# Assessment of pastureland change using remote sensing data in eastern steppe zone of Mongolia

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## Introduction

Relating with the geographical position of Mongolia, its ecosystems and land cover types over whole territory are various. One of the key issues of the global change is a land use/cover change. The monitoring of land cover and research study on its change needs comprehensive information on the land cover. The Eastern Steppe zone of Mongolia is a very specific region by ecosystems and the climatic characteristics. For pastureland change assessment over Eastern steppe zone we have analyzed and integrated different types of satellite and ground truth data and tried to estimate land cover changes.

In this paper we have included some integrated results with land cover classification results.

## Study area

The Eastern Steppe zone includes Khentii, Dornod and Sukhbaatar aimags territory, which are covers 285044.3 km.sq. area with two main types of natural zones as, forest steppe and steppe zones. Within these aimags there are numbers of protected areas and plateau areas for pastureland (about 90 per cent) as well.

## Data and Methodology

For the land degradation assessment over the Eastern Steppe zone we have used the long term NOAA data and Landsat satellite data and ground measurement data. We have used satellite data with lower resolution (NOAA) and higher resolution of Landsat TM (1989, 2002) data and used the mixed approach of supervised and unsupervised classification methods together for classification purposes. For long term assessment of pastureland condition used the time series analysis method mainly and also used the NDVI difference method.

Ground measurement data were collected from meteorological stations and from field surveying observation sites and also from Eastern Steppe Biodiversity Project.

According to the land cover classification results we have compared and analyzed with field measurement data over the Kherlen river basin region.

## Results

According to the long term 10 day composed NDVI (normalized difference vegetation index) data derived from NOAA satellite data of May – September 1982-2004 we have created the range of normalized statistical values. Using these data we have integrated with ground truth measurements.

Land cover changes have been analyzed in various ways of using different satellite imageries from NOAA and Landsat TM satellites.

We have different achievements as,

1. The pasture vegetation condition change have estimated by long term NOAA/NDVI data and integrated with the ground measurements of pasture biomass data.
2. The land cover types were estimated in 2 scales of 1:1 million (by NOAA) and 1:50000 (by Landsat) and their changes have been valuated.

### *1. Pasture vegetation changes over 3 aimags*

The vegetation cover change trends have been estimated within growth seasons (May-September, 1982-2004) using long term NOAA/NDVI data (Fig. 1).

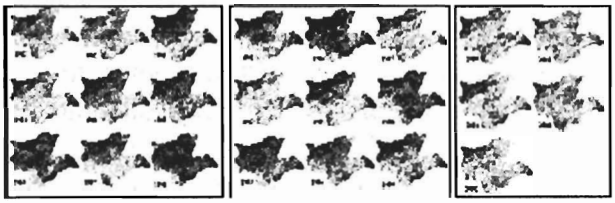

Fig. 1. NOAA/NDVI images of July, 1982 – 2004

Within growing periods over each aimag territory the vegetation covers have changed negatively, but spatially and temporally various in values (Fig. 2). Over last 23 years in eastern steppe zone the NDVI has been decreased in value of 2.51-16.87 (Table 1).

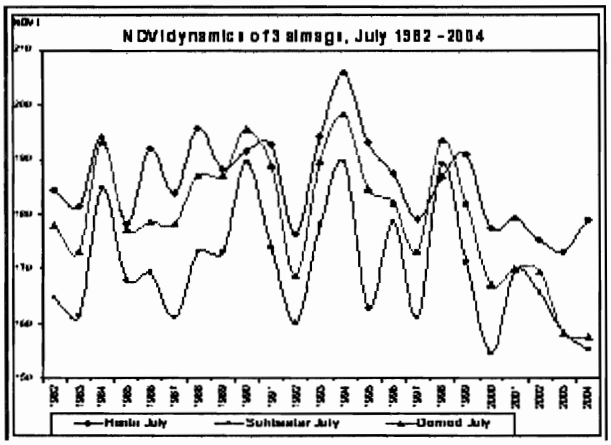


Fig. 2. NDVI dynamics over each aimag.

Within last 23 years Khentii aimag has higher values of the vegetation index values due to forested zone in the northern part. Sukhbaatar aimag has lower values, but its unstable dynamics were observed 2-4 years frequent changes of NDVI.

Table 1. NDVI trend (value/23yrs)

| | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Khentii | -3.1 | -13.2 | -9.67 | -11 | -2.8 |
| Dornod | -2.5 | -7.65 | -16.9 | -15.6 | -8.5 |
| Sukh-baatar | -2.5 | -3.22 | -7.44 | -13.2 | -8.7 |

Over the time period the NDVI decreases occurred differently by zones and by time. Using NDVI difference method we have calculated the NDVI decrease within eastern 3 aimags as showing in Fig. 3. The light green color presents the NDVI increase and blended colors from yellow (1 year decrease) to red (9 years decrease) presented the how many years NDVI have been decreased within 1982-2001.

