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Water Security Under Pressure: Challenges and Strategies Across the Gulf

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Summary

- This Insight examines water security in the Gulf Cooperation Council (GCC) countries of Bahrain, Oman, Kuwait, Saudi Arabia, the United Arab Emirates, and Qatar, and the strategies they are using to address scarcity in a region facing arid climates, rapid population growth, and urban expansion.
- It highlights the reliance on desalination, wastewater reuse, and flood management, while also considering unique challenges such as sea level rise, extreme storms, and groundwater contamination.
- The Insight also details how each country is responding to these pressures. Bahrain is adapting to sea level rise through land reclamation and coastal buffers, Oman is strengthening flood defences and improving emergency planning against cyclones, and Kuwait is addressing long-standing groundwater pollution through soil remediation and monitoring.
- Saudi Arabia is combining desalination, water reuse and agricultural reforms under its Vision 2030, the United Arab Emirates is focusing on innovative water technologies and efficient water use, and Qatar is diversifying its water supply, upgrading infrastructure, and promoting efficient agriculture.
- The Insight further notes the importance of regional coordination to manage shared water resources and enhance resilience.
- Based on these lessons, the Insight recommends:
  - » Expanding investments in robust water infrastructure, desalination, wastewater systems, and flood protection.
  - » Implementing integrated water management approaches that incorporate surface water, groundwater, desalinated water, and reclaimed water for long-term sustainability.
  - » Strengthening regional collaboration and strategic planning to protect transboundary aquifers, anticipate climate-related risks and secure water supply while supporting socio-economic development.

The Issue

Water scarcity is an existential threat to the GCC region, where an arid climate, limited freshwater resources, and growing populations place intense pressure on water systems. Consequently, all GCC countries face a critical level of water stress, in some cases well above the 100% critical threshold, indicating a significant deficit between freshwater supply and water demand (Table 1). Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE) face both common and unique vulnerabilities, such as exposure to coastal inundation due to sea level rise, flash floods brought about by extreme weather, groundwater contamination, and high water demand propelled by urbanization. To navigate these pressures, GCC countries have developed integrated strategies that combine desalination, wastewater reuse, flood mitigation, and water management planning, demonstrating how innovation and governance can work together to strengthen resilience.

The following sections examine key water security challenges for each GCC country, highlighting the water management strategies they have adopted in response. While each example focuses on a specific water challenge that a particular GCC country prominently contends with, the reality is that many of these challenges are shared across the GCC bloc, especially when it comes to groundwater depletion, sea level rise, and extreme weather. These case studies offer a practical approach to managing water scarcity and promoting sustainable water governance in arid and water-stressed regions, thereby emphasizing the importance of the GCC countries' participation and perspective in global water dialogues, particularly in the context of the forthcoming 2026 United Nations Water Conference in the UAE.

Country	Water Stress (Sustainable Development Goal 6.4.2)
Bahrain	134%
Kuwait	3,851%
Oman	117%
Qatar	431%
Saudi Arabia	974%
UAE	1,510%

Table 1. Water Stress in the GCC Countries, 2022[1]

Desalination: The Lifeline of the Gulf

The availability of freshwater in the GCC region is constrained by the Arabian Peninsula's lack of renewable surface water resources, low rainfall, and high evaporation rates. Historically, these countries have relied on non-renewable groundwater, which has increasingly been stressed by the water demands imposed by population growth, urbanization, and agriculture. So much so, that structural water scarcity has become a defining feature of the bloc's efforts to enhance water security, heightening the urgency for alternative water sources. To bridge this gap, desalination has become the cornerstone of water supply in the region, allowing those countries to exceed the supply limits of available freshwater. Today, Arabian Gulf countries account for nearly half of the world's desalination production, with several GCC countries obtaining close to 90% of their drinking water from desalination[2]. The use of desalination continues to grow among the six countries, driven by rising populations, economic growth, and the expansion of water-intensive industries such as oil and gas, agriculture, and urban development (**Figure 1**). In terms of disadvantages, desalination is highly energy-intensive, which makes producing water expensive, and continued dependence creates strategic vulnerabilities, as disruptions in energy supply or extreme weather events could compromise water availability.

