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Water innovation-sharing must become a tool for peace-building

David L. Feldman

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Water innovations such as desalination, wastewater reuse and rainwater harvesting can do more than strengthen water security. International cooperation is needed to ensure that these technologies promote equitable benefit-sharing, mobilize investment and reduce tensions in regions where climate stress and water scarcity threaten stability.



The Itaipu Dam on the Paraná River, located on the border between Brazil and Paraguay.

The 2026 United Nations University Institute for Water, Environment and Health report 'Global water bankruptcy: living beyond our hydrological means in the post-crisis era'[1] contends that water withdrawals may have exceeded a tipping point. Nearly 75% of the world's population live in countries that are water-insecure or critically insecure. Human–water systems are in a post-crisis state of failure caused by decades of drawing more water than climate and hydrology can reliably replenish. To manage this water bankruptcy we need a "transformational fresh start in human–water relations" to adapt to a new hydrological and environmental normal[1]. The report endorses water innovations such as desalination, wastewater reuse and rainwater harvesting as potentially beneficial. However, we must rethink the deployment of these innovations; embed them in demand-management and diversification strategies; and assess their energy use, ecological impact and distributional consequences.

There are more than 21,000 seawater desalination plants in operation with a daily global production of 99 million cubic metres per day of freshwater. The highest rates of adoption are in the Middle East and North Africa region, accounting for 70% of global capacity. Wastewater reuse provides some 40.7 billion cubic metres of treated wastewater annually, with high-income countries in the Middle East and North Africa having the highest reuse rates, mostly in the industrial, agricultural and landscape irrigation sectors[2,3]. Rainwater-harvesting efforts, although they are also important, are more modest. Over 88% of people living in areas without access to safe drinking water reside in regions with over 500 mm of annual rainfall, yet only 1.26% of these people rely on rainwater as their primary source of potable water. State-of-the-art treatment and distribution systems could increase potable rainwater supply and satisfy the needs of over 2 billion people daily[4].

Countries that have adopted innovations share three characteristics. First, those with limited access to internally controlled surface or groundwater basins tend to be highly dependent on shared water sources and are thus highly vulnerable to water insecurity. Second, nations experiencing acute water stress resulting from precarious climatic conditions or high levels of water demand caused by rapid population and economic growth also tend to pursue such options. These countries are often those also vulnerable to water insecurity (owing to dependence on shared sources). Last, states that pursue innovations have the technological capacity for innovation: they can draw upon sources of investment capital from public and private sources and have highly trained workforces able to build complex infrastructure. In recent years, it has also become clear that in some regions, adopting innovations may help to alleviate or lessen transboundary disputes — a goal encouraged by the World Bank's Water Global Practice programme and other initiatives.

Israel and Singapore, notable adopters of freshwater innovations, have long been subject to transboundary conflict. They are also exemplars of how innovations may defuse regional disputes. Singapore shares surface water with Malaysia; Israel shares surface and groundwater sources with Palestine, Jordan and Syria. Singapore employs wastewater reuse to meet industrial demand, and Israel uses recycled water to irrigate agriculture. Both employ desalination to meet urban demand. Rainwater harvesting, used extensively in Singapore thanks to its higher rainfall, is also an important supplement to rural needs in Israel.

During the last few decades, Singapore master planning primarily through the efforts of the PUB, Singapore National Water agency, the Ministry of the Environment, and the National University of Singapore has been to increase desalination, wastewater reuse and rainwater capture[5]. On the one hand, the primary aim of such efforts was to achieve a long term resilient water supply, especially in the light of increasing population and effects of climate change. On the on the other hand, such efforts have reduced dependence from neighboring Malaysia.

After achieving independence in 1948, Israel's leaders declared water provision to be a security priority and established a Water Planning Authority to coordinate efforts[6]. In the early 1950s this authority began diverting the upper Jordan River in the 1948-designated demilitarized zone between Syria and Israel to support agriculture in Galilee. Three additional supply tracks were also pursued: a National Water

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Carrier, an aqueduct system that delivers water from the Sea of Galilee to Tel Aviv and portions of the Negev; local rainwater harvesting via some 250 rainfed reservoirs, providing 7% of Israel's total freshwater supply; and wastewater reuse, now providing 55% of water used for agriculture. Some recycled wastewater is also used for manufacturing, fire suppression and in-stream flow protection. Reused wastewater is not used for drinking owing to its value for growing food. Large-scale seawater desalination was pursued following a severe drought in the late 1990s and is now key to urban supply.

