Antonio H. Ruiz
William Howard Taft High School
Chicago, Illinois, United States of America
Bahrain, Water Scarcity and Environmental Impacts of Desalination Centers
3/29/2026
Revised 9/1/2026

# Water Scarcity and Issues with the Desalination Centers in Bahrain

Water scarcity is a lack of freshwater that is used to meet human, environmental, and infrastructural needs, among others. Water scarcity can come as a result of changing climate conditions, resource mismanagement, pollution, and population growth. Many countries, especially those with infrequent rainfall and limited access to bodies or reserves of freshwater, struggle in getting enough water to meet all their needs. This struggle can be worsened with a dense population, as many more depend on the production of freshwater and there is a large usage, as well as waste, of water. This creates a large water stress on the environment and requires other methods of producing water to meet needs. A country facing water scarcity is Bahrain. Bahrain is an Asian country located in the Arabian Gulf. It has a high population density, being about 2205 people per square kilometer, which places it among the highest in the world. The country has a dry climate, with only 80 mm of rainfall per year, which is why the environment consists of sand dunes. In the northern and northwestern region of the nation, there are natural springs and freshwater springs which support agricultural land and are where government and business facilities are centralized (UN Water, 2023). These characteristics of the state are the cause of water stress and scarcity. To promote the wellbeing of the people and provide stability for infrastructure, the government of Bahrain has had to approach the issue and work better with their resources to meet water needs.

To meet water needs, Bahrain has made use of groundwater, surface water, desalinated seawater, and treated wastewater to meet the water needs of the state. Groundwater has been in reduced use as over-extraction of aquifers has left these water sources degraded in quality and quantity, and other factors like oil spills and seawater invasion also discourage use, which is why efforts are now centered around water sources like the desalinated seawater and treated wastewater. Of the two, the desalinated water is used more to meet the needs of the country, providing around 60 percent of Bahrain's freshwater (Hussein, Mohamed A., 2026). While this is a helpful resource, it has drastic environmental effects. The process of desalination has the freshwater separated from brine, which is the salt extracted from the larger portion of water. This brine is released back into the gulf, and its high salinity alters the overall salinity of the ocean water, especially by the coast. Near one of the desalination plants, Al-Dur, the water's salination was at 55% which is significantly greater than the natural salination of the water, which is 35% salinity (Mounir, Eman, 2025). The brine discharge at the facility also raised water temperature, with an average of 36.5 degrees celsius in the summer (Anwar Al-Osaimi, et al., 2019), when healthy semi-tropical waters usually have a max of 29 degrees celsius (NOAA, 2021). Higher temperatures can be tolerated but only for short periods. Considering the Persian Gulf supports diverse sealife, with coral reefs along the northern coast of Bahrain, this increased salinity and temperature is significantly harmful to the environment. This is an issue in itself, detracting from goals of development for the nation as the

acquisition of necessities comes at the expense of the environment, which should not have to be a trade-off. However, this issue also directly hurts the Bahraini people. As the nation is an archipelago, a large portion of food and trade is in relation to fish. The increased salinity of the water creates a lot of stress on the sealife, as they have to regulate their internal salinity levels in relation to the surrounding water, and with high salinity, they cannot regulate osmosis (Mounir, Eman, 2025). This forces sea life to migrate or die. And, increasing temperatures have a similar impact, as sea life cannot regulate its temperature, so increasing temperatures act as another factor that forces migration against the threat of death. Both of these factors have led to a decrease in coastal biodiversity and quantity of fish that the people of Bahrain relied on for sustenance, and that fisherman relied on for work. The heavy reliance on desalination centers for freshwater in Bahrain harms the environment/coastal ecosystem, impacts food security for the nation, and harms the economy by taking away work from a large group. The provision of freshwater from the desalination centers does not justify the harms caused by them, and thus a change in the usage of these centers needs to take place.