Environmentally, there are concerns regarding the effect of discharging desalination byproducts, like brine, back into the sea, where it could negatively impact marine life and water quality. While the data remains scarce, research studies on desalination in the GCC countries have demonstrated that although brine locally increases salinity around

discharge locations, its impact on the Arabian Gulf's overall water salinity remains limited[3]. Model studies indicate that basin-wide salinity increases due to desalination are small and comparable to seasonal fluctuations. This is largely because water circulation and exchange through the Strait of Hormuz flush high-salinity water out of the Gulf while drawing in less saline water from the Indian Ocean. As a result, salts tend to accumulate near the bottom of the waterbed in localized areas, and the mixing and flushing of waters prevent significant long-term changes to the Gulf's salinity and water quality.

While desalination can be a useful tool to combat water insecurity, it is only one of a broader set of strategies needed to address the water challenges of the six-country bloc. Long-term water reliability depends not just on supply but also on how water is allocated and used across urban, industrial, and agricultural sectors. As population growth and economic development continue to inflate water demand, effective water management policies are essential complements to desalination, ensuring that the GCC countries can sustainably meet its water needs while minimizing environmental and economic vulnerabilities.

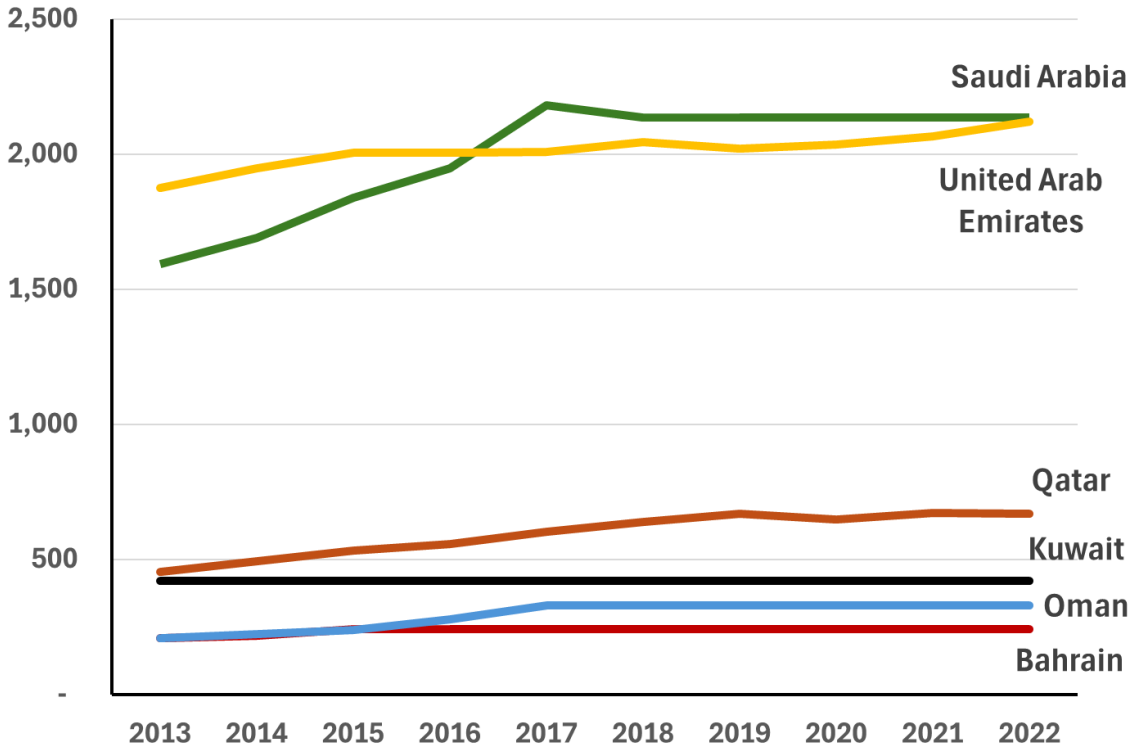

Figure 1. Desalinated Water Produced in Million Cubic Meters per Year, 2013-2022[4]

