaping water in the Arab world

The Shared River
Why culture and emotion matter in water negotiations

Virtual Water
The hidden trades behind water security

From Theory to Practice
Can the WEFE Nexus work in the region?

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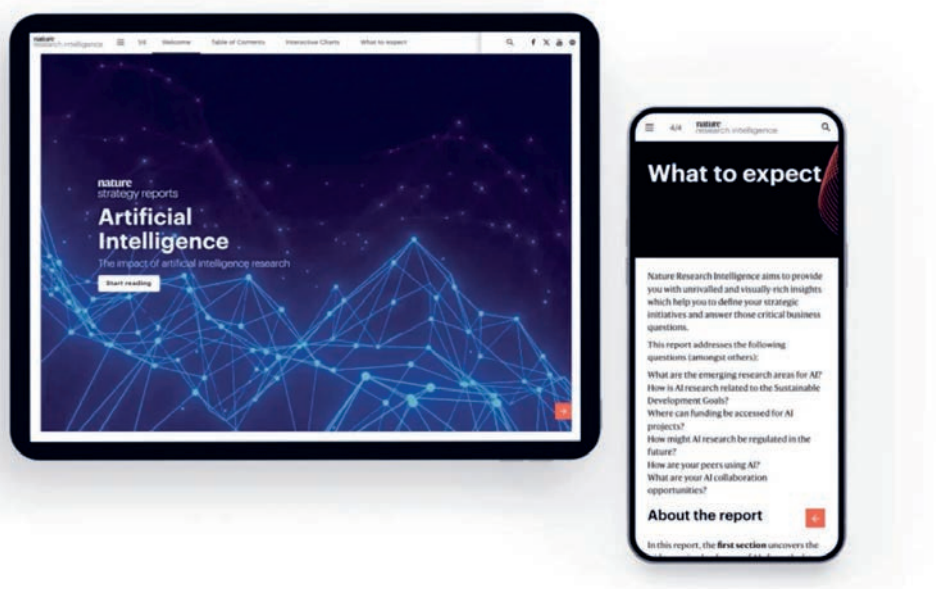

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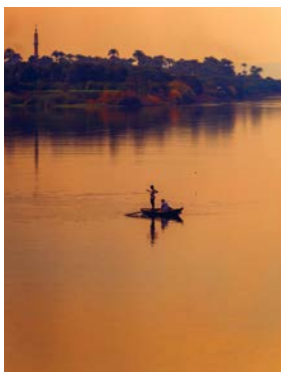

ABOUT THE COVER
Silhouette of two people in a rowing boat on the River Nile at sunrise, Egypt

CREDIT: RUSLANBOLGOV/ GETTY IMAGES

From the editor

Growing up in an Egyptian village, I witnessed how water shapes lives. Abandoned waterwheels, the farmer's joy when the canals were full, and frustration when the flow was minimal, were all part of my childhood memories.

In the Middle East, water is life. It has always been a driver of collaboration, peace, and conflicts. In this special issue, we look at some of the research, history, politics, and economies of water.

Water research in the region spans diverse interdisciplinary domains with studies tackling climate change, agriculture, desalination, technology, and social, economic, and political issues. Here, we highlight seven impactful research studies published in recent months, from droughts and scarcity, to desalination minerals and technologies.

Virtual water is a trending topic, as approximately 30% of the regional water demand for internal consumption and export activities is met through virtual water imports, while the other 70% is from local water resources. We track and analyse the hidden water trading within the region, with illustrations showing the volumes, types, and products associated with virtual water imports and exports.

The Water–Energy–Food–Ecosystems Nexus, known as the WEFE nexus, is dominant in almost every water discussion. We investigate whether its aims could be fully implemented while asking leading experts whether and how policy may play a role.

Narratives are often associated with misconceptions. So, we have asked six Arab water experts what most people get wrong about water, and what can be done to secure its future. We also highlight five historic sites that demonstrate how water was engineered, honoured, and transformed into a lasting part of the Arab heritage.

This special issue brings diverse perspectives, voices, and experiences to share how water stories are told, shaped, and shared in the region. We hope it will spark new discussions, dialogues, and water narratives.

Saad Lotfey
Editor, Nature Middle East

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Research highlights

By Amr Rageh

MINING MINERALS FROM DESALINATION BRINE IN SAUDI ARABIA

Ras al-Khair desalination plant along the Gulf coast in Saudi Arabia.

Saudi Arabia produces large amounts of freshwater from seawater desalination creating a concentrated salty byproduct called brine. Most brine is treated as waste and discharged back to the sea, wasting potential value and stressing local marine environments.

The Saudi Water Authority (SWA) published a report[1] proposing a practical alternative: turning desalination brine into a source of useful minerals, such as sodium, potassium, and magnesium salts, potentially raising revenue that could offset desalination costs.

The authors propose extracting marketable salts and minerals from brine by concentrating the brine through nanofiltration to thicken the brine using less energy than traditional evaporation. This process separates magnesium and sulfate from sodium and chloride, creating two streams that are easier to process. Then, products are separated and recovered, particularly sodium chloride, bromine/bromide salts, magnesium salts, and potassium salts.

The report suggests starting with extracting high-return products, such as bromine and sodium chloride, followed by magnesium and potassium salts.

"The good news is that many countries in the region are already relying heavily on desalination, so adopting something like brine mining is a logical next step. That not only reduces the overall cost of desalination but also creates new economic opportunities", says Ahmad Ayoub, a researcher at Mediterranean Agronomic Institute of Bari in Italy.

There are three main challenges, Ayoub says. "First, the upfront cost is high. These systems need serious investment in infrastructure and R&D. Second, you need skilled people to run them, And third, you must make sure it's done in an environmentally safe way so that marine ecosystems aren't harmed. If countries can address those three issues, the potential is huge."

1. https://swa-cdn.swa.gov.sa/Reports/Brine_Mining_Report.pdf

ADVANCED PVDF MEMBRANES SHOW PROMISE FOR DESALINATION

Researchers have developed new nano-fibered membranes to improve the efficiency of desalination technology.

In their study[1], the team, from the American University of Sharjah (AUS) and New York University Abu Dhabi (NYUAD), revealed advanced polyvinylidene difluoride (PVDF)-based mixed matrix membranes using electrospinning technology, enhanced with five different nanomaterial additives.

Electrospinning is a process that uses high electrical potential differences to produce ultrafine nanofibers from polymeric liquid solutions. This technology offers high and nearly uniform porosity and produces fine fibres free from defects.

The researchers used commercially available plastic (PVDF) and transformed it into nanofibrous membranes with interconnected pores. They mixed in microscopic amounts of five different materials: graphene oxide, carbon nanotubes, zinc oxide, activated carbon (AC), and zeolitic imidazolate metal–organic framework (ZIF-8).

These additives improve how electricity moves through the membrane. The developed structure showed improved conductivity, pore size, and surface properties, featuring a potential for future desalination applications.

1. https://doi.org/10.3390/nano15151151

FAYEZ NURELDINE/AFP VIA GETTY IMAGES;LIULIMING/ MOMENT/ GETTY IMAGES

NUCLEAR POWER MAY SECURE WATER IN THE MENA REGION

The MENA region faces a severe water stress issue, as limited renewable water resources projected to decline by 0.6 km^3/year and water shortage to triple by 2050.

Current conventional solutions include desalination plants, which rely heavily on fossil fuels, creating vulnerabilities to price volatility and supply disruptions. That dependency on fossil fuel resources raises long-term sustainability concerns and contributes significantly to climate change.

To explore alternatives, researchers from the University of Sharjah and the German Jordanian University, conducted an economic and environmental assessments[1] of three nuclear reactors coupled with two desalination technologies.

The analysis showed that nuclear desalination could produce freshwater with costs ranging from $0.69 to $1.04 per cubic meter, making it competitive with fossil-fueled desalination. The authors concluded that the nuclear reactors contribute to reduced greenhouse gas emissions, and support long-term sustainability with reliable uranium fuel supply.

1. https://doi.org/10.1016/j.ijft.2025.101056

HECKEPICS/ISTOCK / GETTY IMAGES PLUS; SERGEY STRELKOV/ISTOCK / GETTY IMAGES PLUS

HOW IN-STREAM WETLANDS COULD IMPROVE EGYPT'S WATER QUALITY

Traditional treatment plants are costly and often not feasible for rural or vast agricultural regions, especially in Egypt. In-stream Wetlands (ISW) could serve as a sustainable and affordable alternative for cleaning drainage water.

Hany Mostafa from the Egyptian National Water Research Center published a study[1] assessing the sustainability of in-stream wetlands in Egypt

In-stream wetlands are sections of stream or river channels planted with aquatic vegetation that serve as natural filters, removing pollutants and improving water quality for irrigation purposes

The study published in Water Science, looked at how in-stream wetlands, located in two Egyptian drains, Tellin and Faraa Al Bahwo, improve drainage water quality before it's reused for activities like irrigation.

The author implemented two analysis methods; SWOT (Strengths, Weaknesses, Opportunities, Threats) and PESTEL (Political, Economic, Social, Technological, Environmental, Legal), based on historical data including how these wetlands operate, how well they clean water, what kinds of plants they use, and what problems or successes they've had.

He evaluated both the technical aspects -like removal of pollutants- and the broader aspects -like government support, funding, social acceptance, and climate threats- to identify whether these wetlands may succeed in the future.

The study showed that "Faraa Al Bahwo" successfully removed 97–99% of pollutants before it was abandoned due to lack of funding. In contrast, the "Tellin wetland" collapsed within months after funding ended, highlighting weak institutional and financial support.

According to the study, while wetlands help restore natural ecosystems, provide habitats for fish and birds, and support climate goals, their long-term success depends on careful planning, supportive policy, and sustained funding.

Maysoon Al-zoubi, a consultant on water diplomacy and international waters, highlighted the need for policies that regulate and facilitate the implementation of in-stream wetlands projects in Egypt.

1. https://doi.org/10.1080/23570008.2025.2463743

Landscapes in Egypt.

MAKING BEST USE OF ALGERIA'S UNTAPPED GROUNDWATER

Algeria's huge groundwater reserves, particularly in the southern Sahara, represent a largely untapped, climate-resilient resource that, if properly managed, could secure long-term water supplies amid increasing surface-water scarcity.

