# Mongolian Vegetation Changes in the Last Two Decades

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## Introduction

Mongolia is in East Asia, landlocked between Russia and China. The country has a total area of 1,566,500 sq km. It is on a high plateau ranging from 900 to 1,500 m in elevation. Rocky desert and grassy semi-arid steppe cover most of the land. Forests, which are limited to the mountainous areas, cover about 7 per cent of the land. Nomadism and animal herding have been central facts in Mongolian life for thousands of years, and herding is still the country's main economic activity. Consequently, a good understanding of the past, current and future vegetation conditions of the vast Mongolian grassland is very important for the nation. However, no solid consensus seems to have been reached so far on this matter. On one hand, there are reports claiming that Mongolian pastures, although hard grazed, are still in good order (Suttie, 2005). On the other, there are reports suggesting possible desertification by climate change due to anthropogenic or natural reasons (United Nations, 1997). To set the baseline information of the recent vegetation trend for both current and future monitoring scheme is therefore worthwhile and is the objective of this study.

## Vegetation Trend Analysis

Vegetation trend analysis using the normalized difference vegetation index (NDVI) data over a 23-year period has revealed a unique spatiotemporal pattern during 1981-2003. Vegetation NDVI typically ranges from 0.1 up to 0.6, with higher values associated with greater density and greenness of the plant canopy. We used the Global Inventory Modeling and Mapping Studies (GIMMS) dataset with a 8 km resolution provided by the Global Land Cover Facility (GLCF) of the USA. These data were originally constructed using measurements from the Advanced Very High Resolution Radiometer (AVHRR) on board the USA's NOAA polar orbiting meteorological satellites and were corrected for calibration, view geometry, volcanic aerosols, and other effects not related to actual vegetation change (Tucker *et al.*, 2005). Vegetation trend for each pixel location was calculated using a series of maximum NDVI values for each year. The process of selecting annual maximum NDVI for each pixel disregards the seasonal timing of the NDVI values. Trend analysis on these annual maximum NDVI produced a collection of slopes that were expressed as coefficient of correlation. Conducting a statistical test on the estimated trend helped the authors identify areas with significant vegetation changes (t-test of correlation coefficient, $P < 0.05$).

## Results and Discussion

Results showed that there were; 1) apparent degrading trend near large cities especially around Ulaanbaatar, 2) major concentrations of degrading trend in the northern mountain areas, 3) localized degrading trend near China border, and 4) a strip of improving trend along 45-47 degree North latitude (Figure 1). We confirmed by conducting a ground survey with GPS tracking that major land degradation is indeed observed near Ulaanbaatar and Darhan, the second largest city in Mongolia. This trend is most likely due to large scale abandoning of crop fields after Soviet retreated and to rapid changes in land use practices caused by sedentarization of traditional nomads around the city. The overall observation of the spatiotemporal pattern of vegetation trend was supported by the local researchers to be reasonable. Concentrations of degrading trend in the northern mountains were attributed to recent wildfires in the late 1990’s, cutting of trees for fuel and building construction material. Rapid development and settlement near China border appears to result in chains of constructions and overgrazing. A strip of improving trend along 45-47 degree North latitude is speculated to be caused by the reduction of plant-eating animals during the recent dzud (a Mongolia-specific winter disaster which undermines the welfare and food security of the herding community through large-scale death and debilitation of livestock). Areas that experienced a severe livestock loss between 1999 and 2002 causing a significant reduction of plant consumption in the following years exhibit apparent vegetation recovery (Hirano *et al.*, 2006). Further ground checking and comprehensive analysis are in progress to draw a more concrete conclusion about the driving forces for the vegetation trend.

## Conclusion

Vegetation trend analysis using GIMMS/NDVI dataset

over a 23-year period has revealed a unique spatiotemporal pattern during 1981-2003. Major degradation was observed in northern mountains and around big cities. Scattered degradation was observed in rapidly developing areas near China border. These were assumed to be caused by wildfires, over grazing and land use conversion, respectively. A strip of vegetation improvement was observed just north of the Gobi desert area. This was speculated be due to the loss of plant-eating livestock during the recent dzud in addition to ongoing global climate change. Ground survey and on-site discussion with the local scientists gave support to estimated vegetation change during these 23 years. The use of time-series NDVI dataset has important implications for setting the baseline information of the recent vegetation trend for both current and future monitoring scheme.

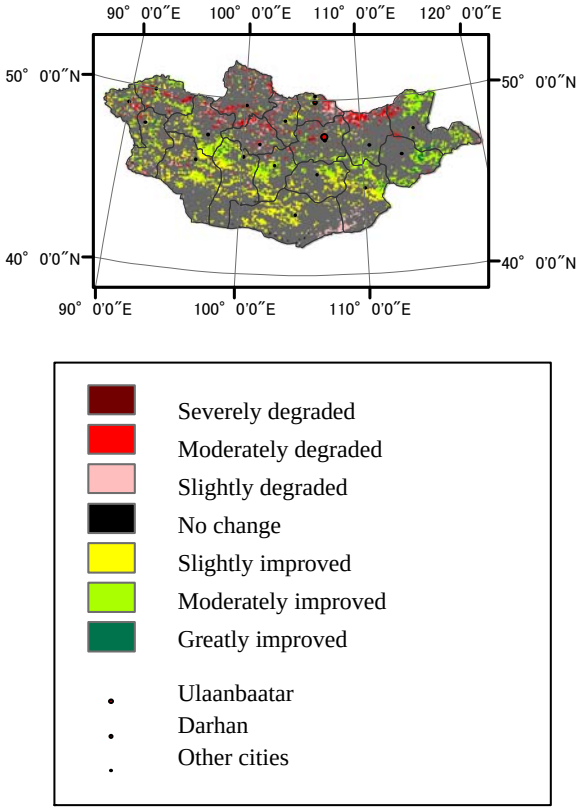


**Figure 1.** Spatial distribution of estimated vegetation trend based on GIMMS/NDVI dataset. (1981-2003)

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