Bahrain: Facing the Tides with Sea Level Rise

Coastal nations face increasing risks from sea level rise, an outcome of climate change driven by warming oceans and the melting of polar ice. As seawater expands and ice loss accelerates, coastlines face the prospect of more frequent flooding and the permanent inundation of low-lying land. And unfortunately, per the IPCC[5], even under aggressive global climate mitigation efforts to curb warming, sea level rise is projected to continue unabated for centuries, making this climate impact a long-term reality rather than a distant threat. The consequences of sea level rise are particularly profound for island nations[6], where land is inherently scarce and populations are concentrated along the coast. Sea level rise may progress gradually, but its effects accumulate over time as it shrinks habitable lands. As such, even small increases in sea level can have wide-ranging effects, with residential neighbourhoods, agricultural lands, and critical infrastructure slowly facing heightened likelihoods of damage.

Bahrain, as a small island nation, has significant exposure to sea level rise. Its flat topography, high population density, and extensive coastal development make it susceptible to the combined effects of sea level rise and coastal flooding. Encroaching seawater also increases the likelihood of saltwater intrusion into the country's freshwater aquifers, thereby degrading local groundwater quality. This increases Bahrain's reliance on desalination, as its potentially more brackish groundwater resources will need to undergo additional treatment, placing added strain on both energy and water systems and raising operational and maintenance costs. At the same time, sea level rise could inundate coastal desalination plants and water treatment facilities, increasing the probability of water service disruption. Historical records show that Bahrain has already experienced annual increases in sea level rise ranging from 1.6 to 3.4 millimetres per year since 1976, with future scenarios further signalling the severity of Bahrain's vulnerability to sea level rise. A sharp surge of 5 meters in sea level would inundate most of the country, while even a smaller increase of 2 meters could plunge 18% of it underwater[7].

Under these circumstances, Bahrain's ongoing land reclamation projects take on heightened strategic importance. Beyond supporting urban expansion and economic development, land reclamation can serve as an adaptation measure to sea level rise by extending existing coastlines further out from critical and populated areas. However,

the protective benefits of land reclamation could be undermined if new coastal areas become densely developed, leaving newly constructed infrastructure exposed to flooding. To address this, new land reclamation projects in Bahrain should incorporate coastal buffer zones into their land expansion plans, effectively creating a floodplain along the coast that serves as a barrier against sea level rise and offers protection for nearby buildings, water systems, and farmland[8]. By aligning its land reclamation efforts with long-term climate adaptation planning, Bahrain can strengthen its resilience to sea level rise by protecting its freshwater resources and water infrastructure while also continuing to support economic growth and urban development.

Kuwait: The Lingering Burden of Pollution

Kuwait's ongoing issues with groundwater contamination trace back to the aftermath of the first Gulf War, when Iraq set fire to more than 700 Kuwaiti oil wells. The fires burned for months, releasing vast quantities of crude oil, heavy metals, and toxic byproducts into the environment. Nearly 300 oil lakes formed across the desert as unburned crude oil pooled on the surface, while fallout from the fires settled into surrounding soils[9]. Seawater was also used to help extinguish the fires, introducing additional salinity that further degraded soil quality. These combined impacts fundamentally altered local soil chemistry, leaving behind contaminants that remain until today. Contaminated soils and added salinity pose a direct risk to groundwater via infiltration and seepage. Rainfall or runoff water percolating through polluted soils can carry contaminants downward. Once groundwater is affected, the consequences are severe for water security. Hydrocarbon and metal pollution can render water unsuitable for drinking, irrigation, or industrial use without extensive treatment, while increased salinity further limits its usability.