A recent paper[1], published by Boualem Remini, from the department of Water Science and Environment, Faculty of Technology, Blida 1 University, attributes Algeria's growing water insecurity to multiple factors.

The high evaporation losses and reduced inflows at dams in northern Algeria due to warming and shifting precipitation patterns, have caused reservoirs to dry up in recent decades. Additionally, the full tapping of open aquifers in the Tell Atlas leads to overdrawn groundwater tables, increasing stress on supplies.

Algeria's arid climate makes surface sources highly vulnerable to variability, underscoring the need for more stable underground supplies. Additionally, ensuring sustainable water supply is critical for agriculture, urban growth, and rural livelihoods in Algeria's expanding population and economy.

The author proposes a comprehensive groundwater management framework centered on subdividing Algeria into eight major basins (four in the north and four in the Sahara south), each managed as an integrated unit for assessment, monitoring, and allocation.

The Sahara hosts six major confined systems covering more than half the country's area and containing multi-decadal to centennial reserves.

While northern aquifers are near full exploitation, deep southern aquifers can supply substantial volumes, if managed sustainably, to urban and agricultural centers.

Effective management depending on accurate hydrogeological data, continuous monitoring, and integrated basin planning, is needed to align extraction with recharge and avoid irreversible depletion.

The study recommends stronger institutional capacity, accurate hydrogeological data, and coordinated basin-level management. Meanwhile, independent experts highlight the potential of using solar and wind energy for pumping in remote desert regions to minimize operational costs and greenhouse-gas emissions, aligning water security with Algeria's broader energy transition goals.

1. https://www.researchgate.net/publication/390406935_ALGERIA'S_GROUNDWATER_AN_UNTAPPED_STRATEGIC_RESOURCE_FOR_WATER_SECURITY

Acquired by the Copernicus Sentinel-2 satellites, the images show the effects of water scarcity at the Al Massira reservoir.

EUROPEAN UNION, COPERNICUS SENTINEL-2 IMAGERY; ANTON PETRUS/ MOMENT/ GETTY IMAGES

SATELLITES REVEAL URGENT THREAT TO MOROCCO'S WATER RESERVOIRS

Morocco's reservoirs have experienced dramatic water losses over recent years, threatening agricultural production as irrigation accounts for 88% of national water use, and socioeconomic stability in rural communities.

Researchers from Mohammed VI Polytechnic University, Ben Guerir, Morocco, in collaboration with international partners, used satellite imagery and machine learning to monitor reservoirs changes across Morocco between 2018 and 2024.

The study[1], in *Scientific Reports*, revealed an apparent decrease in surface water areas across Moroccan reservoirs, with significant declines observed between 2021 and 2023. While southern reservoirs experienced drastic reductions, northern reservoirs exhibited more stable water levels.

Reservoirs located in central and southern Morocco, such as Al Massira and Mansour Eddahbi, showed more noticeable decline, particularly from mid-2021 to early 2024.

Al Massira dam, one of Morocco's largest reservoirs, experienced severe declines in water storage, dropping to less than 3% of its capacity since 2023. By August 2024, "Al Massira had been operating at barely 1% of its capacity, thereby being almost completely depleted", according to the study.

Additionally, the rainy season is becoming increasingly unpredictable; increasing temperatures are leading to excessive snowmelt in the Atlas Mountains, disrupting steady year-round stream flow.

Groundwater levels nationwide are also dropping significantly. In the Mejjat region of the Haouz plain, the decline has been up to 5 m per year since 2016.

The authors plan to extend the monitoring using multi-decadal satellite archives to capture longer-term trends, integrating remote sensing with field data and socioeconomic analysis, and using seasonal crop maps to sort out the specific contributions of different agricultural practices to reservoir drawdowns.

1. https://doi.org/10.1038/s41598-025-06240-1

WORSENING DROUGHTS ACROSS THE ARABIAN PENINSULA REQUIRE IMMEDIATE ACTION

The Arabian Peninsula has seen more frequent dry spells in recent decades, with rising global temperatures threatening to make droughts even worse.

Researchers from KAUST, in Saudi Arabia, showed in a *Scientific Reports* study, how drought patterns will evolve under different future greenhouse-gas scenarios across the Arabian Peninsula.

The researchers aim to determine whether droughts will become more common or severe, and by how much, given both rainfall changes and rising temperatures, up till the year 2100.

The team selected the eight best-performing climate models to calculate two drought measures; the Standardized Precipitation Index (SPI) that is based only on rainfall, and the Standardized Precipitation-Evapotranspiration Index (SPEI) that accounts for both rain and how much water evaporates as temperatures rise.

The researchers examined drought projections for three future periods; near: 2015–2044, mid: 2045–2074, and far: 2075–2100.

They used estimation approaches that emphasized evapotranspiration -how heat-driven evaporation amplifies drought- and systematically quantified each uncertainty source.

Across all tested scenarios, potential evapotranspiration rises about five times faster than precipitation, meaning land dries out even if rainfall increases slightly. Moreover, the projections showed drought frequency and severity increasing steadily from near to far future, with some northern areas witnessing 300 to 400% more drought months by 2100.

Ibrahim Hoteit, Professor of Earth Systems Science and Engineering at KAUST, and the corresponding author, recommends that communities and policymakers in the Arabian Peninsula should "reduce avoidable consumption and protect groundwater. We, also, should rapidly scale safe reuse supported by routine, transparent monitoring to align supply with demand."

Rocky desert in mountains, United Arab Emirates.

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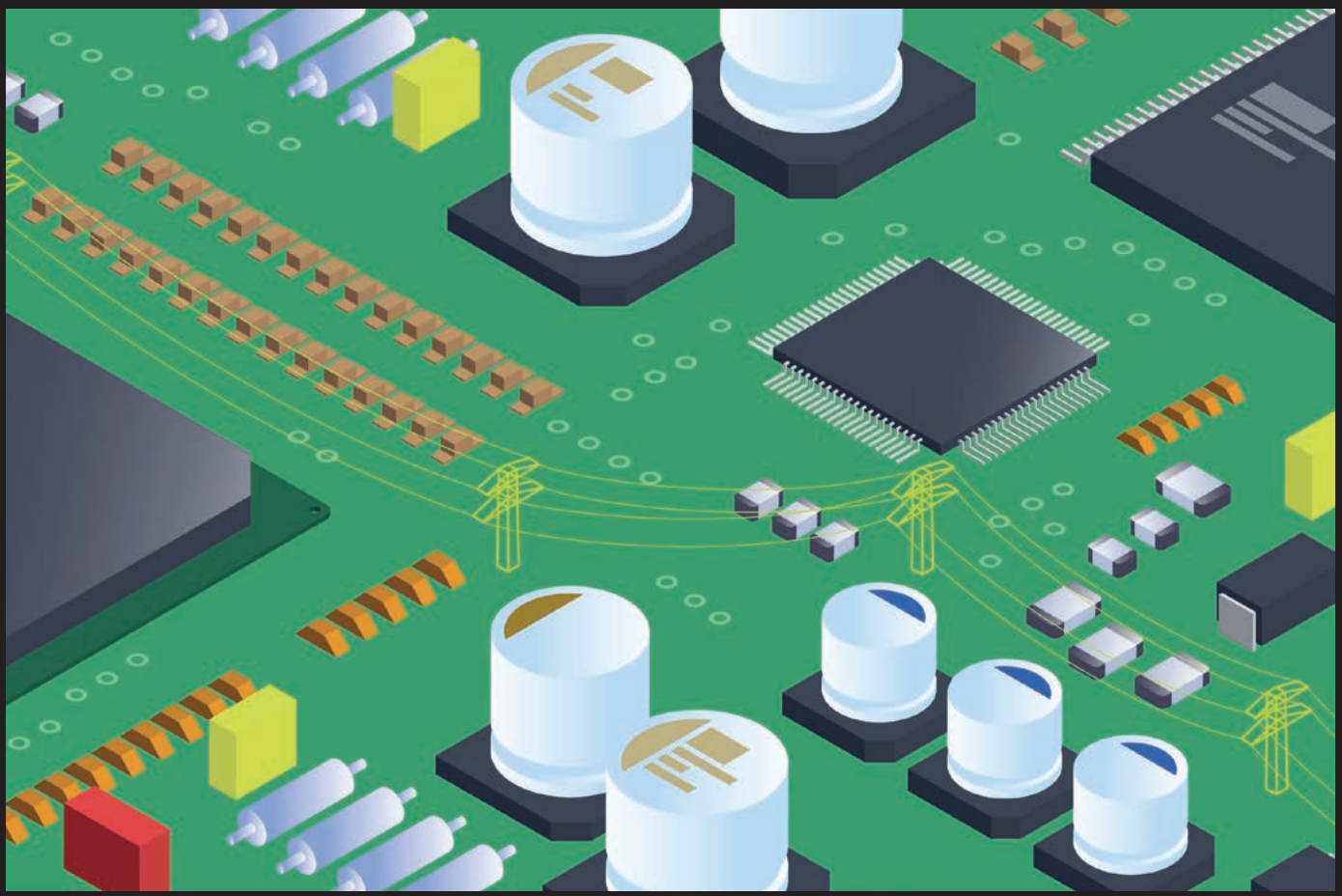

