

WSTA 15th Gulf Water Conference
Water in the GCC, The Role of Technology in Effective Water Management
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Preface

Over the past five decades, the GCC countries have witnessed an unprecedented and sustained economic and social transformation, which has been associated with one of the world's highest population and urbanization growth rates, coupled with rapidly changing lifestyles and consumption patterns. Such transformation has been associated with a rapid increase in sectoral water requirements that goes beyond their limited available freshwater resources.

Although the GCC countries are situated in one of the most water-scarce regions of the world with an extremely poor endowment of freshwater resources, they have done well in the provision of water supply to their populations primarily by relying on desalination technology, which is made possible by their strong economies and substantial financial and energy resources. Currently, a safe, affordable, and stable domestic water supply has been established in each country covering 100% of its population. However, municipal water supply systems are associated with substantial financial, economic, and environmental costs.

On the other hand, agricultural water demands, representing about 80% of the total water requirements in the GCC countries, have been met mainly by heavy groundwater abstraction, and to a lesser extent by treated municipal wastewater. However, a major concern is that the majority of these groundwater resources are non-renewable, are being extensively mined, and are rapidly depleting, while the remaining limited and renewable groundwater resources are being over-exploited beyond their replenishment rates, leading to their quality degradation due to saltwater intrusion.

In the past decades, to address the water sector challenges the GCC countries have been focusing on a supply-side management approach to meet the ever-increasing demands for water, manifested by the construction of desalination plants, dams, systems for groundwater abstraction, and reuse of treated wastewater. Recently, the countries have complemented this traditional approach by a demand-side management approach utilizing structural, sociopolitical, and economic policy tools to influence demand and achieve water use efficiency in the various consuming sectors.

Within the GCC countries' efforts to achieve effective water resources management, technology can play a major part as an enabler for both supply-side engineering measures and demand-side management and efficiency measures. The implementation of technology in the GCC countries' water management system has been more focused on the supply-side engineering measures and operation, and less on the demand and efficiency measures. Examples of these are technologies used to produce fresh and clean water (e.g., desalination and wastewater treatment technologies), and mathematical models that facilitate decision-making in the planning, management and optimal operation of water resources systems (e.g., simulation models for groundwater and surface water systems). The supply and demand systems can be better considered holistically both for longer-term planning and real-time operations facilitated by technology.

Recently, new generation of technologies, driven by the developments in information and communication technologies (ICTs), have been emerging providing powerful enabling tools for effective water management. Examples of these are smart water management technologies relying on ICTs to provide real-time, automated data to resolve water challenges, as well as for planning and operational purposes; e.g., SCADA in water supply, modern in-situ sensors and earth observation, improved metering and billing systems, or creation of "digital twins" of facilities/systems. Other examples include smart agriculture using sensors for data acquisition, transmission and presentation, and hydroinformatic systems which integrate numerical modeling and data science methods in a digital environment (typically GIS and cloud computing to facilitate data management, analytics, and visualization) that facilitate the conversion of data into information, subsequently into knowledge, and eventually management decisions.

As we stand on the brink of a technological revolution, i.e., the fourth industrial revolution, which will fundamentally alter and transform entire systems of production, management, and governance, it is expected that technology will have an impact on the entire water sector and its management-related activities. The current plethora of data coming from all types of devices together with the escalating increase in computer capacity is revolutionizing almost all sectors. The water sector system will not be an exception. For example, in the municipal water supply sector, combining the power of big data analytics, including Artificial Intelligence, with existing and future urban water infrastructure represents a significant untapped opportunity for the operation, maintenance, and rehabilitation of urban water infrastructure to achieve economic and environmental sustainability. Similarly, in agricultural water management, adopting smart water management systems, where sensors measure soil moisture in real-time and automatically irrigate the field without human intervention provide a major opportunity to enhance irrigation efficiency and optimize water use.

There will be a need for stocktaking of these modern innovations, explore their current adoption in the GCC countries, and explore policy, institutional, and technical facilitation of these technologies to improve overall water management and sustainability in the region. The advocated harnessing the potential of technologies in both the supply-side and demand-side management areas to achieve effective water management in the GCC countries. It promotes the exchange of experiences and discussion on the benefits, costs, risks, required human capacities, and barriers faced in their implementation.

