

## Development of a remote sensing derived tool to assess the impact of conservation policy measures and drought for East African ecosystems – The ENDELEO project

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### Introduction

Drought in East Africa is a natural recurrent phenomenon that occurs approximately every seven years. However, the intensity and the scale of the impacts of the droughts have increased during the last decades. Overexploitation and degradation of natural ecosystems results in an increased vulnerability to drought. Natural ecosystems that have been overexploited and degraded over the last decades include rangelands and forests. A number of drivers are leading to the degradation of these ecosystems. Those drivers might include changes in policies, population dynamics, climate and market forces. However, there is a lack of scientific evidence to establish the linkage between the degree and extent of degradation and the drivers.

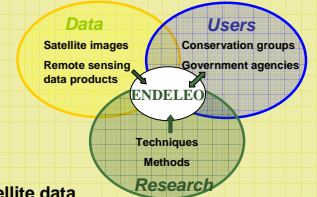
In view of the importance of the services provided by natural ecosystems to key sectors, such as energy, tourism, and agriculture, there is an increasing interest from a large number of stakeholders to actively participate in natural ecosystems management and conservation. Access to updated information on the state of these ecosystems and the efficiency of conservation policy is a prerequisite to ensure effective participative management processes.



Degraded (left) versus protected (right) rangelands

### Objectives

- 1) Enhancing the understanding of management issues in drought vulnerable areas: rangelands and forests
- 2) Providing stakeholders with remote sensing based information tools to foster better environmental governance.



### Methods

#### Change analysis based on remote sensing satellite data

- Low resolution data (AVHRR, SPOT-VEGETATION, MODIS) will be used to detect seasonal and interannual variations in vegetation patterns as well as long term vegetation trends over large areas.
- High resolution data (Landsat, ASTER) will be used to determine and localize changes in specific areas.

#### Interpretation of observed changes

Ancillary data such as climate data, data on policy changes, and demographic data will be used to determine the drivers of the observed changes.

#### Development of remote sensing monitoring tool

Based on the recommendations of the workshop a remote sensing based information tool will be developed.

### The Endeleo stakeholder workshop July 2nd – July 3rd 2007, Nanyuki, Kenya

A workshop was organized in Kenya with representatives of several research institutes, conservation groups, and government agencies. The objective of the workshop was to identify ecosystem changes and their drivers, geographical areas and topics of interest, and information needs and formats.

#### Participants of the ENDELEO stakeholder workshop

From left to right: Mr. Rudolf Makhau, Mr. Esau Omollo, Dr. Henry Cheruiyot, Ms. Juliet King, co-worker of Dr. Boniface Kiteme, Mr. Festus Ihwagi, Prof. Dr. Robert De Wulf, Dr. Chris Field, Ir. Else Swinnen, Dr. Sam Chemua, Mr. Francis Chabari, Dr. George Njiru Kragu, Mr. Christian Lambrechts, Ir. Toon Westra, Mr. Frank Msafiri, Mr. Michael Gachanja, Mr. Mark Mutinda. Not on picture: Dr. Boniface Kiteme, Mr. Geoffrey Chege, Mr. Katelo Shakhe, Mr. Patrick Wargute



### Conclusions from the workgroup discussions

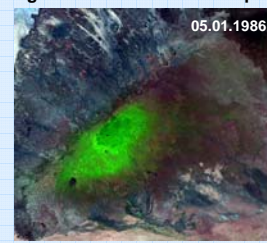
	Rangelands	Forests
<b>Management problems</b>	Overstocking of livestock Land degradation around water sources Human/wildlife conflicts Insecurity causing suboptimal rangeland use Competition between dryland farming and pastoralism	Human encroachments and settlements Tree felling for timber, charcoal and firewood Livestock encroachment for grazing and water Lack of clearly demarcated boundaries
<b>Geographical areas of interest (Kenya)</b>	Riverine Turkana district Mist mountains: Huluhulu hills, Mt. Kulal, Mt Marsabit Samburu and Buffalo Springs, Shaba National Reserves + surroundings Lake Baringo: area of long term degradation Lewa Wildlife Conservancy	Drylands mist forests: Marsabit, Huri Hills, Mount Kulal Drylands forests: Matthew Ranges, Ndotos, Nyiro, Ngare Ndare Montane rain forests: Mount Kenya and the adjacent Imenti forests
<b>Observed ecosystem changes</b>	Decline in wildlife populations Changes in vegetation quality and quantity Loss of woody vegetation Decline in cloud cover and rainfall Increased impact of droughts on livestock	Change in forest composition Falling water level Mount Marsabit: 100 hectares of forest loss every year between 1973 and 2005 Ngare Ndare: regeneration of forest
<b>Drivers of changes</b>	Natural: increased frequency of droughts, floods, and fires; outbreaks of diseases affecting livestock and wildlife Anthropogenic: human population increase, increased sedentarisation, land use changes, overutilization of rangeland by livestock, increased poverty, lack of education	Increased human population leading to increased settlements, farming, and forest resources exploitation Low awareness of the need for conservation (ecosystem values) Lack of policy implementation
<b>Expectations from remote sensing/ topics of interest</b>	Early warning of drought and onset and intensity of rains Relationship between livestock population numbers and mobility, and available vegetation biomass Structure, composition, quality, quantity, and palatability of vegetation Impact of trampling by livestock near boreholes Settlement patterns and increased sedentarisation.	Link between socio-economic data and forest cover change. Changes in forest structure and species. Trends in forest land cover classes. Fire risk.

#### Guidelines for monitoring system

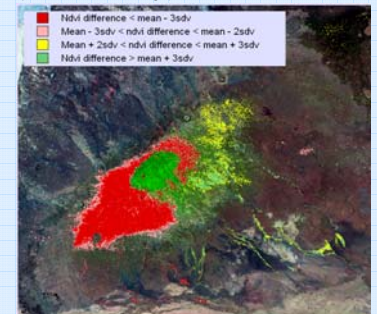
Different levels of products should be supplied, ranging from raw data to processed data, reports and hard copies. The data should be in a simple format, so that land managers should be able to interpret the data. Sustainability of the system is an important requirement.

### Examples of RS derived information products

#### High resolution information products



The Normalized Difference Vegetation Index (NDVI) is related to the amount of green vegetation. Subtracting NDVI images from two dates gives an indication of relative increase and decrease of vegetation. The average NDVI difference gives the overall vegetation trend (due to for example interannual rainfall differences). Lower/ higher differences in NDVI are indications of a relative decrease/ increase of the amount of green vegetation (due to for example land cover change)



Landsat color composite images of 1986 and 2000 of Marsabit Mountain and its surroundings (B=band3; G=band4; R=band5)

Reclassified NDVI difference image (NDVI 21.02.2000 – NDVI 05.01.1986) overlaid on 2000 Landsat color composite image

#### Low resolution information products