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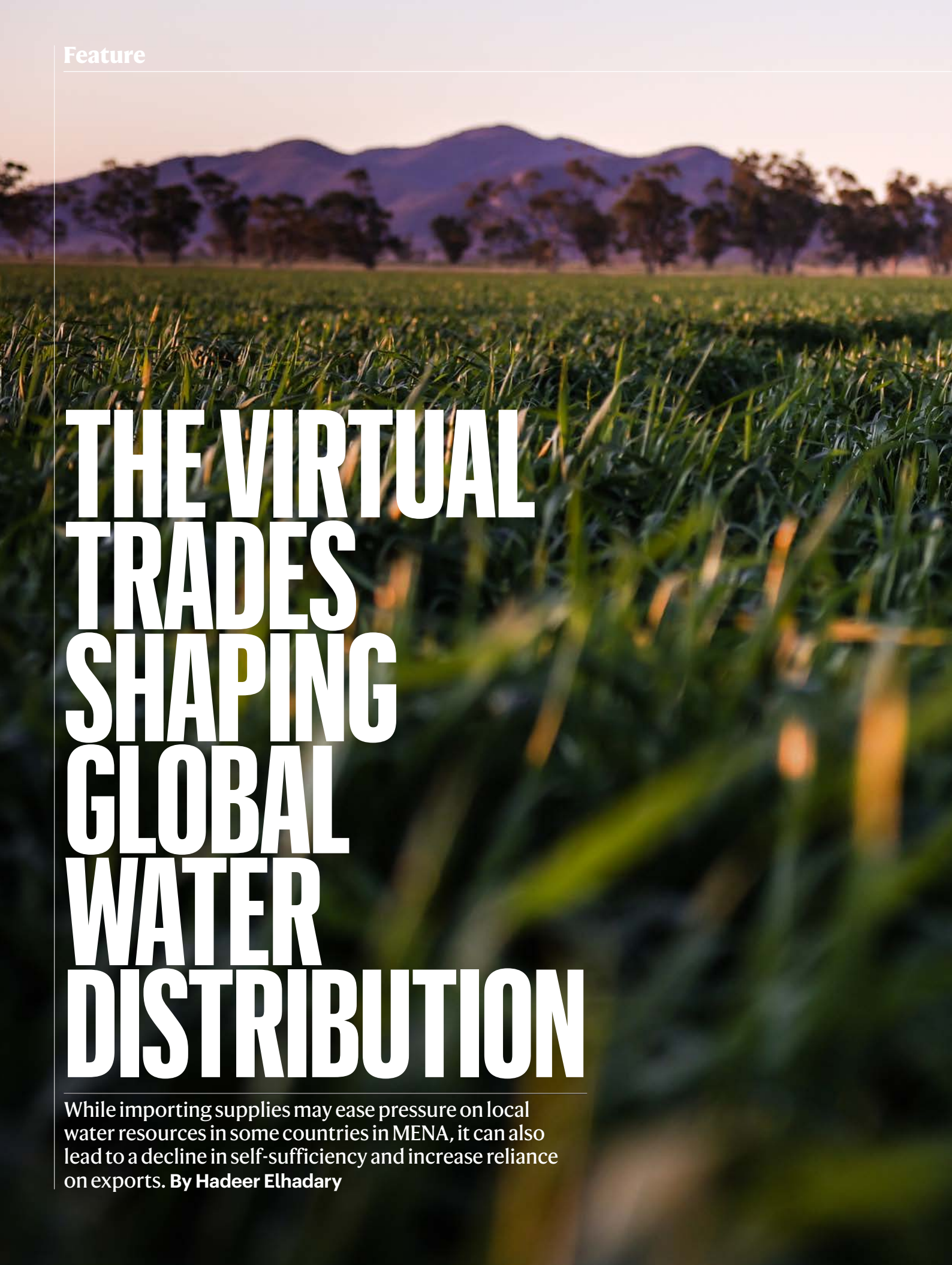

THE VIRTUAL TRADES SHAPING GLOBAL WATER DISTRIBUTION

While importing supplies may ease pressure on local water resources in some countries in MENA, it can also lead to a decline in self-sufficiency and increase reliance on exports. **By Hadeer Elhadary**

DAVID GRAY/GETTY IMAGES NEWS

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Water scarcity is a reality in many MENA countries, limiting their ability to grow food locally. Populations rely on food imports, which bring vast amounts of 'virtual water', the embedded water that is used directly and indirectly throughout the food production chain.

Every tonne of rice imported to the region carries the water used to produce it. While this hidden trade helps conserve local water resources, there are inbuilt risks through climate change, potential supply disruptions, and global market challenges.

In principle, virtual water trade should relieve water stress in developing countries, as they import the majority of their food rather than producing it. However, the reality is often the opposite, as all net exporters of virtual water are developing countries, except Australia.[1]

An *Ecological Indicators* study[2] found that virtual water trade reduced water stress in 86% of developed countries and increased it in 71% of developing countries in 2005.

Many water-scarce countries use their limited resources to grow crops for export, helping developed countries conserve their own supplies.

Another study published in 2021 in *Water Supply* highlighted that India, one of the world's largest rice exporters, may lose its water resources within 300 years.[3] India exports around 32 billion m^3 of water or 1.6% of total available water and contributes a 24% share in the global virtual water export, while virtual water import is negligible.

Strategic Necessity

MENA is the most water-scarce region in the world[4], and achieving complete food self-sufficiency is not a realistic goal for most countries, according to Mohamed Hamdy, Senior Land and Water Officer and Delivery Manager of the Regional Water Scarcity Initiative at FAO's Regional Office for the Near East and North Africa.

"Food imports and virtual water trade are a strategic necessity for Arab countries that face water scarcity, increasing population growth, and increased demand for food," Hamdy explains.

"Each country should allocate its water resources to the most important crops, whether based on national consumption needs or economic value, and import the rest," he adds.

As part of the solution, Hamdy calls for enhancing climate-smart agriculture, cultivating water-efficient crops, relying on technology that enhances climate change prediction and offers advanced forecasts of the state of agriculture and water, and using treated wastewater in agriculture.

VIRTUAL WATER IN MENA

Virtual water refers to the water embedded in the products, services, and processes that people buy and use every day. This water has been consumed throughout the value chain, which makes the creation of that product or service possible.

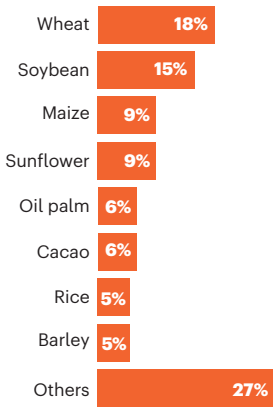
Green Virtual Water
The water from rainwater held in the soil and used by plants

Blue Virtual Water
Surface and groundwater stored in lakes, streams groundwater, and rivers.

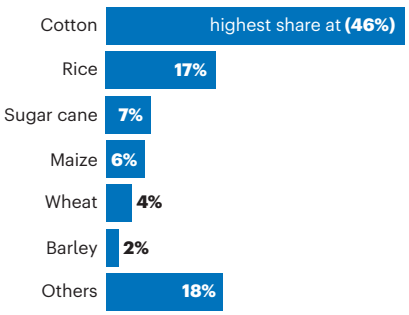
Virtual water imports outside the region
Percentage breakdown of virtual water import for each crop in relation to the total green and blue virtual water imports

The region annually imports 91 billion m^3 of green water and 12 billion m^3 of blue water in relation to the import of agricultural products

Green virtual water imports



Blue virtual water import



Dependence and Sovereignty

Hala Youssef Mahmoud, a senior official at Egypt's Ministry of Agriculture, believes that virtual water trade has become a key component of achieving food security, as the Arab world imports more than half of its food needs. However, "it may also expose countries to external shocks."

Arab countries imported more than 921.2 billion cubic metres of green water and 80.5 billion cubic meters of blue water through staple crops between 2000 and 2012. While importing contributed to easing pressure on local water resources in countries like Egypt and Saudi Arabia, it led to a decline in self-sufficiency and an increase in reliance on exports.

Food sovereignty should be ensured through stable and diversified access to food, since exporting countries may use food as a political tool. As Hala explains, "overdependence can weaken the political and economic negotiating power of Arab nations, especially during crises."

Maaden El-Ervane, Mauritania.

The Way Forward

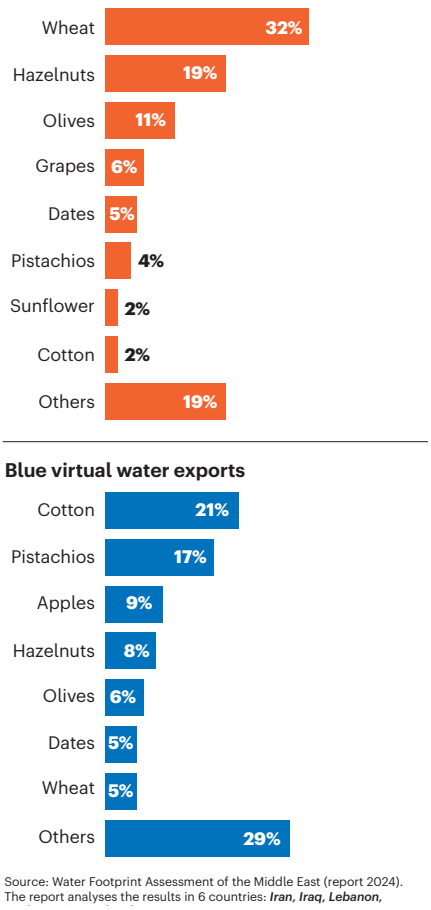
Despite the risks, virtual water trade still offers a chance to strengthen intra-Arab agriculture integration, says Ali Eissa, senior agricultural economist at the Arab Organization for Agricultural Development.

Ali explains, "countries like Sudan and Mauritania, rich in water and arable land, could become regional suppliers of water-intensive crops if their resources are efficiently utilized."

"Each country should allocate its water resources to the most important crops, whether based on national consumption needs or economic value, and import the rest."

Virtual water exports outside the region
Percentage breakdown of virtual water export for each crop in relation to the total green and blue virtual water exports.

The region annually exports a combined total of 10 billion m³ of green water and 5 billion m³ of blue water embedded in its exported goods to destinations outside the region.



Source: Water Footprint Assessment of the Middle East (report 2024). The report analyses the results in 6 countries: ***Iran, Iraq, Lebanon,***

Climate-smart agriculture, the development of intra-Arab agricultural trade, the use of non-conventional water resources, and the integration of the virtual water concept into water and food policies could be key solutions to enhancing food security and reducing pressure on limited water resources.

"However, weak institutional coordination and inadequate trade infrastructure between Arab countries limit these benefits," Ali adds.

Ali agrees that the path forward lies in smarter allocation of local water resources, stronger regional agriculture integration, and climate-resilient technologies and practices. If managed properly, the virtual water trade may become a foundation for the region's long-term food security, rather than a liability for future generations.

