Remote Sensing with GIS and GPS for Monitoring Steppe Degradation

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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 2460km^2 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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