

# Mapping Armenian Deforestation

Research based on the  
Geographical Information Systems (GIS) and  
Remote Sensing technologies

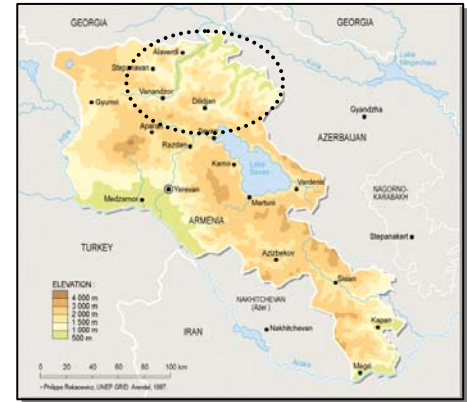


*Yerevan,  
June 1, 2006*

By Armen Asryan

The motivation for the research has originated due to understanding of the critical state of the Armenian forests coupled with the opportunity to apply the available expertise in remote sensing technologies. According to the information provided by the Armenia Tree Project, around 25% of Armenia was covered with forests at the turn of the 20th century. Today's estimates indicate that only 8% of the tree coverage is left. According to the World Bank, 80% of Armenia is at risk of becoming a desert and with the current trends of deforestation, there will be no forests left by 2050. The application of remote sensing for environmental studies is not a new phenomenon. Satellite imagery has been extensively used for forest inventory and assessments for national and sub-national level decision making, policy formulation and monitoring purposes. Since the launch of Landsat programme by NASA, the imagery derived from Landsat sensors have been extensively used for identification of deforestation around the world. The availability of the Landsat imagery archive for over 30 years presents a unique opportunity for the application of remote sensing and image classification for not only forest mapping, but also identification and tracing deforestation on a temporal and spatial scale.

Fig. 1: Republic of Armenia



Source: UNEP, GRID Arendal, 2004

Vegetation and, therefore, trees strongly reflect solar radiation in near- and mid-infrared bands of the electromagnetic spectrum. These two spectral bands, along with the visible spectrum (red-blue-green) bands are available in the Landsat imagery and allow accurate mapping of land cover.

The research seeks to identify the extent of deforestation in the north-eastern regions (Fig.1) of Armenia and serve the Armenian public agencies, non-governmental and international organisations as an unbiased visualisation of the problem for formation of policies and programmes. In addition, the findings of this research are planned to be used as environmental education and public awareness tools by the above mentioned stakeholders. The objectives of the research include the acquisition, processing of satellite imagery and land cover classification for the period of 1980s-2000. The research makes use of modern remote sensing and image classification technologies to reveal and visualise the land cover changes between the specified periods of time.

### Pilot study

The pilot data analysis for the purposes of forest cover change detection was run for the surrounding areas of Vanadzor city. Two satellite images (Landsat TM/1989 and Landsat ETM+/2000) were processed and analyzed. The results indicate that a significant change in land cover occurred between the 1989 and the 2000. In particular, the analysis revealed the reduction of vegetative cover in the study area. The data analysis was then followed by fieldwork to verify the results on the ground. Trips were organized to the study area for gathering observational data as well as taking photographs of the affected areas for subsequent verification with the forest cover classification of satellite imagery. The research produced a forest cover map of the study area for the years 1989 and 2000 (see illustrations below).