1. https://www.iwmi.org/news/the-quiet-power-of-virtual-water-trade-in-shaping-global-resource-dynamics/
2. https://www.sciencedirect.com/science/article/pii/S1470160X22011852?via%3Dihub
3. https://iwaponline.com/ws/article/22/2/1704/84269/Virtual-water-trade-and-its-implications-on-water
4. https://www.iwmi.org/where-we-work/mena/

IMPLEMENTING THE WEFE NEXUS IN THE ARAB REGION

Arab countries are turning the Water–Energy–Food–Ecosystems Nexus from theory into practice. But while pilots in Egypt, the UAE, and Morocco show promise, experts warn the framework applications remain distant from the theory's ambitious goals. **By Ayah Aman**

ANDREA DICENZO/GETTY IMAGES NEWS

Hatta Dam, UAE.

STRINGER/AFP VIA GETTY IMAGES

A framework that highlights the interconnectedness of the water, energy, and food sectors has been central to discussions on sustainable development in the Arab world. Known as the Water-Energy-Food-Ecosystem (WEFE) Nexus approach, many Arab countries have designed programmes turning it from theory into policy and practice.

Pilots in countries like Egypt, UAE, and Morocco have shown measurable results. In Egypt, water recycling projects produce around 21 billion cubic metres of water annually, while the United Arab Emirates aims to produce 90 to 100% of its desalinated water using renewable energy by 2030.

The WEFE nexus framework focuses on the interdependencies among vital sectors instead of treating each sector in isolation. For example, water is essential for both agriculture and energy production, while energy is needed to extract, treat, and distribute water, and to power food production and processing.

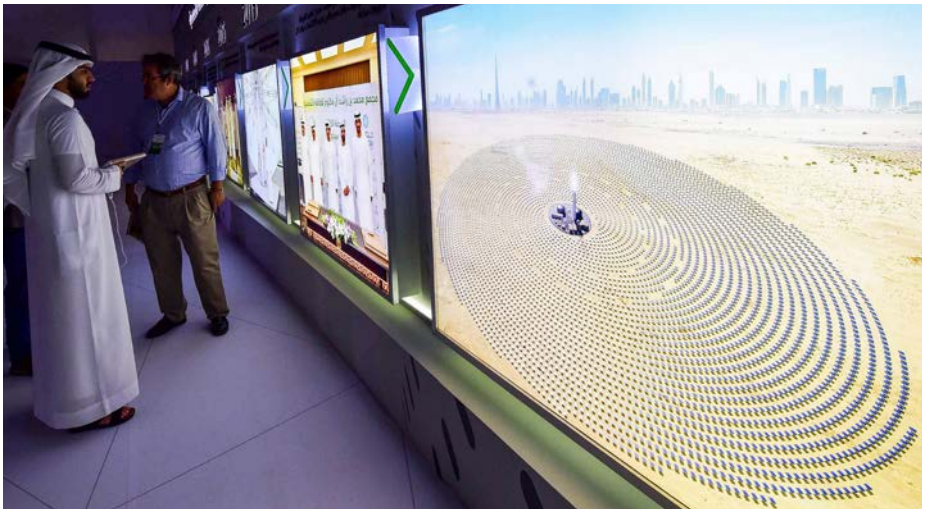
For the Arab region, the nexus framework is critical due to the chronic water scarcity[1] combined with the reliance on energy exports, and the growing dependency on food imports. The region's arid climate and rapid population growth drain the limited water resources, making it a necessity to manage water, energy, and food systems in a coordinated manner.

Many countries have incorporated this framework into their projects and policies. The UAE issued its National Energy and Water Demand Management Programme in 2021[2], as part of the Energy Strategy 2050 and the Water Security Strategy 2036, to increase efficiency in the three major energy-consuming sectors: transportation, industry, and construction by 40%.

At COP 27, Egypt launched the National Platform for Green Projects "NWFE" to mobilize climate finance and attract private sector investments for green projects. Morocco launched its National Strategy for Sustainable Development, and incorporated the WEFE nexus approach in its project "Management of Interconnections in Mediterranean Coastal Areas," to address the interconnected challenges of water, energy, food, and ecosystems in coastal areas.

While there is significant interest, and multiple projects linking the water, energy, and food sectors, the application of the framework is still not uniform across the Arab region. "Each country implements the nexus according to its specific requirements and the internal availability of its resources," says Inas El-Gafy, Director of the Strategic Research Unit at Egypt's National Water Research Centre. "The full-scale application of this theory remains largely confined to research centres, which highlights a persistent gap between the theoretical concept and the practical implementation," she adds.

Each country has its own approach for the WEFE nexus implementation. The UAE relies on technology, integrating renewable energy solutions with water desalination and agri-tech innovations. Within its National Energy and Water Demand Management, the UAE launched Mohammed bin Rashid Al Maktoum Solar Park, the Green Hydrogen Project, and the Bustanica vertical farm in Dubai, which are designed to connect desalination plants with renewable energy sources and consume the lowest possible water rate in agriculture.



Mohammed bin Rashid Al-Maktoum Solar Park, UAE.

The UAE's Sustainable Development Strategy encourages farms to achieve sustainable management of water and energy resources from the outset. This approach aims to produce food with minimal water usage and rely on renewable energy. Dubai's Bustanica vertical farm demonstrates this principle, with its vegetable production using 95% less water than traditional agriculture.

Egypt approaches the nexus framework through large scale water reuse projects, backed by NWFE platform to secure funding. The total amount of recycled water in Egypt is estimated at 21 billion[3] cubic metres annually, mainly for agricultural purposes. Some of the nexus-led projects include the Bahr El Baqar[4] Wastewater Treatment Plant, which produces 5.6 million cubic meters of irrigation water per day, with the aim of reclaiming 400,000 feddans in the Suez Canal region using treated agricultural, sanitary, and industrial wastewater. Another project is the Mahsama Wastewater Treatment Plant[5], which has a daily capacity of one million cubic metres, for the purpose of reclaiming 42,800 feddans in Sinai.

Morocco's approach is more policy-led, embedding the nexus framework into its national Sustainable Development Strategy, to improve the efficiency of water and energy resources and promote a sustainable agricultural sector. Another example is 'Aquifer Contract', a participatory framework to manage groundwater sustainably while balancing the nexus domains. This tool is a demonstration of integrating resource management within national policies to address water scarcity, agricultural demands, and ecosystem protection, putting nexus principles and policies into practice.

Despite the local WEFE approaches in the region, the framework applications remain distant from the theory's ambitious goals.

The full implementation of the framework is limited by the governance and legislative needed to coordinate between water, energy, and food sectors, according to Hussein El-Atfy, Secretary-General of the Arab Water Council.

Funding is another challenge. From one perspective, it's "difficult to create incentives for the private sector to invest in the proposed projects," says, El-Atfy, and from the other is meeting the requirements of the funding agencies. The incentives are challenging as investment must address multiple interconnected sectors at the same time, which involves complex investment structures, and unknown economic returns compared to single-sector projects.

Funding is more difficult with the WEFE Nexus because investments must address multiple, sectors simultaneously, which involves far more complex investment structures, longer payback periods, and obstacles to demonstrating straightforward economic returns compared to single-sector projects.

Many organizations have invested in initiatives to build capacities, and to attract foreign investment for such projects, and as many pilots have shown encouraging outcomes, experts believe that embedding WEFE nexus into law and practice can transform water from a source of vulnerability into the foundation of future security, as Jauad El-Kharraz explains in the next story.

1. The Water, Energy and Food Security Nexus in the Arab Region - E/ESCWA/SDPD/2015/Booklet.3
2. The National Energy and Water Demand Management Programme 2050 - UAE - March 2021
3. The National Agenda for Sustainable Development - Egypt's Updated Vision 2030 - Published 2023
4. https://www.arabcont.com/project-624
5. https://www.presidency.eg/ar

Comment

Why the Arab Region Must Adopt the WEFE Nexus for Water Security

Jauad El Kharraz, CEO of Water-Energy-Climate Experts Network (WECEN)

A legally binding WEFE Nexus framework could turn water from a source of vulnerability into a driver of resilience.

BIM/ISTOCK / GETTY IMAGES PLUS

In Saudi Arabia, desalination meets demand, but consumes nearly 10% of its oil output, linking water security to unstable energy markets.

Water scarcity in the Arab region is often managed in isolation from energy, food, and ecosystem policies, a framework that is no longer sustainable.

If I could change one water policy, it would be making the integration of water governance into a regional Water–Energy–Food–Ecosystems (WEFE) Nexus framework legally binding. Fourteen of the world's 20 most water-stressed countries are located in the Arab region. Climate change is projected to reduce renewable water resources by a fifth by 2030, and population growth is expected to increase food demand by 50% by 2050. Fragmented and isolated policies will not meet these demands.

The cost of traditional water policies is evident, as they ignore systemic leaks. In Saudi Arabia, desalination meets demand, but consumes nearly 10% of its oil output, linking water security to unstable energy markets. In Egypt, 60% of irrigation water is wasted due to inefficiencies, while solar-powered systems remain sidelined.

The WEFE Nexus policies can offer valuable opportunities in terms of cost, innovation, and impact. A 2023 study by the International Food Policy Research Institute estimated that Nexus-aligned policies could save MENA economies $10 to $17 billion annually. The World Bank predicted that these policies could reduce water demand by 25% while boosting renewable energy capacity.

The WEFE Nexus isn't theoretical; it is already working where implemented. The Chtouka desalination plant in Morocco produces 275,000 m^3 of renewable-powered desalinated water daily, supplying drinking water to nearly two million people and irrigating approximately 15,000 hectares, accounting for nearly 65% of Morocco's vegetable and fruit exports.

The choice for us is either repeating cycles of crisis management or adopting policies that offer resilience and sustainability.

In Jordan, the As-Samra plant treats more than 365,000 m^3 of wastewater daily, supplying a large proportion of Amman's irrigation needs while meeting 80% of its energy requirements with biogas from sludge. In the United Arab Emirates, renewable-powered desalination pilots cut carbon emissions by almost 65%.

While these projects demonstrate what is possible when water, energy, food, and ecosystems are managed together, they remain the exception rather than the rule. Scaling them up requires political will, as governments need to coordinate across water and agriculture ministries, tying water budgets to renewable energy and agricultural targets.

We cannot continue to address each crisis in isolation. Climate change, population growth, food insecurity, and volatile energy markets are converging, and fragmented policies only multiply the risks.

