



## **Meadow degradation, hydrological processes and rangeland management in Tibet**

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Alpine meadow dominated by species of *Kobresia* is widely distributed in the Tibetan Plateau. *Kobresia pygmaea* is often a main species and the meadow has evolved as a result of long-term trampling, being a main rangeland resource for livestock grazing. This alpine meadow also plays an important role in regulating the water and energy balance through land-atmosphere interaction, leaving an impact on local hydrological processes and beyond. Therefore, alpine meadow degradation is detrimental to both the health of the ecosystems, and to pastoralism.

This research therefore studies the hydrological process with regard to degradation of *Kobresia pygmaea* meadow, tracing the possible causes, detecting the impacts on soil and biological properties, and further considering the herders' role in future rangeland management. The study area is around the Kema village of the Nagqu Prefecture in Northern Tibet, where human population depends on livestock grazing for livelihood.

Main driving factors of alpine meadow degradation are climatic variations and human disturbance. The periodical change in local climate may be related to quasi-oscillatory atmospheric circulations in this monsoon dominated area and the climatic trends with extreme weather conditions can make the whole system hard to recover. Along with climatic variations, overgrazing is predominant with an exceeding of the carrying capacity by almost every household in this village. This is related to the change of rangeland management by the policies of privatisation of pasture and sedentarisation. The acceleration of degradation since the 1980s results in a series of distinct soil-vegetation combination classified in this research as the normal meadow, compact crust and bare soil. The species composition, soil physical and chemical properties and the vertical water movement along the soil-plant-atmosphere continuum are significantly different at the sites representing stages of degradation, revealed by multiple methods including field sampling and monitoring, model simulation and stable isotope analysis.

The understanding of regional hydrological processes and water partitioning under different surface conditions is crucial to an integrated, interdisciplinary study with regard to sustainable use of rangeland resources. Therefore a further consideration of rangeland management under the current condition is proposed. Herders have witnessed some degradation processes and have noticed some climatic variations. However, they do not naturally link meadow degradation to climate change nor do they tend to blame overgrazing. There may be conflicts between scientific knowledge and indigenous experience when the local people are trying to keep their tradition during modernisation, imposed sometimes without thorough consideration. The dependency on weather conditions is turning to dependency on government subsidies when the rangeland management violates practical traditions and is lack of integrated measures to promote local economy.

This case in Tibet shows that a sound knowledge of the ecological status of rangeland and an understanding of local people's perspective towards development should be considered together, so that holistic measures, with flexible implementation of policies, can be taken to realise long-term benefit, ecologically and socio-economically.