The WSTA Fifteenth Gulf Water Conference is organized in Doha, State of Qatar during the period in collaboration April 28–30, 2024, in cooperation with Qatari General Electricity and Water Corporation (KAHRAMAA) and the GCC Secretariat General Secretariat (GCC SG). The conference is supported and scientifically endorsed by a number of international, regional, and local organizations, including: the United Nations Economic and Social Commission for Western Asia (UN-ESCWA), UNESCO Offices in Cairo and Doha, Food and Agriculture Organization (FAO), World Health Organization (WHO), Arab Organization for Agricultural Development (AOAD), International Center for Agricultural Research in the Dry Areas (ICARDA), International Center for Biosaline Agriculture (ICBA), International Water Management Institute (IWMI), International Desalination Association (IDA), Arab Water Utilities Association (ACWUA), Arabian Gulf University (AGU), Omani Water Society (OWS), European Desalination Society (EDS), and the Qatar Environment and Energy Research Institute (QEERI).

On behalf of the Conference Scientific Committee, I would like to thank all the authors and panelists from various parts of the world for joining us in our fifteenth Gulf Water Conference and for sharing their experience and innovative solutions in improving water sustainability and overcoming the water challenges in the arid GCC countries and Arab regions. I would like to express our sincere gratitude to the our esteemed and dedicated reviewers for their valuable time, expertise, and rigorous evaluation of the submitted papers.

Furthermore, we would like to express our thanks to Prof. Miriam Balaban for editing.

Prof. Waleed K Al-Zubari
Chairperson, Conference Scientific
Committee

Conference Objectives

- Reviewing current and emerging technologies used in the various water sectors, improve their awareness, and identify their advantages, challenges, and limitations.
- Showing how the different technological means of implementation can promote the necessary transformative change in the water sectors.
- Presenting technological solutions implemented in the region and internationally to address water sector challenges.
- Discussing and highlighting the central role of investment in R&D in localizing and producing water sector technologies in the GCC countries to skate away from being just a market.
- Identifying the main barriers to the implementation of emerging technologies in the management of the water sector.
- Connecting water professionals to exchange experiences and best practice case studies in the GCC countries and other countries in the region on the use of technology in the water sector.

Conference Recommendations

1. Digitalization and the use of emerging technologies in the water sector

- Digitalization and emerging technologies have tremendous transformative potential for optimizing water management and enhancing its efficiency and resilience across the GCC countries. However, its employment and unlocking its potential in the water sector is considered slow due to a number of constraints and barriers that need to be addressed, which can be categorized into data, human capacity, modeling, infrastructure systems, and costs.
- There is a need to link water professionals and ICT professionals to overcome many of the constraints facing the employment of digitalization and emerging technologies in the water sector and coupling digitalization and cybersecurity in the water sector.
- It is important to incorporate emerging technologies and digitalization into academic and professional curricula related to the water sector to empower future generations of water professionals with advanced technological to address the pressing challenges facing water resources and contribute to a more sustainable future.

2. Sustainable Management of Desalination (localizing, mitigating impacts, and security)

- Desalination will continue to be the main water source in the water supply portfolio of the GCC and is expected to be increasing with time. Therefore, it is a strategic imperative to localize desalination in the region. Furthermore, it is also imperative to address desalination challenges in terms of energy efficiency, financial cost, and environmental impacts (i.e., air/GHG emissions and desalination reject). Localization of the desalination industry in the region requires strategic planning and cooperation between policy makers, research centers and private sector to establish establishing an industrial ecosystem for desalination with active R&D as well as investment in innovative SMEs.
- Moreover, renewable and alternative energies represent a major opportunity for reducing emissions, and innovative technologies, including brine mineral extraction and electricity generation represents a potential solution for maximizing the benefit of desalination reject as well as reducing its impact on the marine environment.
- Desalination facilities, reliant on the quality of feed water, are vulnerable to oil spills as well as to other hazards in its feed seawater. A comprehensive oil spill management approach integrating advanced offshore cleanup, seawater intake, and onshore water pre-treatment processes is essential to robustly protect seawater quality and prevent desalination plant shutdowns.