The choice for us is either repeating cycles of crisis management or adopting policies that offer resilience and sustainability. By embedding the WEFE Nexus into law and practice, Arab governments can transform water from a source of vulnerability into the foundation of future security.

Q&A

JOHN WREFORD/ SHUTTERSTOCK.COM

The current narrative of scarcity feeds helplessness instead of responsibility.

When it comes to water, all is not clear

By Toka Khalid

In the Arab world, water shapes narratives about scarcity, abundance, and power. Some of these narratives are misconceptions.

We have asked six Arab water experts what most people get wrong about water, and what can be done to secure its future.

Mohamed Dawoud, Senior Water Resources Advisor, Environment Agency – Abu Dhabi (EAD)

"The biggest misconception is that water is only a matter of 'scarcity', and it is 'free.'"

Water scarcity is framed as the main challenge in the Arab region in most published reports and policy papers. The Arab region gets less than 1%[1] of global renewable freshwater resources while having more than 5%[2] of the world's population. The annual per capita renewable freshwater availability in most Arab countries has fallen far below the water poverty line of 1,000 cubic metres per year.

Most countries are investing in costly non-conventional resources such as desalination and wastewater reuse, which have environmental impacts. Yet the real challenge is mismanagement. Water strategies remain supply-driven with little focus on demand management. Irrigation relies on outdated systems that waste more than they deliver.

Focusing solely on scarcity drives expensive supply-side projects while ignoring smarter demand management, recycling, and conservation. The current narrative of scarcity feeds helplessness: "We don't have enough," instead of responsibility, "We must use what we have better." Scarcity is real, but it is only the background. The most crucial issue is how the region chooses to manage, value, and innovate around water.

For Dawoud, the way forward is to rethink how existing water is used, instead of chasing more supply.

"If there is one innovation that can change the narrative, it would be the investment in water demand Research and Development (R&D)."

This investment can transform the way water is managed in agriculture and food production. These solutions can reduce groundwater deterioration and dependence on costly desalination while maintaining or even improving agricultural production.

Ultimately, strategic investment in demand-side R&D improves small farm's income, secures food, and supports sustainable development by ensuring that limited water resources generate maximum economic and social returns.

Scarcity alone doesn't tell the full story. Even a river that never stops flowing can hide a nation's vulnerability.

Tahani Moustafa Sileet, Project Director, VICMED, "Establishment of a Navigational Line between Lake Victoria and the Mediterranean Sea"

"Watching a river flow can create the illusion that water is abundant and will always be available, but that's often far from the truth."

Though the Nile flows through Egypt, it relies on external sources for 97%[3] of its water. This makes it highly vulnerable, as climate change, uncoordinated infrastructure, pollution, and overuse are rapidly depleting water supplies, leading to droughts, crop failures, and sometimes conflict.

Recognizing water as a human right and a finite, precious resource is essential for global sustainability and development.

So, when natural sources fall short, can technology offer dependable alternatives?

"Desalination using renewable energy like solar or wind can be a game-changer in dry and coastal regions."

It can improve access to water, ease the pressure on freshwater ecosystems, and support more stable agriculture, especially in water-scarce areas. Integrating desalination with climate-smart irrigation, efficient distribution, and water reuse systems would create circular water economies despite the challenges of membrane cost, brine disposal, and infrastructure demands. Yet with climate change deepening global water shortages, desalination has the potential to change how societies value and manage water.

Even when water flows in abundance, its availability depends on governance, distribution, and management.

Nidal Hilal – Director of NYU Abu Dhabi Water Research Center

"One of the most common misconceptions about water scarcity is that it comes from a simple lack of supply."

We live on a planet abundant with water; however, a small fraction of it is fresh, accessible, and safe for human use. Even that small fraction isn't spread fairly, gets polluted, and is under pressure from farming, factories, and households.

Relying only on technology to fix the issue is another common misconception, as innovation doesn't succeed in a silo. Without strong governance, transformative policies, and inclusive management, even the best solutions risk failing.

Water scarcity is not only a technical challenge but also a social, economic, and political one. Recognizing this complexity transforms the illusion of endless water into a pressing call for smarter and more sustainable usage.

Water challenges are too complex for a one-size-fits-all solution. Therefore, real progress comes when various innovations, such as improved membrane technologies, more efficient energy use, and AI tools, are combined to change how we manage water.

What excites me most is how these innovations work together; an AI tool predicting membrane fouling can increase desalination plant efficiency, integrating renewable energy can reduce emissions, and combining both with surface-patterned membranes can further cut energy consumption. These interlinked solutions create systems that are smarter, cleaner, and more resilient.

Water challenges go beyond supply and policy; they are about how societies grow, consume, and manage water.

Maha Al-Zu'bi, Regional Researcher - Sustainable and Resilient Water Systems - International Water Management Institute

"Many people assume water scarcity in MENA is purely a natural outcome of living in the driest region in the world. In reality, scarcity here is as much about people as it is about nature."

Scarcity is closely linked to rapid population growth and economic development, which means more people and higher water use per person. Mismanagement, over-extraction, pollution, and unequal access affect who gets water, when, and by how much.

The United Nations Intergovernmental Panel on Climate Change IPCC Sixth Assessment Report shows that climate change intensifies these pressures by accelerating the water cycle, which makes droughts more frequent, rainfall less predictable, and extreme events more damaging.

In a region facing political and social fragility, these stresses increase risks to communities, health, and stability.

Al-Zu'bi believes that the future depends on solutions rooted in nature itself.

"For MENA, where every drop matters, scaling nature-based water solutions is not just an innovation. It is essential for a sustainable future."

In a region as fragile as MENA, where water scarcity shapes many parts of life, no single technology or practice can solve the crisis. The real solution is to think of water as the starting point for community resilience.

Nature-based solutions, including restoring wetlands to regulate water flows, harvesting rain to secure local supplies, and greening urban areas to improve recharge, can bring communities together while strengthening water systems.

These solutions are not meant to replace existing infrastructure, but to work alongside it, cooperating with treatment plants, irrigation systems, and storage facilities to enhance performance and sustainability. They are most effective when linked across different areas, connecting water with food, energy, and ecosystems. By focusing on water in integrated approaches, we can move beyond quick fixes and toward lasting resilience.

When solutions are discussed, one technology dominates the headlines: desalination.

Youssef Brouziyne - Regional Director (MENA) & Principal Researcher - International Water Management Institute (IWMI) - CGIAR

"One common misconception is that desalination is a standalone fix for water scarcity, especially in the Middle East and North Africa."

While desalination is indeed a strategic solution, it isn't a magic bullet. Desalination comes with trade-offs: energy demand, carbon and brine footprints, coastal impacts, cost and equity questions, and governance complexity.

People often underestimate the significant investment capital required to build and maintain desalination plants, as well as the importance of looking at the entire water value chain.

Desalination should fit into a broader framework that includes understanding agricultural and ecosystem water use, carbon footprints, and efficiency improvements. In other words, it should be part of a holistic approach that includes better water management, wastewater reuse, and efficiency gains in agriculture.

So, the real question is not if we should desalinate, but how to make use of every drop produced across the whole value chain.

"An innovation that could transform water management is the concept of value-chain-based desalination hubs."

By focusing on how desalination fits into the entire water, agricultural, and environmental value chain, we can create programmes to efficiently store, transport, and use water.

These hubs would not focus only on technology but also on the necessary economic enablers, institutional frameworks, and social equity conditions. That means improving desalination technology itself, and the way we manage distribution, storage, agricultural productivity, and water-use efficiency.

Crucially, the hubs should be planned scientifically, starting from basic needs and efficiency gains, not from megaproject ambition alone. In MENA and other dry areas, this combined model can change desalination from a backup source to a reliable way to thrive.

The misconceptions shift from scarcity to abundance, but both extremes are illusions.

Waleed Khalil Zubari - Professor of Water Resources Management - Center of Environmental and Biological Studies - Arabian Gulf University

"The GCC countries have built massive, world-leading desalination infrastructures that make water flow continuously from taps 24/7 with almost 100% population access to high-quality, safe drinking water. Heavily subsidized, it creates a misconception for residents and tourists that water is cheap and always available on demand."

This visible reality hides significant costs. The huge subsidies and the opportunity cost of fossil fuels represent billions of dollars that could go toward healthcare, education, or economic diversification. Also, energy-heavy desalination has a

Q&A

large carbon footprint, making it harder to reach carbon-neutral goals, and the brine discharge causes significant harm to marine ecosystems.

By creating the perception that water is a low-value commodity, this illusion directly kills any incentive for conservation and encourages a wasteful lifestyle, fundamentally undermining the path to true water sustainability.

As Zubari explains, desalination creates the illusion that water is endless. Could new technology change this and push us toward real sustainability?

"AI and emerging technologies integration could move the GCC countries from a reactive, wasteful model to a predictive, precise, and efficient one, fundamentally changing how water is managed and conserved in the region."

AI and emerging technologies integration can act as the brain that synchronizes the entire water cycle. AI-powered smart water grids use a network of sensors and meters to collect real-time data on flow, pressure, and quality. When equipped with machine learning analysis, these systems can pinpoint exact leak locations, predict which parts of the aging infrastructure are most likely to fail, and dynamically balance pressure to reduce stress on pipes and minimize losses.

At the demand sites, smart sensors can give consumers insights into their water use and alert them if leaks are found. Within the desalination process, AI algorithms can adjust operations based on salinity and energy costs. In agriculture, AI and smart sensors allow hyper-precise irrigation. Instead of scheduled watering, smart systems can hydrate crops based solely on real-time soil moisture and weather data, eliminating profound wastage.

Misconceptions may cloud the picture, but they are not the whole story. The brighter side lies in how the region rethinks water and designs innovative solutions.

