

## **Environmental and socioeconomic benefits and limitations of water harvesting techniques in semiarid regions**

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Under climate change, sustainable management of soil and water resources is increasingly important, especially in rainfed agroecosystems of semiarid environments. Water harvesting refers to a range of techniques for the collection and management of flood or rainwater for domestic and agricultural use and for water retention in natural ecosystems. Water harvesting represents a good example of sustainable management of water resources that contribute to water and food security. However, there are often environmental and socioeconomic constraints for implementation of water harvesting techniques, so each condition asks for a specific solution.

Here we aim to highlight the environmental and socioeconomic benefits, requirements and limitations of different water harvesting techniques and to characterize their implications for provisioning, regulating, supporting, and cultural ecosystem services. We reviewed 62 water harvesting techniques for semiarid regions extracted from the WOCAT (World Overview of Conservation Approaches and Technologies) database. We discuss aspects related to: i) human and environmental characteristics, ii) cost-benefit ratio during implementation and maintenance phases, iii) socioeconomic and environmental impacts at local and regional scales, and, iv) impacts on ecosystem services.

Our review reveals that water harvesting represents very diverse methods of collecting and managing floodwaters and surface runoff. We grouped techniques as 'floodwater harvesting', 'macro-catchment water harvesting', 'micro-catchment water harvesting', and 'rooftop and courtyard' water harvesting. Almost half of all technologies originates from traditional knowledge. The implementation of water harvesting is generally positive on the short-term, to very positive on the long-term, while its maintenance is very positive at short and long-term. However, perception depends on the type of water harvesting and local conditions.

Most relevant socioeconomic benefits from water harvesting are increased crop yield and farm income. Their implementation also leads to an improved food security and knowledge of soil erosion and conservation and to strengthening of social networks. Their main environmental benefits include an increased soil moisture content and water availability, reduced soil loss and reduced downstream flooding and siltation. These impacts have positive implications for a range of regulating (flood control), provisioning (food production), supporting (nutrient cycling) and cultural (aesthetic value) ecosystem services. Despite their many perceived potential benefits, the main constraints for local implementation of water harvesting techniques are due to labour constraints, implementation costs and the loss of productive land. This highlights the need for political solutions including incentives for implementation for most effective water harvesting techniques adapted to local environmental and socioeconomic conditions.