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Modeling scenarios for water resources management in a semi-arid catchment “Merguellil – Tunisia”

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In the Mediterranean climatic zone, also labeled as semi-arid area, hydrological processes are largely variable both in time and space due to the high variability of rainfall regime, the influence of topography and the spatial distribution of geology, soil and land use. These processes may also have changed due to a range of human activities such as land use changes, dams building, soil and water conservations works. Besides, there is a general agreement that global climate change is taking place in the Mediterranean basin.

The Merguellil catchment (Central Tunisia), as a typical Mediterranean semi-arid basin, suffers regular water shortage aggravated by current drought with different degrees of frequency, intensity and severity. In addition, the hydrological regime has been changed over the last decade in this catchment. The construction of the large El Haouareb dam (1989) increases the surface storage and evaporations losses. Soil and water Conservation Works (SWCW) (ie. benches terraces) and others small and large dams have altered the hydrological regime.

In this study, the Soil and Water Assessment Tool (SWAT-2000) model was used in order to simulate the water and nutrient balance at the catchment scale. The simulation results revealed that evapotranspiration is the major component (91%) of the hydrological balance. Hydrological Calibration (1992-1994) and validation (1996-1998) have been carried out referring to a daily flow data at the Hafouz flowgage. The model performance was satisfactory and the Nash-Sutcliffe coefficient ranges between 0.3 to 0.5. The water quality simulation shows that Phosphorus simulated concentrations better matched existing measurements.

In order to improve the availability of high quality water, three scenarios were generated. Firstly, the total or partial removal of SWCWs from the upstream area has shown an increase of the surface runoff and sediment loading at the outlet. Secondly, by reducing 20% in the applied fertilizers, no change was detected in the crop yield, whereas on a yearly scale, it has been noted a reduction in sediment and nutrient loads. Finally to assess the potential impact of climate change, the predicted precipitations and temperatures (for 2020, 2050 and 2080) from the general circulation model HadCm3 developed by UK Hadley Center for climatic prediction and research, were used. All the components of the water and nutrient balance are foreseen to decrease. A longer arid period in summer is also predicted leading to a decrease of the sediment and nutrient load in that period.