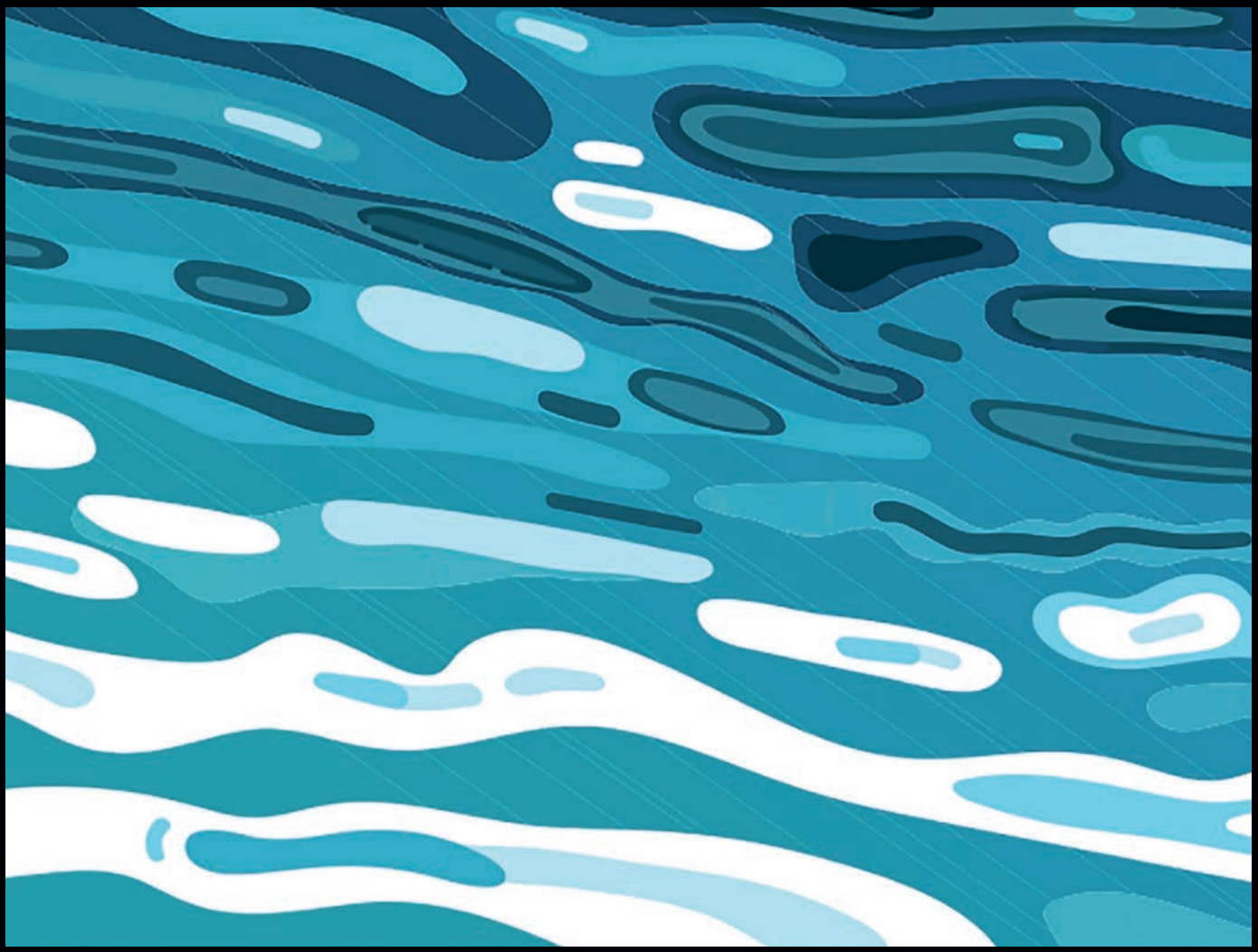
1. DOI:10.58205/fber.v6i1.1562
2. DOI:10.58205/fber.v6i1.1562
3. www.trade.gov/country-commercial-guides/egypt-water-and-environment

FGM/ISTOCK / GETTY IMAGES PLUS

Sugar processing factory on the banks of the river Nile, Egypt.

nature water

Nature Water Talks



A series of online webinars organized by the journal editors, *Nature Water* Talks provide an informal and professional venue for our community to discuss a range of topics related to water resources and their relationship to society. Attendees can expect to hear from invited experts with ample time for engaging discussions on challenges and opportunities in water-related issues.

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SUSTAINABLE WATER INITIATIVES IN MENA

As water scarcity deepens across MENA, wastewater use is emerging as a solution. We look at projects and technologies being adopted across the region. **By Rasha Dewedar**

JAKE LYELL / ALAMY STOCK IMAGES

The As-Samra wastewater treatment plant, Jordan.

The Bahr El Baqar wastewater plant in Egypt recycles more than five million cubic metres of water every day for agricultural use for farmland. Yet across the region, many similar facilities are either operating partially, unfinished, or abandoned.

The Middle East and North Africa region has 14 of the world's top 20[1] water-scarce countries. This challenge, driven by climate change, urbanization, and population growth, demands reliable and sustainable solutions.

Wastewater Treatment (WWT) removes pollutants, microorganisms, and chemical toxins, making water safe for reuse. Plants often combine two or more technologies to reach the required quality, depending on costs, purpose, and environmental factors.

Conventional methods for WWT deliver results quickly but are energy-intensive, whereas extended methods are nature-based systems, like lagoons and reed beds, that require more land but consume less energy and require minimal maintenance.

Why plants fail

One of the main challenges for wastewater treatment in MENA is cost.

"Many WWT plants in MENA have been constructed but never operated close to capacity, or shut down," says Sammy Kayed, co-founder of the Environment Academy at the Nature Conservation Center, American University of Beirut.

Energy is another challenge. Treatment plants require more energy, especially in hot climates, explains Mostafa Hadei, Assistant Professor of Environmental Health Engineering at Tehran University.

Looking for smarter solutions

Efforts are already in place to overcome the challenges and introduce innovations in WWT. Between 2018 and 2022, the International Water Management Institute (IWMI) launched 'ReWater', a regional project aimed at expanding water reuse in Egypt, Jordan, and Lebanon. The project addressed cultural resistance, outdated regulations, and the lack of financial models for cost recovery.

As one of the ReWater project partners, the International Center for Agricultural Research in the Dry Areas (ICARDA), has experimented the usage of wastewater on specific crops and soil to reach the best techniques for irrigation systems, at the Sarapium Wastewater Treatment Plant in Ismailia, Egypt.

ReWater MENA launched the National Analysis of Water Reuse Potential in Irrigation, offering a technical and governance guidance to the potential of water reuse in Lebanon and the potential of its manifestation in the current political and economic context.

Kayed suggests nature-based solutions that benefit both people and the planet. This method usually involves Reeds, coarse grasses

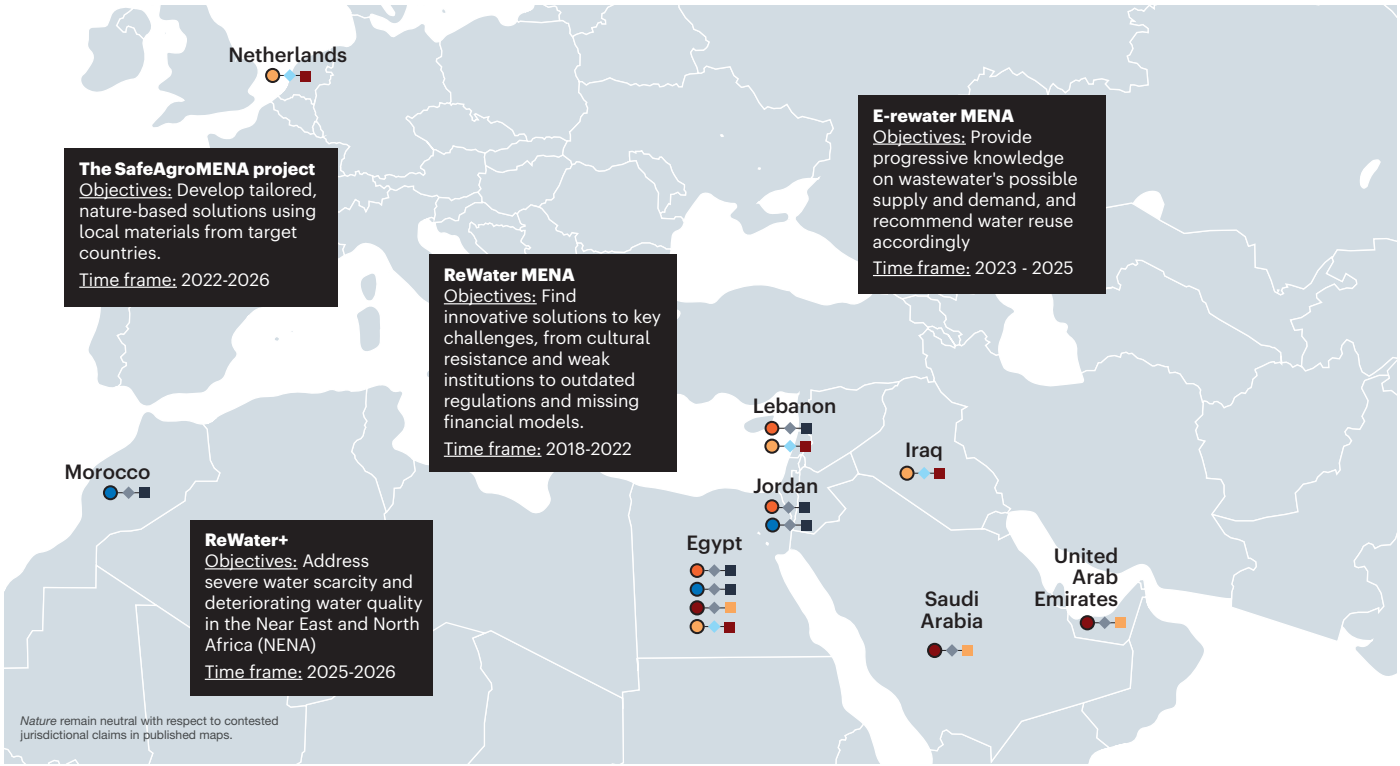
REUSE WATER PROJECTS IN MENA

This infographic traces four major wastewater reuse initiatives across the region, highlighting where projects are being implemented, their timelines, and institutional partners.

Projects
- ReWater MENA
- ReWater+
- E-rewater MENA
- The SafeAgroMENA project

Implemented by
- IWMI
- IHE Delft Institute for Water Education

Funded by
- Swedish International Development Agency (SIDA)
- Google Foundation
- Dutch Ministry of Foreign Affairs



that grow in wet areas, and is used as a cheap method to treat liquid waste.