3. Sustainable Management of Surface Water and Groundwater

- Recent climatological studies indicate increased frequency in extreme events of rainfalls in the region, which is attributed to global climate change, leading to less stationarity of historical climate data. It is important to maximize the utilization of the produced surface water and at the same time protect human life and infrastructure. Flooding risk maps and flood simulation based on Regional Circulation Models predictions represent an important activity in this regard. The natural drainage system of wadis to be re-identified and protected to reduce potential damage and to increase resilience of areas along wadi channel and downstream urbanized areas to flashflood hazards. An integrated approach that supports protection of cities and harvest part of the flashflood needs to be considered in the region.
- Groundwater, renewable and non-renewable, represents a major water source for all the GCC countries. Sustainability of non-renewable groundwater should be based on socio-economic criteria, while renewable groundwater will require plans for restoration. In addition to the demand management and conservation efforts, MAR represents a potential option for the supply side management, especially by surplus desalinated water and treated wastewater.
- Continuous and proactive monitoring, state of the art simulation modeling, and the existence of MIS are important components of groundwater resources and its management.

4. Maximizing Wastewater and Sludge Utilization

- To maximize the beneficial use of wastewater in treated wastewater reuse in agriculture, cooling, and energy generation, and energy and fertilizers production from sludge. A major push in this direction can be made by attracting private investors as part of the transition to circular economy of the water sector.
- Furthermore, decentralized wastewater systems have proven to be more efficient than the traditional centralized systems in terms of cost and operation. Establish a GCC network on energy conversion from wastewater.

5. Institutionalization of Water Safety Plans (WSP) and Sanitation Safety Plan (SSP)

Institutionalization and Implementing WSP and SSP, which are plans that are based on pro-active risk assessment and risk management approaches, present a major opportunity for ensuring safe management of water supply, protecting public health, maximizing health benefits of sanitation. Such plans need to be part of the performance criteria of the water supply and sanitation utilities.

6. Water Use and Management of the Municipal Water Sector

To enhance the water utilities participation in the provision of water supply and sanitation services to improve the quality of the service and reduce cost. However, this participation should be effectively regulated by a clear contract framework that is based on achievements. Moreover, benchmarking of water utilities (using the framework of Effectively Managed Utilities, EMU) is an important mechanism for achieving highest levels of performance and best practices within the country and between the GCC countries.

7. Water Use and Management of the Agricultural Sector

Digitalization of agriculture could be the next transformation in water management, and implementing emerging technologies (i.e., AI, RS, IoT, ..) has a major potential to increase water productivity and the contribution of the agricultural sector to food security. Innovative agricultural water management include: precision irrigation systems, smart irrigation, use of AI, use of analysis-ready remote sensing data platforms, integration with water management technologies and addressing climate change.

8. MIS in the Water Sector

A water MIS is an important component of the water management system to facilitate informed decision-making at various levels in the water sector, as well as policy formulation. It is important to establish a water MIS as a comprehensive framework that integrates data, information, and technologies to collect, process, analyze, and disseminate information related to water quantity, quality, usage, and availability.

9. Decarbonization of the Water Sector

The water sector has great potential in reducing GHGs emissions and contribute to the national commitments of carbon neutrality, especially in the municipal sector which depends mainly on the energy-intensive desalination. Technological solutions like Enhancing energy efficiency and increasing renewable energy, and demand management and efficiency solutions like reducing per capita water consumption and physical leakage represent the main area of work to reduce emissions.

10. Involvement of the GCC Research and Scientific Community in the International Decade of Science for Sustainable Development (IDSSD)

Encouraging the effective engagement of scientific and research institutions in the GCC under the umbrella of the UNESCO led “International Decade of Science for Sustainable Development” (IDSSD) to advance regional collaborative multidisciplinary innovative research initiatives in the water sector including all forms of knowledge within the realms of science, policy, and society.

The conference authorizes the Board of Directors of the Water Science and Technology Association to submit the conference recommendations to the Secretariat General of the Cooperation Council of the Arab States of the Gulf (GCC SG) for presentation at the Water Ministerial Committee meetings and to follow up on their implementation progress. The Conference also request WSTA to circulate the recommendations to relevant regional and national organizations and water-related forums.