Efforts to lessen transboundary conflict through the benefits of water-supply innovations have been less successful than in Singapore and Malaysia. In 1995, Israel, Jordan and Palestine concluded Phase II of the Oslo Accord, which established a Joint Water Committee to defuse conflict. Renewed in 2017, its charter declared the goals of protecting water infrastructure from the effects of the region's cyclic violence and ensuring provision of adequate supplies to local communities in the West Bank and Gaza. Water and wastewater treatment systems are jointly managed, and the charter acknowledged the existence of a (region-wide) water shortage and the need to develop additional sources including effluent recycling and desalination. However, despite the commitment to furnishing adequate supplies to the West Bank and Gaza, substantial barriers remain. These include the Joint Water Committee's limited water-sharing authority, its inability to curtail Israeli settlement in the West Bank (which increases demands on scarce freshwater); and the lack of policy coordination for Gaza and the Jordan basin. Palestinians in the region have access to roughly 73 litres per person per day, far below the World Health Organization's minimum recommended standard of 100 litres per person per day[7].

In sum, the experience of Singapore and Israel highlight how water innovations alone cannot ensure regional water peace unless: (1) parties feel secure in their share of available water and perceive that allocations are equitable; (2) innovations reduce sole dependence on any single source, including transboundary natural water sources.; (3) regional agreements respect national sovereignty and ensure that relevant water data are shared transparently; and (4) parties have overall confidence in the larger framework under which innovations are pursued.

Overcoming adoption barriers

Reports by the United Nations have noted both the advantages and drawbacks of innovations. Reuse is recognized as a means of stimulating a circular economy that fosters resource recovery, and rainwater harvesting can reduce urban runoff. However, all innovations harbour potential risks: capturing excess rainwater may disrupt local watershed processes; reuse poses human health concerns; and desalination is energy-intensive and generates brines that can affect coastal ecology.

To achieve the goal of a transformational fresh start in human–water relations, two reforms are needed. First, adoption decisions for wastewater reuse, rainwater harvesting and desalination must address their negative ecological and societal impacts in order to improve public trust[8]. Second, affordability, cost and siting burdens disproportionately affect under-represented minorities and should be mitigated by incorporating these groups in decision-making.

Public concerns regarding the potential risks of innovations are often ignored and citizen engagement may be absent. Low-income communities are often bypassed when deployment decisions are made, and affordability and siting concerns are frequently overlooked[9]. Moreover, innovation adoption remains largely concentrated in wealthier, more developed polities that have readily available capital and highly trained workforces able to build and manage complex water projects[10]. New development approaches are required to link innovation adoption to demand-side management efforts, protection of natural capital and promotion of equity.

A promising path towards appropriate innovation adoption is the so-called One Water approach, which has gradually come into vogue over the past 30 years. One Water seeks to combine water supply, water quality, ecosystem health and risk reduction into a unified management strategy. It focuses on local, place-based decision-making. The United Nations and other international bodies could help to promote this approach to innovation adoption.

One Water relies on so-called green infrastructure and various water-saving and conservation advances to permit groundwater basin recharging, lessening of runoff pollution, flood alleviation through non-structural measures, and supplemental urban supply by harvesting runoff and combining it with recycled wastewater treated to grades suitable for various end uses[11]. By incorporating 'low impact' development methods (including wetlands restoration, rain gardens, permeable pavements, and replacement of traditional landscape with native vegetation), these designs foster sustainable systems that protect urban ecosystems by mimicking pre-urban hydrologic characteristics with respect to volume balance of runoff, infiltration and quality.

One Water calls for community engagement in planning and implementation. By embracing bottom-up cooperation with civil society groups, social learning through efforts that permit public participation in decision-making, wedding of expert knowledge to local experience, and flexible policy outcomes, the One Water approach has proved effective in prioritizing innovative water supply options based on the articulated needs of regions and communities. As practiced in places as varied as Australia, Sweden, Nigeria, Jordan and Brazil, the One Water methodology combines good science with community-level insights, enabling the introduction of water innovations designed to cope with urgent environmental challenges such as climate change and restoration of ecosystem health. In rural areas, variants of this approach include such innovations as 'off grid' small-scale solar desalination systems to improve water quality and permit new varieties of vegetable crops to be grown in water-stressed regions, and decentralized wastewater reuse systems in communities not connected to large wastewater treatment networks.

