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Cryosphere-fed irrigation networks in the north-western Himalaya: Threatened livelihoods and adaptation strategies under the impact of climate change

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Irrigated agriculture is crucial for livelihood security of local mountain communities in the northwestern part of the Himalayan arc and adjoining regions of the Karakoram, Hindu Kush and Trans-Himalaya. Based on meltwater from glaciers, snow packs and permafrost, mountain dwellers have developed sophisticated techniques to cope with the challenge of recurrent water scarcity, posed by glacier retreat, glacier thinning, and seasonal snow-cover variability. Using empirical case studies from the Nanga Parbat region, Hunza-Karakoram and Ladakh, the study seeks to identify general patterns and site-specific particularities of agrarian practices and adaptation strategies in the face of climate change. The comparative case study approach reveals various responses to water scarcity, which depend on local conditions and include the construction of new irrigation channels, installation of pipes and building of artificial ice reservoirs. The conceptualization of this research draws on the integrated concept of socio-hydrology and is based on long-term research in the three study areas. The methods used include multi-temporal and multi-scale remote sensing analyses in order to map changes of natural water storage components and irrigation infrastructure between the 1960s and the 2010s. Interviews and empirical socioeconomic surveys allow taking into account factors such as the expansion of off-farm income opportunities and market integration. We identify key variables that affect the sustainability and resilience of land use systems beyond the three case studies.