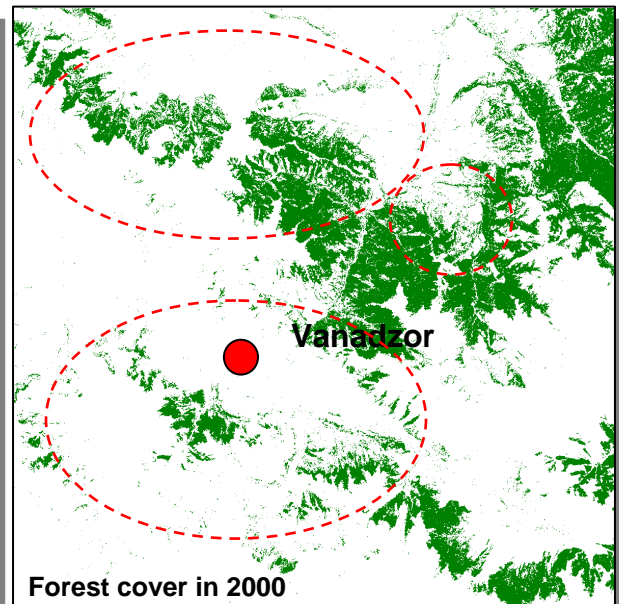
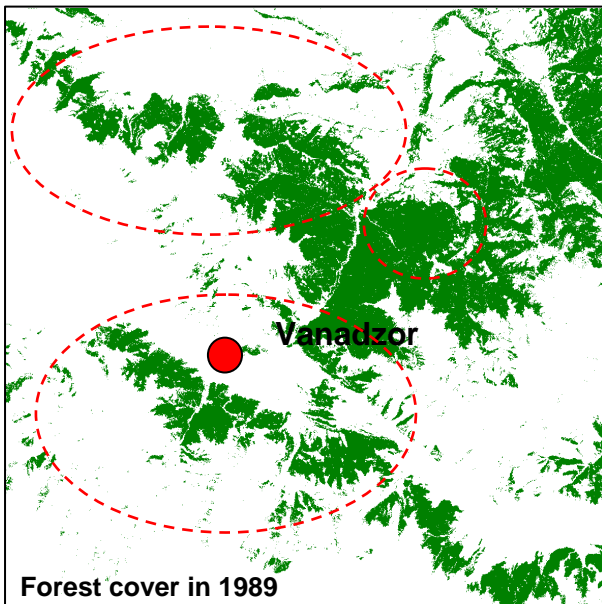
## Preliminary results

The surrounding area of Vanadzor city as seen on the Landsat satellite imagery taken from 1989 and 2000. The first row shows the original satellite imagery, with forest areas in dark green colour. The second row shows the forest cover classification results, where the green colour represents the forest areas.

