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Remote sensing with GIS and GPS for monitoring steppe degradation

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Key words : GIS, GPS, satellite remote sensing, steppe degradation, Xilingol steppe

Introduction Mr. Xu, the Director-general for the Science and Technology Agency of Inner Mongolia, expressed that the desertification area in China is increasing at 2460km² per year. The most important procedure to prevent steppe degradation is to discuss and share the information about steppe conditions with decision makers and herders in a timely and exact manner. The objective of this paper was to review our methodology for monitoring degradation in an experiment in the Xilingol steppe, Inner Mongolia.

Methods How can we grasp the present and future states of grasslands? Grassland conditions are determined by the balance of grass production (GP) and herbage intake (HI) by animals. When HI is higher than GP, grasslands will be degraded. However, if the GP is greater than the HI, grasslands will be conserved and the land will recover (Akiyama and Kawamura, 2007). GP may be regulated by soil fertility and topography of the area, and pasture management and climate conditions of each year. HI will be affected by grazing intensity, animal behavior, and animal management. Geographic information systems (GIS) will be helpful for this type of analysis. This system is intended for real-time monitoring of GP and HI using satellite data, GIS, global positioning systems (GPS) and mathematical models.

Results (1) *Changes in grassland type*: Comparing time series of Landsat data between 1979 and 1997, it was determined that the areas of productive Meadow steppe decreased and croplands and low productive Typical steppe were increased (Akiyama et al. 2003). (2) *Biomass change*: Seasonal and yearly changes of steppe biomass could be shown by composite images of NDVI derived from NOAA and MODIS (Kawamura et al. 2003). (3) *Herbage quality*: Kawamura et al. (2005a) found that MODIS/EVI estimates crude protein concentration in the green biomass. Seasonal changes in quality was detected. (4) *Animal behavior*: Daily traveling distance, location and animal movement was estimated by attaching a GPS monitor to sheep (Kawamura et al. 2005b). (5) *Real-time monitoring system*: GIS database consists from 3-D topography derived from ASTER image, biomass and forage quality maps obtained by MODIS, grazing information by GPS on the sheep, from which we can build a real-time steppe management system.

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