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Mechanized Micro-catchment Water Harvesting for Improving Arid Rangelands in Syria

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Abstract

Arid rangelands of West Asia and North Africa have been severely degraded due to high grazing pressure and limited but highly variable rainfall. The main objective of this research was to assess the suitability of mechanised micro-catchment water harvesting combined with shrub plantations for combating desertification in arid rangelands. Three micro-catchment water-harvesting techniques were installed on a 100-ha site in the Syrian steppe (117 mm average annual rainfall). The techniques were (i) semicircular bunds established by an up-and-down movement with a Vallerani dolphin plough, (ii) continuous contour ridges established by Vallerani plough, and (iii) continuous contour ridges established by standard plough. Micro-catchments were set up with two slope lengths, 6 and 12 m, resulting in six different water-harvesting systems. Target areas were planted with three fodder shrub species: *Atriplex halimus*, *Atriplex leucoclada* and *Salsola vermiculata*. The water-harvesting systems were evaluated by measuring and analysing shrub survival, canopy volume and soil moisture during the 2005–2008 seasons. Shrub survival rates four years after transplanting were significantly higher ($p < 0.05$) for the species *S. vermiculata* (62 %) and *A. halimus* (54 %) than for shrubs of the species *A. leucoclada* (37 %). However, shrub survival was not affected by the water-harvesting systems. Spreading of seeds and germination of new plants could be observed for *S. vermiculata* shrubs. These results made up for the small canopy volumes produced by this species (0.16 m^3), compared to *A. halimus* shrubs (0.53 m^3). The micro-catchments provided favourable growing conditions for native annual species; 13 different species were observed in the catchment areas. Soil moisture changes after rainfall events were significantly higher ($p < 0.05$) in the semicircular-bunds systems than in the four continuous systems, which can be explained by a more targeted concentration of water in the semicircular bunds. The water-harvesting effect could be observed very well after large events (>5 mm), as soil moisture change in the target areas exceeded the rainfall on six of nine measurement dates.

Mechanically established micro-catchment water harvesting is a promising technique to capture surface runoff and re-establish vegetation in degraded rangelands. However, the management of grazing remains an important challenge in these marginal areas.

Keywords: Arid rangelands, Atriplex, canopy volume, mechanised, micro-catchment water harvesting, shrub survival, soil moisture, Syria

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