



## **Socio-hydrology of artificial glaciers in Ladakh, India: assessing adaptive strategies for water conservation in the Trans-Himalayan region**

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The consequences of cryosphere changes are critical for the functioning of meltwater-dependent agriculture in cold-arid mountains, such as in the upper Indus Basin of Ladakh. Recent research on glacier changes in the Trans-Himalayan region shows that even small glacier decrease and changes of seasonal snow cover impact on the timely availability of meltwater for agricultural land-use.

In order to cope with recurrent water scarcity, different types of ice reservoirs, commonly called “artificial glaciers”, have been introduced in central Ladakh. Such site-specific hydro-technological interventions are promoted as appropriate adaptive strategies to cope with the expected reduction of water storage in the cryosphere. Located at altitudes below the glaciers and above agricultural settlements, these man-made structures utilize the process of icing to facilitate freezing of stream water at particular sites in winter. The resulting seasonal ice reservoirs increase meltwater availability during the critical period of water scarcity at the time of sowing in spring, thereby reducing risks for local smallholders. We examine the extent to which such claims are justified based on a long-term analysis of the functioning of these ice reservoirs within the environmental and socioeconomic context of Ladakh. Based on an integrative approach including multi-temporal satellite data (1969-2017), close range photogrammetry and repeat field measurements (2014 and 2015), we provide an inventory and typology of these ice reservoirs and one methodological example for the estimation of their storage volume. Combined with expert interviews and household questionnaires (2007-2017) we offer a novel engagement with the nexus of glacio-hydrological processes and local mountain livelihoods. We suggest that while “artificial glaciers” are remarkably suited to the physical environment, impacts of climatic variability, natural hazards and an incomplete integration into the local socioeconomic setting significantly reduce their efficacy.