



## **Human-Nature Interaction in the Eastern Pamirs of Tajikistan – Ecosystem services against the background of pasture use and energy consumption**

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Mountains play an important role in the world's sustainable development. Despite the acquired knowledge about their importance the Global Environment Outlook 3 (UNEP 2002) states that most "mountain commons are ecologically under-managed and suffer from the classic 'commons syndrome': while all seek to benefit, stakeholders lack coordination, incentives and instruments for joint care." For the Eastern Pamirs, a dry (< 100 mm/a) and high (3,500-5,500 m asl) mountain plateau in the east of Tajikistan, grazing and fuel-wood are identified as key ecosystem services. Extensive pastoralism is a prime adapted land use strategy. Therefore, the Soviet administration allocated the production of meat on collective and state farms as the region's main task. Elaborate management plans, usually with four seasonal pasture camps, and additional imports of fuel and forage, led to a well-balanced utilization of all pastures. The dissolution of the USSR resulted in significant structural changes in the region. Most notably, the end of the subsidy system stopped the provisioning from outside. Without external inputs bridging long distances between the seasonal pastures poses a major problem to most smallholders. Furthermore, the limited supply and high cost of imported fossil fuels induced the increased use of dwarf shrubs as an energy resource. However, they are also important forage plants, particularly in winter. This study aims to provide a well-founded overview of the pasture and fuel-wood resources and the spatiotemporal variability of the actual pasture use with associated livestock numbers to make assertions on overuse in particular areas. Therefore, an interdisciplinary approach was used, combining geoecological and socio-economic methods. To assess the pasture potential information about land cover, phytomass availability, and forage quality were collected. Vegetation classes were modeled with a Random Forest (Breiman 2001), based on land cover information of 262 test plots, and explanatory variables derived from remotely sensed data. Phytomass availability was estimated using a point-intercept method (Mueller-Dombois & Ellenberg 1974). Forage quality of the most important fodder plants was analyzed according to van Soest (1994). By combining the results the availability of metabolizable energy throughout the study area was estimated. Spatiotemporal variations of pasture use were mapped by repeatedly visiting all pasture camps from 2007 until 2009 and 280 pastoralist were interviewed. Furthermore, the development of usage rights, and the size and ownership of the herds since the Soviet era were assessed through archive work and topic-specific expert interviews. It could be shown that the mono-seasonal pasture utilization on the state farms contrasts with a distinct multi-seasonal present-day use. Consequently, pastures close to villages are permanently used, particularly in winter, and are heavily overgrazed. In contrast, grazing pressure on summer pastures is much less. However, also several distant summer pastures show high livestock numbers, which indicates that they are not underused, as it is often argued. Furthermore, it could be demonstrated that the actual degradation of dwarf shrub vegetation is not yet as severe as stated in reports and literature. These results can help to advise stakeholders (e.g. local administration, herders, NGOs) about sustainable management of the natural resources.