Today, groundwater remains an integral component of Kuwait's water system, serving the water needs of irrigation, landscaping, construction, and livestock. Approximately 54% of groundwater supplies are allocated to agriculture, and it satisfies 92% of domestic and industrial water demand. It provides water to more than 75,000 consumers at a substantially lower cost than alternative sources such as desalination or water recycling[10]. These current uses underscore the importance of monitoring groundwater quality, particularly given Kuwait's groundwater pollution risks, to better assess the extent and impact of contamination on this critical water supply.

Previous groundwater monitoring studies in Kuwait assessed the presence of organic matter from petroleum hydrocarbons and dissolved solids in groundwater[11]. Analysis from these studies indicated that the spread of hydrocarbons and salts in the subsurface was propagated by the infiltration of water from the surface through the soil. The proliferation of these contamination issues can greatly influence Kuwait's dependency on nonconventional water sources, specifically desalination. This dependence increases vulnerability to energy disruptions, raises costs, and limits the strategic flexibility that readily available and uncontaminated groundwater could provide.

To address this long-standing contamination problem, the Kuwait Environmental Remediation Program (KERP) was established as a coordinated effort to remediate soils and restore lands affected by oil pollution and salinization[12]. KERP provides a framework for identifying, excavating, treating, and safely disposing of polluted soils. The program was formally launched in 2012, with the Kuwait Oil Company designated as the primary stakeholder responsible for overseeing field remediation operations. Since its inception, KERP has executed multiple large-scale remediation projects, steadily rehabilitating land, reducing ongoing environmental risks, and mitigating the long-term impacts of hydrocarbons and salts on soil and groundwater.

Restoring groundwater quality is essential for Kuwait's future water security, particularly given the country's heavy reliance on desalination. Even modest improvements in groundwater quality could allow for expanded use in irrigation and the firming of water reserves, helping to ease the burden on energy-intensive and costly desalination systems. Beyond water supply benefits, rehabilitated soils and protected aquifers could strengthen environmental resilience, enable more sustainable land use, and reduce long-term contamination risks. Effective management of groundwater in Kuwait should also consider regional cooperation for transboundary aquifers that are shared with neighbouring countries. Collaborative monitoring and management with other groundwater riparians can help protect this shared resource and ensure its sustainable use. Together, these gains could provide Kuwait with greater flexibility in managing its water resources despite its water scarcity and ongoing environmental challenges.

Oman: On the Frontlines of Extreme Weather

Climate change is increasingly fuelling extreme weather events around the world, and the Arabian Peninsula is no exception. Rising global temperatures contribute to warmer ocean waters, which fuel tropical storms and cyclones. As sea surface temperatures rise, severe thunderstorms become not only more frequent but also more intense, producing stronger winds, heavier precipitation, and greater potential for coastal and inland flooding. In recent years, the Arabian Sea has seen a notable increase in the formation of extreme weather –specifically, a 150% increase in extremely severe cyclones since 1982 – due to higher sea surface temperatures[13]. Meteorological data points to a rising frequency of cyclones in the Arabian Peninsula, bringing sudden and intense rainfall[14].

Oman, with its extensive coastline, has historically been on the receiving end of these extreme weather events[15]. The country has experienced many tropical storms throughout the years, heightened by its geographic exposure to torrential rainfall and storm surges from severe cyclones forming in the Arabian Sea. The impacts of these storms on Oman have been significant. Heavy periods of rainfall often lead to flash flooding, while storm surges can inundate coastal areas, damage infrastructure, and disrupt service and utility networks. Extremely severe cyclones cause fatalities, destroy homes, and result in extensive property and economic losses. Cyclone Gonu, the most intense cyclone on record to make landfall in Oman, was singularly the cause of $4 billion in damages and the loss of 50 lives[16]. Even less severe tropical storms can produce dangerous localized flooding, landslides, and damage. Furthermore, these storms pose direct threats to Oman's water infrastructure and freshwater resources. Flooding can damage dams, water treatment and desalination plants, and water distribution networks, while debris and floodwater can seep into the soil and contaminate groundwater aquifers. In the short term, residential communities in Oman may face interruptions in water supply and public health risks, while over the long term, recurrent storm events can degrade groundwater aquifers, prompt extensive rehabilitation of water infrastructure, and increase reliance on desalination or treated water to meet water demand.

