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Impacts of grazing pressure and rangeland ecological potential on the degraded rangeland recovery of dry steppe

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Abstract

The uncontrolled livestock population growth and increasing pressure on rangeland have led to a decline in rangeland productivity and shrinking of previously underused grazing areas. These rotational grazing practices have become increasingly difficult as heavy grazing accelerates the degradation of seasonal rangeland. Therefore, there is a critical need to identify community-supported and ecologically advantageous strategies for the recovery of degraded rangeland in the steppe zone, which is home to over 60 percent of the national herds. Efforts must be multidisciplinary, considering heterogeneous ecological sites to better understand the state of rangeland and to experiment with grazing regimes suited to the specific steppe climate and soils.

This study investigates the long-term (12 years) impacts of adjusted grazing pressure based on pre-study carrying capacity on the recovery of rangeland with varying degrees of degradation. The overall objective was to integrate grazing management practices informed by these findings into the rangeland management strategies of local herder organizations. Specific research goals included:

1. Determining how degraded rangeland could recover through grazing management tailored to its initial state and carrying capacity;
2. Understanding the interrelation of ecological site descriptions and the recovery class concept of degraded rangeland;
3. Determining the impact of grazing on the recovery of degraded rangeland in the steppe zone;
4. Assessing the effect of ecological potential on the restoration of degraded rangeland;
5. Developing a grazing model based on rangeland recovery and state change;
6. Piloting the optimal use of recovered rangeland at the herder community level.

Introduction

The decline in rangeland condition and productivity, which forms the foundation of livestock production and Mongolia's economic development, has been severe over the past 20 years. The steppe grasslands, which make up 66.12 percent of Mongolia’s natural grasslands, are especially affected, with 30.8 percent categorized as dry steppes. Over 60 percent of the country’s livestock graze in these areas. Degradation in this zone is expanding rapidly, underscoring the urgent need to develop and implement mechanisms for maintaining and recovering pastures at various degradation levels.

The national report on rangeland health of Mongolia (2015, 2018) noted that 80 percent of degraded pastures could recover naturally, emphasizing the importance of adjusting pasture use loads and regimes scientifically. Rangeland productivity, carrying capacity, and recovery potential vary depending on climate, geography, and vegetation. Therefore, research suggests aligning pasture use and recovery measures with the ecological capacity and degradation level of each site.

The continuous rise in livestock numbers has decreased the availability of underused pastures, limiting seasonal and rotational grazing possibilities. Consequently, it is critical to introduce practices that support the resilience and recovery of pasture ecosystems by balancing grazing pressure with environmental capacity. This study piloted the uniform use of degraded pastures in Undurshireet soum, Tuv aimag, from 2013 to 2022.

Methods

Field research focused on Steppe zone areas (n=4), representing typical pasture types. Data collection occurred between August 2009 and 2022. Enclosure and control plot pairs were established, with fenced plots measuring 25 m x 25 m. Three transects were set outside the enclosures and six inside. Samples were collected from 1 m^2 plots, with biomass and vegetative cover assessed and species diversity quantified using Shannon's diversity index (SHDI). Data were analyzed using one-way ANOVA and Non-Metric Multidimensional Scaling (NMS) ordination.

Results

The study found that moderately degraded Stipa krylovii-Poa-Caragana steppe rangeland in deep sandy alluvial plains could support an additional 31 sheep units through controlled grazing. Long-term consistent grazing pressure over 12 years established sufficient forage resources for controlled herd management.

The ecological potential-based approach increased herder income by 10-15% through improvements in the livestock product value chain and certification based on set criteria. Moderately degraded pastures transformed into slightly degraded pastures within two years with balanced grazing loads.

Changes in total vegetation cover showed an increase to 97 percent under uniform use, while frequent use led to a decrease to 37 percent. Dominant plant species, such as Krylov's sedge, increased by 19-57 percent with uniform use but decreased by 7.5 percent with frequent use.

Discussion

The recovery of degraded grasslands in the steppe region is heavily influenced by annual rainfall and degradation levels. Studies indicate that once a threshold is exceeded, natural recovery within five years becomes unlikely. Recovery also depends on the dominant species' grazing tolerance and the balance between above-ground and underground biomass. Effective recovery requires methodologies that assess both visible and subsurface transformations.

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