Complete termination of these facilities is unreasonable. These facilities, while harmful, provide a large amount of a necessary resource for an ever-increasing population. To shut these facilities down entirely would most likely lead to immediate harm and an arduous recovery following. Therefore, there should be an altered approach to their usage. The desalination centers could be further developed to include processes that make the discharge of brine back into the sea less harmful. A lot of resources, like capital and energy, are used to run the desalination centers and this may discourage the use of different processes to get fresh water. Also, considering there are 58 desalination plants around the state of Bahrain (Mounir, Eman, 2025), many may seek to continue using these centers which have been produced in a great number and in which many resources have already been spent. So, to utilize these facilities which are already depended on without causing too much harm to the environment, focus could be put on the development of the desalination centers to include diffusers at the outfall pipeline. Diffusers dilute the discharged brine from the desalination centers by mixing it with seawater or other effluents before or while it is being released back into the sea (Sangir, 2026). This mixing decreases the salinity of the discharge which helps limit the environmental impact. The use of diffusers is already being worked on in other plants around the world, so moving resources to support it in Bahrain will be helpful for the nation and reasonably attainable. This can be a helpful option as it doesn't stop the use of centers which are already relied on to produce fresh water, but improves the use of these centers to more sustainably meet fresh water needs and protect the environment. This also would not greatly impact the use of resources as it builds on facilities which are already established and relied on rather than moving resources to different systems entirely. These desalination centers do meet the water needs of the people of Bahrain, so additions to decrease harmful effects of these centers could allow continued reliance on these sources without too much concern over its impacts.

The Bahraini people would favor this option over other solutions. Not only do the desalination centers provide 60% of the nation's freshwater, but when looking at what is used for Bahrain's drinking water, the desalination centers make up about 90% of it (Hussein, Mohamed A., 2026). These centers cannot just be shifted away from or done away with because they make up the day-to-day life for the populace of Bahrain. The preservation of these facilities means the preservation of the people's way of life, and so to suggest alternatives would most likely be unpopular. The government would have an easier time implementing standards for the use and development of the desalination centers rather than trying to shift

the people's dependency onto an entirely new system. Due to the large support for the sourcing of freshwater as it is in Bahrain currently, it is reasonable that the people wouldn't be opposed to the movement of more resources to these facilities in the form of added diffusers, as it comes with the outlook of making a trusted source of a necessary resource better and more reliable. Further, it would provide a positive image for the authorities of Bahrain to work to interact with the people and their needs, as well as the needs of the environment around them. This positive perception of the actions of Bahrain serves as a form of soft power, producing a reputation for the state to concern itself with environmental and international needs. This may serve the state in global affairs, which could be favorable to its economics and its position on the global stage. Internally, the change in the facilities would be most appreciated by the coastal regions of the nation. Along the coast, the condition of the water makes it so that entering it can cause irritation to the eyes and damage the skin (Mounir, Eman, 2025). These waters stand as a health hazard and should not be the condition by which communities must live, so by taking action which could lessen the harms already caused, it would be a celebrated choice. Also, coastal regions have many employed in the fishing industry, and with the decline of fish along the coast, this threatens the livelihood of many families. Not only does this impact the condition of their lives, as they cannot afford resources and are thus hindered in their wellbeing, but with fewer people being able to interact with the economy, it would weaken, which would pose a problem for the larger populace. Thus, the interests of the coastal communities being met plays a larger part in the needs of all Bahrain being met. The impacts of this issue touch every corner and every person in the country, so by considering the needs of different communities, even smaller ones outside of municipal sectors, it serves the country as a whole.