**Forests around Vanadzor city in 1989**

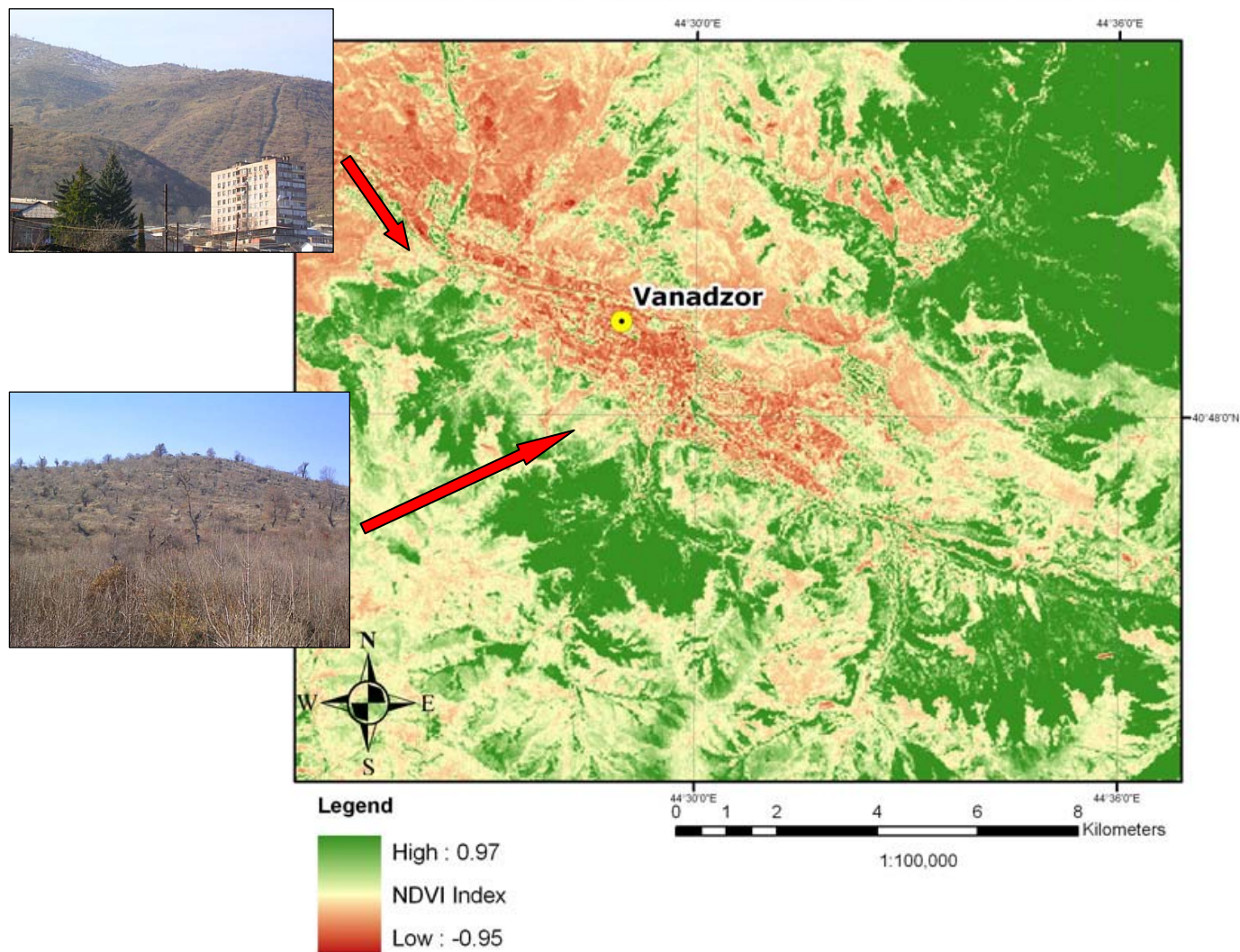


**Forests around Vanadzor city in 2000**



The analysis of the data indicates a change in forest cover in the study area from **~25%** in 1989 to **~19%** in the year 2000.

## Normalized Difference Vegetation Index (NDVI) using Landsat 2000 imagery



The *Normalized Difference Vegetative Index* (NDVI) has been in use for many years to measure and monitor plant growth, vegetation cover from multispectral satellite data. The NDVI is calculated as a ratio between measured reflectivity in the red and near infrared portions of the electromagnetic spectrum. These two spectral bands are chosen because they are most affected by the absorption of chlorophyll in leafy green vegetation and by the density of green vegetation on the surface. Also, in red and near-infrared bands, the contrast between vegetation and soil is at a maximum.

Index values can range from -1.0 to 1.0. Higher index values are associated with higher levels of healthy vegetation cover, and vice versa, non-vegetation cover (for example soils, rocks) produces negative values.

The photographs (taken in October 2005) on the left of the NDVI map show the deforested hill slopes south to Vanadzor city. They confirm both the results of the land cover classification (page 2) and the calculation of NDVI index (above). (For NDVI index for a larger area in north-eastern Armenia, see Appendix 1)

## Contacts

We would highly appreciate your feedback and opinion, so please, drop us a message at [info@greensat.am](mailto:info@greensat.am)

## Acknowledgements

We would like to thank our research partners: Armenia Tree Project NGO, Kingston University London, Broncway llc as well as the Rufford Maurice Laing Foundation (UK), which kindly provided financial support for this research project. Also, we would like to thank the Environmental Conservation Research Center of the American University of Armenia and the Armenian Forests NGO for ongoing advice and guidance.

## Data Sources

*Landsat imagery:* Source for this dataset was the Global Land Cover Facility, <http://www.landcover.org>

*Vector maps of Armenia:* Source for these datasets was the Environmental Conservation Research Center (ECRC) of AUA, <http://www.ecrc.am>

## Appendix 1

### Normalized Difference Vegetation Index (NDVI) using Landsat 2000 imagery