International cooperation is needed to ensure equitable, appropriate and beneficial use of innovations; to foster third-party funding; to mitigate adverse impacts; and to reduce conflicts over shared water sources. Cooperation can be hastened in two ways. First, we must strengthen trans-boundary collaboration in water innovation development. This can be done by establishing public–private partnerships to facilitate cost-effective, economical financing of innovative water supply, irrigation and wastewater infrastructure. Second, we must protect water infrastructure from violence by insulating dams, desalination plants and other facilities from attacks during war or internecine conflict.

Because water innovations are expensive, assistance by third parties (such as the World Bank) might offer alternative funding options. A recent initiative exemplifies how such a programme of third-party participation might lead to broader transboundary adoption of innovations and regional peace-building. A former World Bank official and author of a report by the Policy Center for the New South has proposed that the Middle East and North Africa region could adopt integrated renewable energy and desalination projects at a cost upwards of US$500 billion, split among the parties to construct solar-powered desalination plants along the Mediterranean and Red seas. Such projects might enable reliable supplies at an economy of scale, enhance recycling and encourage joint water supply planning and allocation[12].

Finally, with the adoption of innovations come new risks, particularly during periods of acute conflict. Although wars over water are rare, when wars erupt for other reasons, water infrastructure can become a prime military objective. Germany's Ruhr dams were effectively targeted during World War II, and attacks on water supply and treatment facilities have occurred in parts of the Middle East since 1948. Renewed international efforts to insulate these facilities from such attacks are needed. One approach might be to designate critical water facilities, including desalination plants, as 'protected humanitarian infrastructure', as hospitals and schools are. The Oslo Accords may afford a precedent as to how to insulate water infrastructure from attack. Measures to physically fortify such facilities might also be needed, which would increase the cost of these innovations. Demilitarized zones (although imperfect remedies) could help to reduce infrastructure exposure to hostilities, to safeguard their operation and to encourage joint development of such projects.

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References

1. Global water bankruptcy: living beyond our hydrological means in the post-crisis era. *United Nations University Institute for Water, Environment and Health (UNU-INWEH)* https://unu.edu/inweh/collection/global-water-bankruptcy (2026).
2. EU Blue Economy Sectors: desalination. *EU Blue Economy Observatory, European Commission* https://blue-economy-observatory.ec.europa.eu/eu-blue-economy-sectors/desalination_en (2022).
3. Jones, E. R., van Vliet, M. T. H., Qadir, M., & Bierkens, M. F. P. *Earth Syst. Sci. Data* **13**, 237–254 (2021).
4. Yuan, Q. et al. *Nat. Commun.* **16**, 11320 (2025).
5. Tortajada, C. & Buurman, J. Water policy in Singapore. *ThirdWorldCentre* https://thirdworldcentre.org/2017/07/water-policy-in-singapore/ (2017).
6. Shlaim, A. *The Iron Wall: Israel and the Arab World* (Norton, 2014).
7. UN Office for the Coordination of Humanitarian Affairs. OCHA Annual Report 2020. https://www.unocha.org/publications/report/world/ocha-annual-report-2020 (2020).
8. Jones, E., Qadir, M., van Vliet, M. T. H., Smakhtin, V. & Kang, S. *Sci. Total Environ.* **657**, 1343–1356 (2019).
9. Ross, V. L., Fielding, K. S. & Louis, W. R. *J. Environ. Manag.* **137**, 61–68 (2014).
10. Water stress: a global problem that's getting worse. *Council on Foreign Relations* https://www.cfr.org/backgrounders/water-stress-global-problem-thats-getting-worse (2026).
11. Grant, S. B. et al. *Environ. Sci. Technol.* **47**, 10727–10734 (2013).
12. Arab Ministerial Water Council. Arab strategy for water security in the Arab region to meet the challenges and future needs for sustainable development 2010–2030. *United Nations Network on Migration* https://www.unescwa.org/sites/default/files/event/materials/arab_strategy_for_water_security-english_translation-2012_0.pdf (2012).

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Competing interests

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