Consequently, Oman has prioritized adaptation to extreme weather in its water and infrastructure planning, recognizing the growing risks posed by tropical storms and flooding. To that end, the government has recently secured loans valued at $630 million to continue investing heavily in flood protection and water management infrastructure to support the construction and expansion of dams designed to capture storm runoff, reduce flash flooding, and protect residential areas and water systems from damage[17]. In addition, Oman has launched a national flood preparedness project to update maps that identify flood-risk areas, implement more comprehensive emergency management and response plans, and improve urban planning and development to limit flood damages[18]. These measures are especially critical in Oman's capital, Muscat, where nearly half the city is exposed to flash flooding and one-fifth faces coastal flooding because of sea-level rise and storm surges. Despite these proactive steps, the growing frequency and intensity of extreme weather emphasize that, for Oman, managing the impacts of tropical storms on water infrastructure is no longer an intermittent challenge but a consistently recurring one that will continue to shape national planning and long-term water security.

Qatar: Unlocking Water Resources Diversification

Qatar's water security is characterized by a structural dependence on non-conventional water supplies. The country largely depends on desalinated seawater to meet its municipal and industrial needs, with desalination accounting for 60 percent of its water supply[19]. Prior to the construction of desalination plants, groundwater was Qatar's only source of water. As population growth and irrigated farming expanded, groundwater withdrawals increasingly exceeded natural recharge rates, leading to declining water tables. This drawdown allowed saline water from seawater intrusion in coastal areas to encroach into freshwater zones. Simultaneously, intensive agricultural practices introduced additional contaminants, including fertilizers and salts from irrigation runoff, further degrading groundwater quality[20]. The combined effects of aridity, minimal recharge, and sustained over-pumping have transformed groundwater from a strategic freshwater reserve into a largely non-renewable and deteriorating resource, limiting its long-term viability as a dependable component of Qatar's water supply.

The risk of dependence on a largely centralized and non-renewable water system was brought into sharp focus during the 2017–2021 blockade on Qatar. Although desalination plants continued to operate, the crisis exposed vulnerabilities across the water supply chain. These weaknesses were evident in sectors dependent on water-intensive imports, especially food, where Qatar relied on international markets to meet the bulk of its demand and effectively imported large volumes of "virtual water" embedded in agricultural products. When traditional supply routes were disrupted, the country experienced an indirect water shock: the sudden loss of access to external water resources that had long addressed domestic scarcity. The blockade underscored that water security was not only a matter production capacity but also a matter of continuing access to water, both domestically and externally sourced. It prompted a reassessment that characterized water as not merely a consumable resource but rather a strategic asset vulnerable to disruption from geopolitical events[21].

Following the blockade, Qatar implemented its National Food Security Strategy (2018–2023) to strengthen the resilience of its food and virtual water supply chains. The Strategy focused on diversifying trade routes to reduce the impact of sudden disruptions, increasing domestic food self-sufficiency, maintaining strategic reserves of food and agricultural inputs such as seeds, water, and fertilizers, and ensuring efficient food distribution from farms to consumers. These measures enabled Qatar to secure new suppliers for food that it cannot produce locally, while also expanding domestic agriculture. As a result, vegetable self-sufficiency increased from 10% in 2017 to 46% in 2023. The adoption of indoor hydroponic farming also helped Qatar overcome the agricultural constraints of its limited arable land, a practice that yields a 70% reduction in freshwater use when compared to conventional farming methods[22].

