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AN INTERDISCIPLINARY METHODOLOGY TO DESIGN INTEGRATED AND INNOVATIVE MAR SYSTEMS IN ARID AND SEMI-ARID REGIONS. TWO CASE STUDIES IN ALGERIA AND IN TUNISIA

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In order to combat drought and desertification, it is essential a holistic approach such that represented by the paradigm of the Integrated Water Resources Management (IWRM). Within the IWRM framework, an effective solution consists, in particular in arid and semi-arid regions, in sustainable water management practices which in many cases provide for a combination of both water harvesting and Managed Aquifer Recharge (MAR) techniques.
This research was developed within WADIS-MAR demonstration Project (2011-2016) (www.wadismar.eu), funded by the EC under the SWIM Programme (www.swim-sm.eu). An interdisciplinary methodology was developed to define guidelines for the design and implementation of integrated and innovative MAR systems that can be applied in arid and semi-arid environments. This approach was tested in two watersheds in Maghreb Region: Wadi Biskra in Algeria and Oum Zessar in Tunisia. Both areas are characterized by water scarcity and overexploitation of groundwater resources. As required by the application of this methodology, the different components of the Water Resources System (WRS) were defined: the water budget, the 3D hydrogeological model and the hydrogeochemical and isotopic characterization. A physiography-based indirect method for determining the runoff coefficient (Ghiglieri et al., 2014) was applied at sub-basin scale for three watersheds in the Tunisian study area. The water budget was estimated on a daily time scale basis, over a 10-year period (2003-2012) through a simplified water balance model, modifying the model proposed by Allen et al. (2006), that considers effective infiltration as part of the surplus from water storage in the soil. An average Available Water Content (AWC) of soils and an average runoff coefficient were considered for each sub-basin. 3D hydrogeological models were implemented for both study areas through the realization of several balanced geological cross-sections and data processing in a 3D environment by 3D MOVE software. A detailed hydrogeochemical characterization was carried out, including bulk chemistry and multi-isotopic analyses of water and solid samples. The estimated average annual groundwater recharge of the aquifers is consistent with the reference values found in literature. 3D hydrogeological model reconstruction showed that groundwater circulation and aquifers geometry are strongly influenced by several tectonic

structures. This is confirmed by hydrogeochemical and isotopic data. All these results allowed to design innovative MAR systems including some technical innovations to improve the efficiency of MAR schemes: the recharge chambers and the Passive Treatment System. Finally, the estimated potential recharge rate (m^3 $year^{-1}$) for the target aquifers related to the designed MAR systems are about 1.7 hm^3 $year^{-1}$ and 1.2 hm^3 $year^{-1}$ in Algerian and Tunisian study area, respectively.

References

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