"One promising method I've worked on is lagoons and reed beds," says Kayed. "If designed carefully, they can operate relatively passively at a fraction of the cost and are best suited for irrigation of orchards".

Hadei says that the broader adoption of WWT depends on comprehensive planning, strong public-private partnerships, financial incentives, and applying "fit-for-purpose" treatment that cleans water only as much as needed for its intended use.

Sustainable Practices

Building on the ReWater project, IWMI launched ReWater+ in Egypt, Jordan, and Morocco, as part of the Near East and North Africa Water Scarcity Initiative. The project involves multiple partners and stakeholders collaborating to analyze costs, benefits, and social impact.

"Reuse projects often reduce emigration from rural areas, fix soil, and increase employment rates, which in turn offer financial gains," says Youssef Brouziyne, the International Water Management Institute's (IWMI) MENA representative. In the Bahr El Baqar project operational costs are optimized at every step, and revenue is diversified through selling byproducts. The plant was launched Bahr El Baqar in 2021, and treats 5.6 million cubic meters of water per day to cultivate more than 400,000 acres in Sinai.

> "MANY WWT PLANTS IN MENA HAVE BEEN CONSTRUCTED BUT NEVER OPERATED CLOSE TO CAPACITY, OR SHUT DOWN"

Integrating local capabilities is another factor in ensuring sustainability. "WWT plants can produce biogas from sludge to lower energy costs, and nutrients can be recovered and reused in agriculture," says Hadei. The As-Samra plant in Jordan, for example, produces almost 80% of its required operational energy from biogas and hydropower, while generating bio-solids for fertilizer and fuel.

Other projects highlight the social dimension of water reuse, like the SafeAgroMENA[2] project by IHE Delft, running in Egypt, Lebanon, Iraq, and the Netherlands. The project employs an interdisciplinary approach to provide safe water for agricultural use, helping small-scale farmers reuse treated wastewater safely, according to Hadeel Hosney, the project leader.

"SafeAgroMENA is economically relevant and sustainable, as it conducts comprehensive assessments from a technical, political, and socio-economic perspective," says Hosney. This practice allows the development of tailored, nature-based solutions using local materials from target countries.

Digital innovation is also shaping the sector, including decision-support, earth observation, and data analytics tools, all powered by AI. Such tools offer valuable insights into wastewater's supply and demand, and recommend water reuse accordingly, in countries like the United Arab Emirates, Saudi Arabia, and Egypt.

1. Renewable Energy Desalination: An Emerging Solution to Close the Water Gap in the Middle East and North Africa. The World Bank
2. https://www.un-ihe.org/revolutionizing-agriculture-mena-tackling-water-crisis-and-pollution-innovation

How water flows through Arabic heritage

Five historic sites demonstrate how water was engineered, honoured, and transformed into a lasting part of the Arab heritage. **By Ifath Arwah**

Water has shaped the Arab region across centuries, as a matter of identity, power, cultural expression, and survival.

From the early Islamic period to the Ottoman era, rulers and communities invested heavily in systems that supplied, displayed, and celebrated water. Wells and canals sustained pilgrims on desert routes, public fountains doubled as charitable gifts and schools, water wheels powered irrigation and became symbols of civic pride, and palaces were painted with imagery of rivers, seas, and myths, shaping cultural memory for centuries to come.

These projects were both practical infrastructures and cultural statements. They reveal how societies in the Arab world combined engineering skill with artistic ambition to make water visible, memorable, and enduring. In the Arab world, water has been a symbol of purity, generosity, and power, expressed through art, architecture, storytelling, and ritual.

Five historic sites offer vivid reminders of this legacy.

MONICA MOSCATELLI/SUSTAINABILITY 2024, 16(16), 7055

Photographic survey of the findings of Fayd Fortress, one of the wells in the archeological site.

Zubaydah's Canal & Wells

(COMPLETED BY 801 AD)

Stretching across some of the harshest terrain between Kufa and Mecca, the Darb Zubaydah served as a lifeline for Hajj pilgrims. Commissioned by Queen Zubaydah, the infrastructure included dozens of wells, cisterns, dams, and shaded rest stations, sustaining travellers with carefully managed water.

"Queen Zubaydah's commissioning of this water infrastructure was both charitable and strategic," says Monica Moscatelli, Associate Professor of Architecture at Prince Sultan University in Riyadh. "The Darb Zubaydah was a pioneering example of how infrastructure could sustain religious, social, and political cohesion."

Its legacy endures beyond its engineering. As Moscatelli notes: "Today, its significance goes far beyond its technical function. The Darb Zubaydah embodies the cultural values of Islamic architectural heritage, where water was considered sacred and central to life, spirituality, and community resilience."

In her 2024 study[1], Moscatelli highlights it as "a model of how heritage can drive sustainable tourism development by connecting faith, identity, and history with contemporary cultural and economic opportunities."

1. https://doi.org/10.3390/su16167055

Mosara Garden & Great Waterwheel

(FEZ, 13TH CENTURY)

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Ruins on the south side of Dar al-Makina and Bab Dekkakin/Bab Sebaa.

In 1287, Marinid Sultan Abu Ya'qub Yusuf commissioned the Mosara Garden on the northern outskirts of Fes elJdid, Morocco. It was a vast royal pleasure estate, irrigated by a 26-metre noria, that lifted water from the Fes River into aqueducts feeding gardens, pavilions, and ornate grounds.

As historian Inigo Almela observes[2] in his published paper: "Although the estate is 250 metres from the Fez River and from the city, its dependence on the water course and its connection to the court scene linked it directly to New Fez.... It became one of the most remarkable highlights in Fez during the Marinid period."

This feat was not just technical but symbolic, a demonstration of hydraulic ambition and dynastic prestige, inscribing water into the very identity of Marinid urban design. Though now mostly vanished, the Mosara estate remains a potent symbol of how water, architecture and power were intertwined.

2. https://doi.org/10.1163/26666286-12340051

Norias of Hama

(SYRIA, 12TH–14TH CENTURY; THE OLDEST SURVIVING NORIA: 1361 CE)

Along the Orontes River in Syria, vast wooden water wheels once turned day and night, lifting water into stone aqueducts that fed gardens, mosques, and homes. The largest, the Noria al-Muhammadiyya, was built in 1361 CE, measuring 21 metres in diameter.

Beyond their practical function, the wheels became an emblem of Hama itself; their rhythmic creak and spray forming the city's soundscape for centuries.

In 2006, the American Society of Mechanical Engineers designated the Noria al-Muhammadiyya an ASME Historic Mechanical Engineering Landmark[3], citing it as a rare surviving example of pre-modern hydraulic technology. What survives in memory is the "creaking and splashing as the wood is distorted by the weight of the water and the endless rotation. Given that these are some of the oldest water wheels in the world, maybe they can be forgiven for their groaning and moaning," wrote[4] Trevor Cox, Professor of Acoustic Engineering at the University of Salford, in his Sound Tourism blog.

3. Noria al-Muhammadiyya - Historic Mechanical Engineering Landmark. December 2006 - The American Society of Mechanical Engineers
4. https://www.sonicwonders.org/author/admin/

ERIK ALBERS/CC0 1.0

Noria and houses in Hama, Syria.

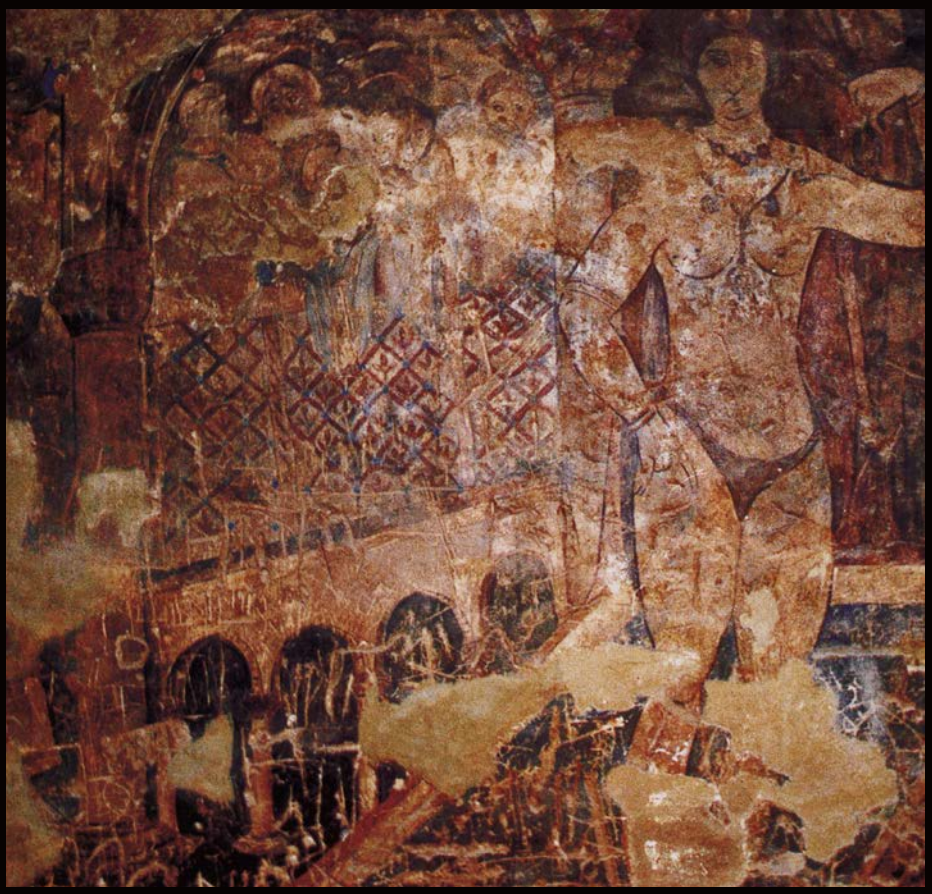
Frescoes at Qusayr 'Amra

(JORDAN, C. 723-743 CE)

In the eastern Jordanian desert, the Umayyad prince al-Walid ibn Yazid built Qusayr 'Amra, a bathhouse retreat whose walls are covered in painted scenes. Bathers recline in flowing waters, zodiac signs adorn the domed ceiling, and mythic tales unfold across the plaster; one of the richest surviving examples of early Islamic secular art.