Recognizing the importance of diversification across all components of its national water portfolio, Qatar implemented several large-scale infrastructure projects, in addition to desalination capacity expansion, to strengthen its water security and resilience. As part of a five-year infrastructure strategy, Qatar is investing over $22.3 billion to enhance drainage, sewage, and flood-prevention systems[23]. The plan includes the construction of newer sewage and rainwater management facilities, such as strategic pumping and treatment stations, and water connections to homes, designed to reduce flooding risks and improve the efficiency of the national network. A central component of this effort is the Strategic Outfalls Project, which manages rainwater drainage in Doha and reuses it for irrigation and cooling, reflecting a broader focus on integrated water management and resource efficiency. Alongside programs that reduce water loss, agricultural water use, and per capita water consumption[24], Qatar has reached a high level of water sufficiency that nearly satisfies all of its national water needs[25]. As such, and retrospectively, Qatar's water management history offers an important lesson: water security depends not only on the availability of supply but also on strategic planning, system redundancy, and the careful alignment of water resources with long-term national development plans.

Saudi Arabia: Managing Water Use at Scale

Saudi Arabia's water needs are fundamentally shaped by its size and scale. With a large population that comprises 60% of the GCC region's population and spreads across a vast, arid landscape, the Kingdom faces a persistently high water demand despite having extremely limited renewable freshwater resources, so much so that Saudi Arabia ranks as the world's third highest per capita water consumer[26]. Urban growth, rising living standards, and expanding industrial activity have increased municipal water consumption, while the country's geography and climate constrain the availability of water needed to satisfy this scale of water consumption. As a result, water use in Saudi Arabia is propelled not only by population growth, but also by the logistical and infrastructural demands of supplying water reliably across long distances and diverse regions.

These pressures are expected to intensify as Saudi Arabia advances its Vision 2030 agenda, which explicitly integrates water security into its long-term development plans. Vision 2030 aims to enhance water efficiency by reducing the wastage in agriculture and urban use, adopting advanced irrigation and water recycling technologies, and promoting sustainable practices such as renewable-powered desalination and treated wastewater reuse[27]. Large-scale development initiatives, like NEOM and the Red Sea Global tourism projects, are inherently water-

intensive, requiring secure supplies for construction, operations, and new urban centres. Economic diversification and population concentration in new cities are increasing demand across municipal and industrial sectors, making water availability a critical enabler of Saudi Vision 2030's success and a key constraint on how fast and far these projects can expand.

Within this evolving water management framework, agriculture remains the largest consumer of water by volume in Saudi Arabia, using more water than residential and industrial sectors combined. However, industrial and municipal uses account for a disproportionately large share of water-related expenditures (61.4%)[28], reflecting the higher costs of treatment, desalination, and long-range distribution required to meet water quality and reliability standards. Groundwater remains part of Saudi Arabia's water supply portfolio, though its contribution has been relegated in favour of more reliable and secure sources of water supply.

To meet growing demand, Saudi Arabia has invested heavily in water augmentation programs, particularly large-scale desalination, which now provides roughly half of the Kingdom's distributed water supply. Desalination capacity continues to expand alongside wastewater reuse, while other localized efforts such as cloud seeding[29] and surface water capture are used to enhance the benefits of precipitation. At the same time, the Kingdom has pursued demand-side measures, especially in agriculture, by phasing out water-intensive crops and sourcing livestock feed production from overseas through land and water leasing arrangements (such as those in the American Southwest), effectively exporting water demand to conserve domestic resources[30].

Yet, managing water supply and demand in Saudi Arabia remains increasingly complex. The Kingdom must balance a large and growing population, rising expectations for water reliability, and the ambitious scale of future projects, such as those anticipated in Vision 2030. Ensuring long-term water security will require continued integration of infrastructure investments, efficiency improvements, and strategic planning to allow for Saudi Arabia's ambitious development goals, well beyond 2030.

