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WATER BALANCE ESTIMATES FOR DETERMINING NATURAL AQUIFER RECHARGE IN THE ARID CONTEXT OF THE OUM ZESSAR AREA (SE TUNISIA)

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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 designing and implementing integrated and innovative MAR systems in the Oum Zessar study area (SE Tunisia). A relevant component of its application was the water budget calculation for three watersheds (Koutine, Megarine-Arniane and Hajar) within the study area, in order to estimate the natural groundwater recharge. Due to the lack of an appropriate data set for hydrological modeling, a physiography-based indirect method for determining the runoff coefficient (Ghiglieri et al., 2014) was applied at sub-basin scale for the three watersheds. The coefficient was calculated using specific physiographic characteristics (slope, vegetation land cover and outcrop permeability) and the aridity index that defines climatic conditions. In order to calculate the annual average aridity index over a 30-year period (1981-2010), spatial interpolations of average monthly precipitation and temperature data were performed through single and multiple regressions, considering elevation and sea distance, obtained from the SRTMGL1 DEM, as independent geographic variables (Canu et al., 2014). Considering that in such arid environments, only after short but intense events, rainfall can greatly exceed evapotranspiration, leading to runoff and recharging the aquifers, the water budget components were estimated on a daily basis, over a 10-year period (2003-2012). For this purpose, a simplified water balance model was applied 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. Results show that sub-basins covered mainly by the "artificial" soils of tabias and jessour, the traditional Tunisian water harvesting structures, with average AWC values greater than 150 mm, didn't contribute to groundwater recharge during the period considered. Indeed, only very intense rainfall events can saturate these soils and generate a water surplus, especially after dry periods. A necessary trade-off between the spread of the traditional water harvesting systems for agricultural purposes and the need in ensuring an adequate natural recharge for aquifers must be considered. In these studies, a more refined approach combining hydrological and agronomic models that require wide and complete datasets in input is therefore essential.

References

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