Designated a UNESCO World Heritage Site[5] in 1985, the bathhouse is also the subject of ongoing preservation by the World Monuments Fund[6], which highlights the frescoes' unique depiction of water as both ritual and luxury in a desert setting.

5. https://whc.unesco.org/en/list/327/
6. https://www.wmf.org/monuments/qusayr-amra

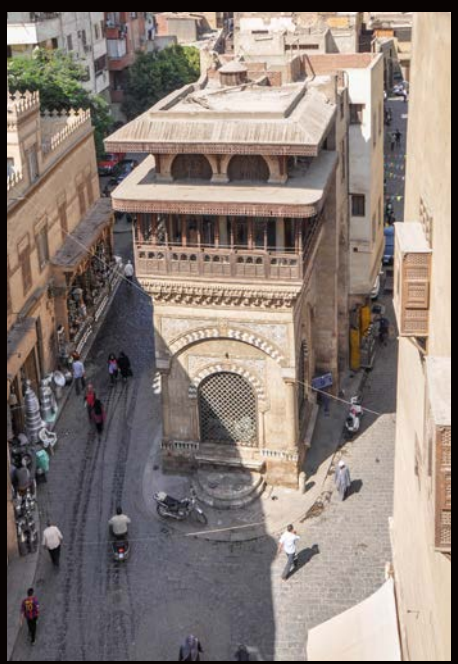


C.VIBERT-GUIGUE

Fresco of bathing woman — at Qasr Amra in Jordan.

Sabil-Kuttab of Abd al-Rahman Katkhuda

(CAIRO, 1744 CE)



JORGE LÁSCAR/ CC BY 2.0

Sabil-Kuttab of Katkhuda.

Built on Cairo's Al-Mu'izz street in 1744 CE, the Sabil-Kuttab of 'Abd al-Rahman Katkhuda stands as one of the Ottoman city's urban landmarks.

At street level, its sabil dispensed free water; above it, the kuttab served as a Qur'an school for children. This architectural pairing embodied the charitable ideal of fi sabīl Allāh—giving water for God's sake—while also tying philanthropy to education and civic presence.

According to Nehal al-Shamy, a researcher at the American University in Cairo, whose thesis is on the Sabil-Kuttab, "Sabils, in general, were parts of waqfs (religious endowments). Therefore, although they might seem utilitarian, they still possessed a clear religious identity. Water has a special place in Islam as the material of life and creation. Many sabils also bear inscriptions likening them to sacred sources, such as Salsabil, Kawthar, and Zamzam, highlighting their role in sustaining lives."

Yet they also carried political weight. As al-Shamy explains, Katkhuda's sabil "was meant to cement the patron's position and convey his political ambitions through creating an architectural icon in one of the most politically significant neighbourhoods in Cairo."

Doris Behrens-Abouseif, emerita professor at SOAS University of London, and a scholar of Cairo's Islamic architecture, highlights the broader evolution: "The sabil was always a charitable institution to give water to the thirsty. In the Mamluk period, we get the sabil-kuttab together. The Ottomans, rather than investing in many new mosques, built sabil-maktabs all across Cairo. They emphasized public hygiene, while the combined sabil and primary school created a lasting civic presence." She also notes their aesthetic appeal: "Vastly decorated, with fine interiors and painted ceilings. People came for water and looked up to see art."

Today, many sabils are preserved under Egypt's antiquities authorities. Some, including Katkhuda's, have been adapted for new uses: "It is used as a display gallery for the products of the Fustat Traditional Crafts Center," says al-Shamy. "These initiatives keep the sabil active, allowing it to be open for visitors."

Comment

The Nile and the Grand Ethiopian Renaissance Dam: why culture and emotions matter

Emanuele Fantini, IHE Delft Institute for Water Education

While most comments on the inauguration of the Grand Ethiopian Renaissance Dam have focused on its technical and geopolitical implications, we argue that to reach an agreement, the three riparian countries should also consider the symbolic and emotional dimensions of the river.

The Grand Ethiopian Renaissance Dam.

In September 2025, Ethiopia inaugurated Africa's largest hydroelectric dam, the Grand Ethiopian Renaissance Dam (GERD) on the Blue Nile.

Since its inception, the construction of the GERD has been a source of contention with downstream countries, Sudan and Egypt. In addition to technical and legal considerations, any prospective agreement must account for the river's symbolic and affective dimensions.

As the first major dam constructed by Ethiopia on the Nile, the GERD challenges a century-long regime of water allocation and management rooted in the 1929 and 1959 treaties, which were concluded exclusively between Egypt and Sudan. These agreements codify what Egypt and Sudan describe as their "historical rights" to Nile waters, whereas Ethiopia characterizes them as a "colonial regime."

The three countries have been engaged in several rounds of negotiations – involving external mediators or facilitators like the African Union, the US government, or the World Bank – with a few achievements, such as the signature in 2015 of a tripartite Declaration of Principles, and several deadlocks.

The GERD inauguration in 2025 occurred without agreement between the three governments on the filling and operation of the dam, as well as on the mechanisms to be implemented to address and resolve future disputes over the dam.

Egypt, heavily dependent on the Nile waters for agriculture and drinking water, is concerned about the river's flow and asks for a binding treaty to oversee the management of the dam.

Upstream, Ethiopia considers the dam as a strategic project to boost its economic development and ensure electricity in a country where only half of the population has access to it. The Ethiopian government prefers an ad hoc mechanism for conflict management.

In the middle lies Sudan, which might benefit from the GERD in terms of improved flood control, but also sees risks in terms of the safety of its own dams and reservoirs. Therefore, the Sudanese government emphasizes the need for data sharing and coordinated operations between the GERD and downstream dams.

For all these reasons, the Eastern Nile basin

has been described as one of the hotspots for ongoing water conflicts, also at risk of future escalations toward a water war.

Most analyses and comments have focused on the technical and legal aspects related to the dam. From colleagues who have been involved in the negotiations[1], we learned that an agreement on the technical aspects (how to fill the dam and how to operate it during drought) had been almost achieved by technical negotiators, but in the end was rejected by the political leadership. This is because the Nile and the GERD are loaded with political, symbolic, and identitarian meanings on which national leaders can hardly compromise.

To find a sustainable agreement and modus operandi, the three riparian countries should acknowledge the symbolic and emotional dimension of the river, and work with the emotions and representations that can create a common ground across countries, cultures, and water uses.

Our research: media and emotions in water diplomacy

With an international and transdisciplinary team comprising researchers, photojournalists, artists, communicators, and museum curators from Ethiopia, Egypt, Sudan, Italy, and the Netherlands, we have been studying the role of media, science communication, and representations of the river, and how these influence understandings about contemporary water issues or shape diplomatic negotiations.

Our findings: representations matter and shape emotions

We have learned that the Nile holds a deep symbolic meaning for all the riparian countries in terms of national identities, religion, history, popular and material culture. This contributes to collective emotions about the river and its infrastructures.

These cultural aspects are linked to the river ecology and physical properties. For instance, since the Nile contributes to soil erosion and flushes away Ethiopia's land, contributing instead to the fertility of downstream countries, it has been depicted as a traitor in Ethiopian popular songs[2] and poems. The construction of the GERD has changed this narrative, and now the river is celebrated as a son coming back home[3] and taking part in the development of the country.

Narratives and representation are not neutral; they are shaped by power relations. In the case of the Nile, they are often caught in what we call the 'nation trap': the three riparian countries are represented as unitarian and homogeneous actors who speak with one voice and have one "national interest".

The voice is often that of the government, and it gets hardly challenged in national debates.[4] Often, the controversy is depicted as a mere bilateral issue between Ethiopia and Egypt, overlooking the fact that Sudan lies in the middle. Including Sudan in the picture allows for a more comprehensive account of the issue, discussing both the benefits and risks of the dam.

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The Nile in Aswan (Egypt).

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Media representations influence collective emotions. For instance, the GERD generates anger and pride among the Ethiopian public opinion, and fear in the Egyptian ones. These emotions contribute to shaping narratives[5], such as the exaggeration of the dam's benefits in Ethiopia or its risks and impact in Egypt.

However, emotions remain a neglected issue in water diplomacy[6], both among practitioners, diplomats, and researchers. Besides the collective emotions elicited by the river and its infrastructure, we should also consider the emotions of the diplomats involved in the negotiations and those of the scientists studying these dams.

When it comes to popular culture and narratives, scholars are not mere external observers. We are also consumers and sometimes (co) producers of such narratives. This position, together with the emotions that it brings, should be explicitly acknowledged and critically reflected upon to inform researchers' contributions to water diplomacy.

As scientists, researchers, and science communicators, we can contribute to dialogue over shared waters. Our experience shows the potential for trans-disciplinary collaborations and co-production of knowledge[7] across the media and academia.

For instance, through the #EverydayNile photo-journalism project[8], we learned that photos can be an effective tool to promote empathy and dialogic conversations over shared waters, across countries, disciplines, professions, and water users.

Our research indicates that when negotiating over the GERD and the Nile River, the three countries are not merely discussing water flows or the operation of a dam; rather, they engage with political identities, nation-building projects, popular imaginaries, and collective emotions associated with the river.

This conclusion suggests the need to better incorporate emotions in water diplomacy theory and practice, for instance, by designing tools to conduct an emotional impact assessment of large dams, as is already done for the environmental and social impact.

As journalists, researchers, and practitioners, we should become more aware of how our representations of the river contribute to these emotions and shape negotiations over shared waters.

1. www.soundcloud.com/user-548968254/episode-10-when-scientists-and-journalists-become-water-diplomats
2. www.nilepop.bridginghumanities.com/
3. https://doi.org/10.59490/ijwg.10.2023.7359
4. https://doi.org/10.23810/1345
5. Emotions in water diplomacy: Negotiations on the Grand Ethiopian Renaissance Dam. Wondwosen Michago Seide and Emanuele Fantini
6. Water Conflicts and Cooperation: A media handbook. CABI
7. www.flows.hypotheses.org/13699
8. https://doi.org/10.1080/1472586X.2024.2390679full/10.1080/1472586X.2024.2390679?scroll=top&needAccess=true

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