United Arab Emirates: Sustaining Growth through Water

Over the past decade, the UAE has sustained continuous socio-economic growth, emerging as a global hub for finance, tourism, and innovation. This progression has been accompanied by a significant increase in population growth (estimated to be close to 30% over the last ten years)[31], largely because of new international residents drawn to the country's employment opportunities, quality of life, and safety. Major cities like Dubai and Abu Dhabi continue to attract professionals, entrepreneurs, and tourists, reinforcing economic growth defined by rapid urbanization and a highly diverse population. This development trajectory is fundamentally dependent on water. Expanding urban populations increases residential and municipal water demand, while the UAE's tourism sector, which includes hotels, resorts, and theme parks, can be particularly water intensive. Additionally, the UAE's active real estate industry requires a reliable municipal source of water for construction and the water distribution and sanitation needs of new residential areas.

Beyond population growth and urbanization, the UAE will need to continue investing in maintaining and expanding its water infrastructure to meet rising demand. Rapid urban development and high-density construction place additional pressure on water distribution networks, pumping stations, and treatment facilities, while desalination plants must continue to operate reliably despite high energy requirements and the challenges of extreme temperatures. Ensuring infrastructure resilience, reducing system vulnerabilities, and effectively managing water use across cities, industries, and agriculture are critical components for sustaining the UAE's water supply and long-term socio-economic development.

To support this level of growth, the UAE is pushing forward a range of innovative and diverse initiatives to boost its water security. Non-conventional water supplies from desalination and treated wastewater form the backbone of the UAE's water resources, constituting more than half of the country's water supply portfolio, with recycled wastewater supplying most of the country's irrigation needs, as approximately 73% of treated wastewater is used to irrigate public green spaces. As part of its long-term planning, the UAE's Water Security Strategy 2036 looks to ensure reliable water access by targeting a 21% reduction in overall water demand and a 95% increase in wastewater reuse by 2036.

Many of these improvements in water security will be made possible by the UAE's investments in practices that relieve demand on freshwater resources, like rainwater harvesting, wastewater reuse applications for irrigation, and desalination powered by clean energy[32]. Complementing these efforts is the UAE National Centre of Meteorology's Rain Enhancement Program, which utilizes cloud seeding to increase precipitation and, subsequently, groundwater recharge[33]. Additionally, the Mohamed bin Zayed Water Initiative supports the incubation of cutting-edge solutions that address water scarcity. By combining innovation, research, and strategic partnerships, the initiative helps fund projects that secure reliable and sustainable water access, while supporting communities and ecosystems within the UAE and beyond[34].

Sustaining the UAE's growth will require a robust, integrated, and forward-looking water management approach that combines technological innovation, policy planning, and coordinated implementation. More importantly, the UAE's water management approach illustrates how closely water security and socio-economic growth are connected. The same drivers that have propelled the country forward, including population growth, urbanization, and global integration, will continue to test the limits of its water resilience, making long-term water management a core component of the nation's future. How effectively the UAE addresses this challenge will impact not only the sustainability of its cities and economy, but also its projected growth in an increasingly water-constrained region.

2026 UN Water Conference: Advancing Regional Collaboration

The 2026 United Nations Water Conference, co-hosted by the UAE and Senegal in December 2026, is a pivotal meeting for global water governance[35]. As only the third UN water conference convened since 1977, it reflects growing international recognition that water challenges are no longer just sectoral or localized, but systemic and deeply intertwined with economic development, regional stability, and human security. The UAE's role as co-host is particularly relevant given its position at the intersection of water scarcity, rapid development, and technological innovation. By hosting the conference, the UAE can bring into focus the challenges faced by water-stressed regions, while also giving the GCC countries a unique opportunity to influence global water discussions from the perspective of some of the world's most water-constrained yet innovation-driven economies.

