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EDITORIAL MESSAGE

Special Issue: Hydrogeology in Algeria

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As climate change is growing, water security becomes an urgent challenge in the Middle East and North Africa (MENA), the most water scarce region in the world (World Bank, 2018; UN Water, 2020). Algeria is one of these countries under large stresses (Kwasi & Cilliers, 2020). The water stress index is poor with a water availability ratio of 411 m^3/cap/year. Forecasts estimate a value of 300 m^3/cap/year in 2050 (Falkenmark et al., 1989; Kherbache, 2020). Although, the natural factors (climate change) affect the access to water and lead either to severe water shortages and regional disparities, the water deficit is mainly due to a lack of sustainable groundwater management associated to poor knowledge of the resource (PNE,2010; Kherbache, 2020).

Within a total water demand estimated at 8.3 billion m^3, agriculture uses 5.4 billion m^3 for irrigation in 2019. Drinking water represents a total volume of 2.1 billion m^3/year provided both from aquifers, and from 11 stations of desalination of seawater (Kwasi & Cilliers, 2020). Industrial demand represents 10% of the total water supply (CEA, 2004; Progress, 2016). Out of the whole water demand, groundwater production represents 50% against 33% from surface water, while desalination of seawater stays at 17%.

A regional disparity exists between the North and the Sahara region. In fact, water resources are evaluated in the North at 12.5 billion m^3/year, in contrast, the Sahara contains only 5.5 billion m^3/year (Bouchentouf & Benabdeli, 2021). The country have an annual surface water estimated at 10.5 billion m^3/year, with about 10 billion m^3/year in the North and only 0.5 billion m^3/year flowing into the Saharan basin. Groundwater resources are estimated at a total of 7.5 billion m^3/year with 2.5 billion m^3/year in the North and about 5 billion m^3/year in the South (Bouchekima et al. 2008, Hamiche et al., 2015). As said, large part of the groundwater resource is localized in the Sahara and 96% of water demand in the South part of Algeria is provided from the transboundary North-Western Sahara Aquifer System (NWSAS) as shown in Figure 1.

The North of Algeria is characterized by shallow aquifers, renewable with 1.9 billion m^3/year of recharge, but overexploited, being the total withdrawals estimated at 2.5 billion m^3/year (Bouchekima et al. 2008; Langenberg et al., 2021). At the same time, the fractured and karstic aquifers are under-known. In the South, the main aquifer is represented by the NWSAS, spreading over 700,000 km^2. It includes two main sub-systems: the Continental Intercalar (CI) and the Complex Terminal (CT). These are fossils, non-renewables, and exploited using deep boreholes. Still in this area, shallow aquifers are exploited through the traditional *fouggara* system (UNESCO, 1972; OSS, 2003). The CT (100-400 meters deep) and the CI (1,000-1,500 meters deep) contain significant reserves estimated at 30,000-40,000 billion m^3 (OSS, 2003).

Since three decades the water strategy in Algeria focused on the mobilization of surface water over 80 dams. While precipitations are currently decreasing, the storage is drastically reduced and several dams went dry. In parallel, a rapid growth in exploitation of water resources, the frequent inefficient use of water, and water leaks exacerbate the situation. Algeria is now confronting with an acute water crisis. In this context, groundwater is considered as the most reliable conventional water resource. Basic needs of the population of the region must be considered and fulfilled in one of the biggest country in Africa and the Southern-Mediterranean area. Because groundwater is poorly monitored in Algeria, this Special Issue "Hydrogeology in Algeria" comes to highlight groundwater researches in some critical areas.

In this Special Issue, Aissaoui et al. (2023) in their study propose a methodology to identify the most suitable areas for groundwater recharge in the Middle Seybouse subcatchment in Guelma, North-East Algeria. They produced a map showing 60% of the investigated area has very high potential aquifer recharge and used receiver operating characteristic curve to validate it. Makhlouf et al. (2023) assessed the main climatic characteristics and their impact on the hydrological regime at the watershed and the hydrodynamic functioning of the aquifer in the Eastern Mitidja plain. They identified a dry period from 1974 to 2018, characterized by a rainfall deficit between 15% and 19% compared to the previous period (1906-1973). To improve groundwater management in the area, they suggest the use of treated wastewater to recharge the aquifer, complemented by reduced abstractions and dedicated monitoring. Kessasra et al. (2023) used an integrated approach including geophysical investigation correlated to the geological and hydrogeological context in the Chetma area (Biskra). The results highlight a deep structural form with significant hydrogeological features. To achieve the drinking water supply by 2030, projected at about 35.1 hm^3/year, and to ensure groundwater sustainability in arid environment, they suggest to consider Droh as an excellent drilling site for future groundwater boreholes. Finally, Toumi et al. (2023) presented a methodology to the Tindouf basin (south-western Algeria) to understand the hydrogeology of a complex aquifer system with a limited number of data. This in order to identify the favorable areas for the design and set-up of new wells, and to know whether there is still current recharge of these aquifers. The combination of the different methods (principal components analysis, diagram

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of deuterium versus oxygen-18, and equilibrium diagrams Mg/Na and Ca/Na) made it possible to define and characterize the main groundwater flow paths from their sources to the discharge zones.

This Special Issue "Hydrogeology in Algeria" presents a view of current researches on hydrogeological topics. A further, second leg of this Special Issue, will follow in the June 2023 Issue of the Acque Sotterranee – Italian Journal of Groundwater. We then invite you to discover the recent insights on groundwater in this southern Mediterranean country.

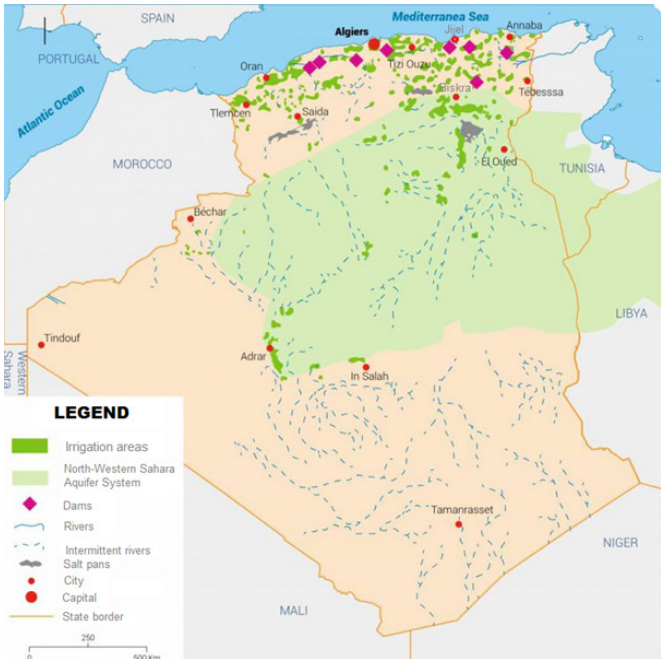

Fig. 1 - Water resources and infrastructure in Algeria

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