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Modelling and optimizing rainwater harvesting in the wadi Oum Zessar watershed, Tunisia

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Rainfall in arid and semi-arid regions is generally insufficient to meet crop water requirements. Rainwater harvesting (RWH) techniques have been adapted in these regions to minimise the risk from droughts. The demand for water has increased but water resources have become scarcer, so the assessment and modelling of surface water related to RWH in catchments has become a necessity. An understanding of the hydrological processes at the sub-catchment level is generally lacking, and little attention has been given to the assessment of RWH after implementation. A simple water-balance model was developed, combined with field measurements to analyse the performance of various RWH designs and management scenarios. The model was applied to rainfall data for 1980-2004 in 25 sub-catchments of the watershed of Wadi Oum Zessar (southeastern Tunisia), and the terms of the water-balance equation were calculated for more than 300 individual rainfall events. The performance and analysis of RWH in three types of years (dry, normal, and wet) are presented and discussed. This study emphasises the advantages of simulating long-term water balances at the sub-catchment level for improving our understanding of hydrological processes in the RWH system and provides several solutions for optimising RWH performance in various scenarios. Changing the spillway heights together with the flow directions had a significant impact on the performance of RWH by increasing the efficiency of water availability for crop requirements in 92% of all sub-catchments in a wet year compared to 44% in base scenario (no change in spillway heights/flow direction).