The six interactive dialogue themes of the conference provide a framework for examining water challenges that are directly relevant to the GCC region:

- **'Water for people'** emphasizes safe water and sanitation as essential for health, equity, and society, offering pathways for GCC countries to further strengthen the reliability of municipal water supply systems through desalination and wastewater reuse.
- **'Water for prosperity'** focuses on integrating water use across sectors, providing insights that can assist ongoing Gulf efforts such as Saudi Arabia's water management, agricultural efficiency, and urban expansion under Vision 2030, as well as the UAE's investments in water technology innovation.
- **'Water for planet'** addresses natural and environmental vulnerabilities associated with water, highlighting approaches that can help mitigate risks faced by GCC countries, like Bahrain's vulnerability to sea level rise and Oman's exposure to severe tropical storms that threatens coastal water infrastructure.
- **'Water for cooperation'** highlights inclusive governance and international water collaboration, which can guide the GCC group in managing their shared transboundary aquifers through agreements that preserve and protect groundwater quality and sustainability, while also reinforcing the value of strategic long-term planning in support of Qatar's national goal of water sufficiency.
- **'Water in multilateral processes'** situates water within the context of UN Sustainable Development Goal 6 and global water initiatives, creating opportunities that can enhance Kuwait's ongoing groundwater remediation and water quality management efforts, while also enabling the integration of water issues into other climate-related multilateral processes, such as the UNFCCC, given the clear intersection of climate change and water security.

- **'Investments for water'** underscores the need for financing, innovation, and capacity building, and offers a financial framework to advance shared priorities across the GCC region with respect to desalination expansion, flood protection, and infrastructure modernization.

Exploring these conference themes through the lens of the GCC bloc's water management framework illustrates how integrated approaches can address extreme water scarcity. By linking technical innovation, strategic governance, and regional cooperation, the GCC countries experience demonstrates how water systems can be maintained, water resources can be allocated efficiently across sectors, and rapidly urbanizing economies can grow sustainably, even under one of the world's most water-scarce environments.

Conclusion

Water management approaches across Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE show that securing water in the GCC region goes beyond addressing scarcity. It requires anticipating climate risks, supporting growing populations, and ensuring that industrial and urban needs are met without compromising future supply. These cases demonstrate that resilient water systems do not rely on technology alone; comprehensive planning, system redundancy, and adaptable infrastructure are essential to maintaining water reliability under changing conditions. By continuing to invest in innovative desalination and wastewater reuse, reinforcing protection against flooding and sea level rise, and fostering regional collaboration, the GCC bloc could strengthen its long-term water security. Looking ahead, the region's ability to align water resource management with socio-economic development, economic diversification ambitions, and sustainability targets will determine whether it can sustain its growth while meeting the evolving demands of a water-stressed environment.

Policy Recommendations

Building on these insights, the GCC countries must address both immediate and long-term water challenges to sustain growth, manage scarcity, and increase resilience against pressures from climate change and population growth. Effective water governance will require a proactive and coordinated combination of strategic planning, innovation, and regional cooperation that includes:

- Strengthening water infrastructure to ensure reliability and resilience through investments in desalination, wastewater treatment, and distribution networks capable of supporting urban, industrial, and agricultural demand under extreme conditions.
- Expanding integrated water resource management practices that incorporate surface water, groundwater, desalinated water, and reclaimed water to optimize allocation, reduce losses, and maintain strategic reserves.
- Enhancing adaptive planning to anticipate climate-related risks such as sea level rise, flooding, and extreme weather, thereby ensuring that water systems and critical infrastructure remain robust under uncertain future conditions.
- Promoting technological innovation and research in areas such as energy-efficient desalination, advanced irrigation, hydroponics, and water monitoring systems to improve efficiency and reduce environmental impacts.
- Fostering regional collaboration across the GCC region to coordinate on transboundary aquifer management, water quality standards, and emergency preparedness, creating a more resilient and cooperative water management framework.

By prioritizing these strategies, the GCC countries can move beyond short-term fixes and establish a long-term foundation for sustainable water security that supports regional socio-economic growth and positions the region as a model for water management in arid environments.

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