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The efficiency of trenches as runoff water harvesting systems and the role of their design in minimizing water losses

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Water is a primary limiting factor to agricultural development in many arid and semi-arid regions. In these regions, much of the annual rainfall occurs as a result of a few intensive convective storms. Only a small fraction of the rain is absorbed by the soil, does not penetrate deeply into the soil profile and is mostly lost by direct evaporation into the atmosphere shortly after the rain event. Usually the fraction that is not absorbed by the soil, flows as the runoff to the lower laying parts of the land and is thus lost for plant production. The technique of collecting the runoff and conveying it to areas, in which it can be ponded, is known as runoff harvesting. This technique may be used for food, fuel production, flood and erosion control, as well as for landscape development. In terms of combating desertification and degradation, water harvesting appears to be a viable solution. Microcatchments are one of the primary techniques used for collecting, storing and conserving local surface runoff for growing trees/shrubs. In this system, runoff water is collected close-by the area in which it was generated, and trees/shrubs may utilize the water during the next dry season. The main objective of the present research was to estimate the effect the shape of the micro-catchment collection area (shallow basin and deep trench) has on the efficiency of the water conservation in the soil profile

The study was carried out using regular micro-catchments (three replicates) with a surface area of 9 m2 (3 x 3 m) and a depth of 0.1 m and trenches (three replicates) with a surface area of 12 m2 (12 x 1 m) and 1 m depth. One and three olive trees were planted inside the trenches and micro-catchments, respectively. Access tubes for neutron probe were installed in micro-catchments and trenches (four and seven, respectively) to depths of 3 m. Soil water content in the soil profile was monitored. Sap flow in trees was measured by PS-TDP8 Granier sap flow system every 0.5 hour and fluxes computed for the time intervals that correspond to the soil water measurements.

The study included flooding trenches and regular micro-catchments with the same amount of water (1 m3), monitoring the water balance components and estimation of evaporation losses and water use efficiency by olive trees. Evaporation from trenches and regular micro-catchments was estimated as the difference between evapo-transpiration obtained by soil water content monitoring and transpiration estimated by sap flow measurements.

The results clearly show that the evaporation from the regular micro-catchments was significantly larger than that of trenches during the entire duration of the experiment. The fractional loss due to evaporation for the entire experimental period was 53 and 22% for micro-catchments and trenches, respectively.