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"Challenges to Organic Farming and Sustainable Land Use in the Tropics and Subtropics"

The Hydrology of Mountain Oases in Northern Oman

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Abstract

Oasis agriculture in the desertic Northern Omani mountains is based on the millennia-old use of spring water. However, little is known about the hydrogeology of the generally small springs, their buffering capacity against drought periods which may last for several years and the movement of water in irrigated fields.

To address these questions, the flow of water in a spring network was monitored over 20 months in the oasis of Balad Seet. Water samples were analysed for their time of retention in the calcareous rocks of origin using their unstable isotope signatures (tritium/helium ratio). Soil moisture was measured in an alfalfa (*Medicago sativa* L.) field using dielectric probes within 14-day irrigation cycles. Quantitative data obtained were integrated into a three-dimensional model of the entire oasis watershed. This model was derived from several thousands of differential GPS measurements and laser-based distance measurements.

During the observation period, 120 mm precipitation had been measured, however only 50 mm might be effective for ground water recharge. In the same period, a decline of the spring outflows of 24% was observed. These observations and the results of the isotope analysis of the water indicate retention times of several years. This underlines the role of bedrock as a natural buffer system for water in this oasis watershed.

The measured volumetric moisture content in the upper 0.1 m of the soil dropped after a 35 mm water application within a few hours from saturation to 15% and steadily declined to 7% until the next irrigation event. The water use efficiency of the crops in this system is very high with apparently only minor small seepage losses necessary to avoid salinity build-up. The ancient channel irrigation system of this oasis with its nested terraces seems to be an elaborate form of adaptation to limited water availability on small land surfaces.

Keywords: GPS, hydrology, oases, oasis, Oman, terraces, water

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