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Assessment of sustainable agriculture in the irrigated perimeter of Tadla, Morocco using the CRIWAR strategy module

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To ensure sustainable agriculture in an irrigated area, the conditions under which crops grow, should remain stable over a prolonged period. For crops production, actual evapotranspiration should be close to the potential evapotranspiration. At the same time degradation of the soil (salt accumulation), mining of the groundwater aquifer and the negative influence of drainage water on the downstream environment should be avoided. Water management therefore should balance the need of water for agriculture and the need for a sustainable environment.

The CRIWAR strategy module is a tool, which evaluates ET_a from the gross irrigated area and the annual fluctuation of the groundwater table under this area. It expands on the concept that the part water in an area not being consumed or discharged (groundwater flow or surface drainage) will be stored in the area. A major part of this non-depleted part will be stored as groundwater. This results to a rising groundwater table and potential salinity in semi-arid regions. If water consumption is relatively high, water storage can be negative and the groundwater table drops.
Management information for the groundwater table is obtained through the depleted fraction (Molden 1997, Bastiaanssen et al 2001). The depleted fraction is defined as the ratio of the actual evapotranspiration over the sum of precipitation and irrigation water, the latter parameters being the total inflow into the gross irrigated area. It gives information on the rate of change with which water is stored in the area (Bos, 2004) and thus the rate of change of the groundwater table. When there is no change in groundwater storage on a yearly basis, water consumption (ET_a) in the area is sustainable from a water balance point of view.
By managing the volume of irrigation water, the depleted fraction can be influenced and thus the volume of water stored in the aquifer.

The CRIWAR strategy module is applied in the Tadla irrigated perimeter in Morocco. The area is known for a long history of irrigation, which started in 1935. Before 1980 groundwater tables in the phreatic aquifer rose due to large irrigation supplies. This caused soil deterioration and the need for an artificial drainage system. After a large drought between 1981 and 1984 and the structural decrease of the annual rainfall since 1992, farmers started to exploit groundwater on a large scale (Hammani, 2004). Cropping intensification and excessive groundwater subtraction have resulted in mining of the groundwater resources. If this mining continues at the present rate the rural agriculture based economy will become non-sustainable.

Conclusions

The CRIWAR model can be used to evaluate the past and present use of the water resources in the irrigated perimeter. It can be used as a planning tool for water managers and decision makers to assess the impact of measures like change in cropping patterns, reallocation of

water or improved efficiency. In the Tadla perimeter the model is applied to match the crop water requirements with the surface water availability and the allowable groundwater subtraction to ensure a sustainable use of the water resources.

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