Bahrain is a large state with a large population. Due to factors, ranging from the dry climate to the overextraction of aquifers, the nation faces water scarcity. Water is a human right and therefore everyone should have access to it as they need, promoting health and wellbeing. People receiving necessities is important to the development of a state, but also important to this cause is protection of the environment and promotion of sustainable practices to benefit all life on Earth. So, Bahrain's reliance on desalination centers which cause great harm to the ecosystem of the Persian Gulf needs to be confronted and altered. To maintain use of these facilities which are already depended on, the desalination centers can be further developed to include diffusers which will limit the impacts of their processes as they continue to provide needed water. With a state as dense as Bahrain, creating comprehensive solutions to meet the needs of the population while still promoting the health of the environment is vital. With continued growth of the world population, impacts of growing industrialization, and decreasing environmental health, situations like that in Bahrain hold significance to the future of the global community. It is vital human rights are protected throughout the world, including access to necessities like water. However, the necessary industrialization to provide these necessities should never come at the expense of the environment or any other life. Promoting the health of ecosystems keeps the world healthy and ensures humanity still has a home in the future. Starting at a smaller scale, such as at the national level with Bahrain can influence how the world approaches its relationship with the ocean in the future. All humanity needs water and has the right to it, but by promoting methods of sourcing fresh water that have a lowered impact on the ocean and life within it, it sets a standard for the global community to serve each other as all people continue to protect the world and the resources it provides.

## Sources


Abbas, Fatema Fadhel, and Waleed Khalil Al-Zubari. "Evaluating Future Alternatives for a Sustainable Water Management System in the Kingdom of Bahrain." *Computational Water Energy and Environmental Engineering*, vol. 14, no. 02, 1 Jan. 2025, pp. 97–118, www.scirp.org/journal/paperinformation?paperid=141779, https://doi.org/10.4236/cweee.2025.142006.

Ahmad, Rehan. "Water Scarcity in Bahrain | EcoMENA." *EcoMENA*, 12 Jan. 2019, www.ecomena.org/water-scarcity-in-bahrain/.

Anwar Al-Osaimi, et al. *Effect of Brine Discharge from Al-Dur RO Desalination Plant on the Infauna Species Composition in the East Coast of Bahrain*. 30 May 2019, www.researchgate.net/publication/360939637_Effect_of_Brine_Discharge_From_Al-Dur_RO_Desalination_Plant_on_the_Infauna_Species_Composition_in_the_East_Coast_of_Bahrain.

Brears, Robert. "Bahrain's Water Security under the Spotlight: New City Water System Brief from Our Future Water Unpacks Governance, Infrastructure, and Strategic Challenges." *Our Future Water Intelligence*, Oct. 2025, ourfuturewaterintelligence.com/blogs/news/bahrain-s-water-security-under-the-spotlight-new-city-water-system-brief-from-our-future-water-unpacks-governance-infrastructure-and-strategic-challenges.

Hussein, Mohamed A. "How Much of the Gulf's Water Comes from Desalination Plants?" *Al Jazeera*, 12 Mar. 2026, www.aljazeera.com/news/2026/3/12/how-much-of-the-gulfs-water-comes-from-desalination-plants.

Mounir, Eman. "The Decline of Bahrain's Fisheries due to Desalination Expansion." *Pulitzer Center*, 2025, pulitzercenter.org/stories/decline-bahrains-fisheries-due-desalination-expansion.

NOAA. "In What Types of Water Do Corals Live?" *Noaa.gov*, 26 Feb. 2021, oceanservice.noaa.gov/facts/coralwaters.html.

Sangir. "Why Pre-Insulated Pipes Are Vital for Smart Infrastructure." *Sangir Plastics Pvt Ltd*, 28 Jan. 2026, sangir.com/large-diameter-hdpe-diffusers-for-dahej-desalination-plant/ . Accessed 30 Mar. 2026.

"Water Action Hub | Country: Bahrain." *Wateractionhub.org*, wateractionhub.org/geos/country/18/d/bahrain/.

*UN Water, WHAT PROGRESS LOOKS like BAHRAIN -SUSTAINABLE WATER USE (SDG TARGET 6.4)*. Food and Agriculture Organization of the United Nations, Feb. 2023, https://www.unwater.org/sites/default/files/2023-03/sdg6_acceleration_snapshot_642_bahrain_feb_2023.pdf