Fig. 3. NDVI decrease map of Eastern Steppe zone, June – September, 1982 – 2001

Over eastern aimags the NDVI values have been decreased differently during the growing season. For example, the percentage of NDVI decreased area more than 3 years covers from 15.8 to 29 and 1.3-7.9 per cent of which occurred frequently more than 7 years.

The NDVI data has been integrated with ground biomass measurement data over the region collected by ESBP group. The correlation between NDVI and pasture biomass data reached the value of $r=0.489$.

## 2. Land cover changes

Mongolia with its nomadic animal husbandry is one of the most dependent countries from nature and climate. The global warming and climate change problems are affecting to the land cover changes.

As mentioned the Eastern Steppe zone is a specific region by ecosystems and the climatic characteristics.

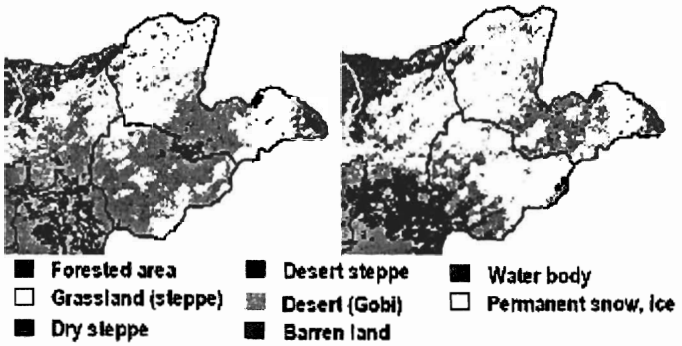


Fig. 4. Land cover type of Eastern Steppe zone 1992 and 2002.

The results over Eastern Steppe zone did showed the similar figures of land cover types. In general assessment of land cover type changes used NOAA satellite data for more precise assessment of land cover changes used Landsat TM data of 1989 and 2002 (1989-09-24 and 2002-07-26).

Surely we did sufficient land cover classification using mixed approach of supervised and unsupervised classification methods based on all scenes and NDVI of Landsat. But the used data

of different periods could make results difficult in order to compare the changes.

In Fig. 5 showed the Landsat TM data and classification results over the study area. The classification results can be illustrated not only pastureland changes, but also the some forest cutting and burnt areas.

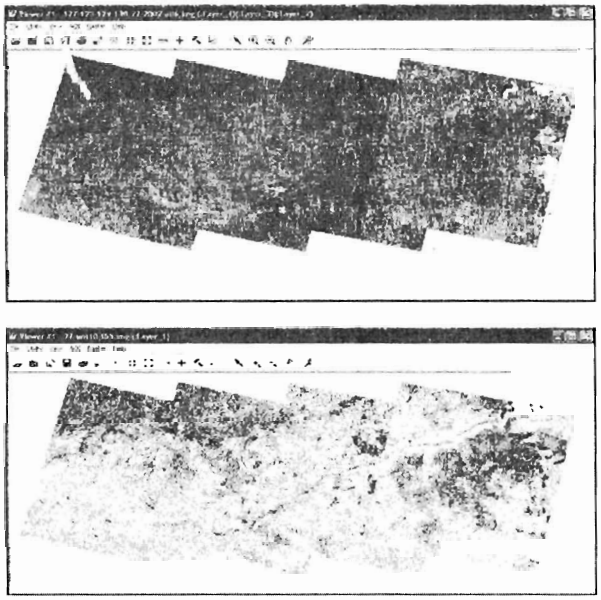

Fig. 5. Landsat TM scenes and classification results

## Conclusions

Within the Eastern Steppe zone pastureland vegetation cover changed spatially and temporally different. The land degradation could be caused by both of climatic and the human induced factors. For further land cover change detection needed some more suitable data of Landsat TM for comparison of results.

## References

Ariungerel D., Narantuya N., Some results of monitoring research of Eastern steppe of Mongolia. Contribution of Biological studies to the improvement of rangeland management in the steppe of Mongolia (2002, 2003). A conference for researchers. Ulaanbaatar.

David E. Heffernan., A report on an assessment of the protected areas of the Eastern Steppe of Mongolia (2005). Ulaanbaatar, Mongolia.

Erdenetuya M., Pastureland monitoring of Eastern Steppe of Mongolia using satellite data (2002, 2003). A report of ESBP project. UNDP/ ESBP, Ulaanbaatar, Mongolia.

Erdenetuya M., Remote sensing methodology and technology for pasture monitoring of Mongolia (2004). Dissertation. Ulaanbaatar, Mongolia.

Khudulmur S., Erdenetuya M., Bayasgalan M., Odbayar M., *Land cover change analysis of Mongolia* (2005) Proceedings of Mongolian Geoscientists II, Ulaanbaatar, Mongolia.

Munkhtuya Sh., Land cover classification methodology using remote sensing and GIS (2004). Dissertation. Ulaanbaatar, Mongolia.

Narantuya N., The present state of Eastern typical steppe. Report of project on Grassland health and it's trends (2003). UNDP. Ulaanbaatar.. 102p.

Narantuya N., Biology-ecologycal assessment of natural hay-pastureland of Mongolia (2000). Press of Mongolian Academy of Sciences. No. 1.