Optimal Pastureland Use Planning in Bayan, Mongolia using Remote Sensing and GIS

(リモートセンシングと GIS を用いた モンゴル・バヤンにおける最適草地利用計画)

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Background

Mongolian pasturelands remain state-owned and are not covered by appropriate regulation and planning to preserve and use them. The semi-arid steppe of Bayan soum, Mongolia, was chosen as the field investigation site. Pastureland occupies 96% of the study area and the associated economy depends strongly on livestock production. The Bayan soum is facing livestock feed shortages due to overgrazing. In order to improve vegetation biomass growth, a proper pastureland use planning is needed.

Objectives

Exploring the optimal spatial resolution of remote sensing data

Determination of the relationship between vegetation biomass and accumulated NDVI

To estimate potential pastureland biomass productivity

To recommend proper pastureland use planning

Materials and methods

The percentage of vegetation cover was calculated at 200 sampling points and field work concerning the vegetation biomass was undertaken at 50 sampling points. Photos of the ground cover at 1 square m were taken to compute the percentages of the ground surface components such as green grass, dried grass, bare soil and shadows using an unsupervised classification approach. Vegetation dry biomass and MODIS13Q1 250 m resolution satellite images between 2001 and 2011 have been used to determine the relationships between vegetation biomass and accumulated NDVI period of 2001 and 2011. The spatial distribution of the aboveground biomass was analyzed by geostatistical semivariogram analysis.

Results and discussion

The field survey percentage vegetation coverage was correlated up to 130 m for green grass, 170 m for dried grass, and 110 m for total grass. Considering these spatial correlations, the spatial resolution for each pixel in the remote sensing data should be less than 130 m. The spatial correlation of pixels in an NDVI map of the study area shows the maximum spatial resolution would probably be around 560 m, 140 m and less m, respectively, for the non-overgrazed, moderately overgrazed and severely overgrazed pastures. The relationship thresholds between the vegetation biomass and the accumulated NDV ranged from 0.7 to 0.85. Thus, the estimation of the pastureland vegetation biomass was expressed by accumulated NDVI, obtained from the regression equations. Five different zones of vegetation productivity, namely, rich, high, normal, low and poor biomass productivities have been identified in vegetation productivity map.

Conclusion

Remote sensing data with less than 130 m resolution is preferred for the vegetation biomass related study. The spatial distribution of the vegetation coverage was strongly dependent on soil type, elevation and the rates of overgrazed pasture. The accumulated NDVI has given a significant estimate of the vegetation biomass for a vegetation productivity analysis. Finally, using the productivity map, the zonal planning for pastureland use has been recommended to establish the suitable pastureland management for better vegetation productivity.

Key words: *Accumulated NDVI, vegetation biomass productivity, geostatistics, semivariogram and pastureland use planning*