USE OF GEOSPATIAL TECHNOLOGY IN MONITORING AND ASSESSMENT OF DESERTIFICATION
CASE STUDY: TAITA TAVETA COUNTY

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PRESENTATION

OVERVIEW

TOPICS
- REMOTE SENSING
- CHANGE DETECTION
- DESERTIFICATION

FORMAT
- INTRODUCTION
- METHODOLOGY
- RESULTS ANALYSIS
- CONCLUSIONS
- RECOMMENDATIONS
The concept of sustainable development that constitutes the focus of environmental policy making implies that environmental problem cannot be tackled without taking into account the broader development framework into which they fall. While this is true for most environmental issues, desertification is even more closely associated with development process in so far as it impacts on peoples livelihoods more directly than other environmental problems.

- The loss of productive land is of major concern in the world.
- Food production in Kenya today is a major national challenge where we have witnessed famine and drought throughout the country.
- This has resulted from factors such as; climate change, deforestation, changes in land use patterns and human activities that pollutes or degrade the quality of soils and land utility negatively affecting food production livelihoods which eventually leads to desertification.
The ever increasing competition for land, and the environmental pressure being placed on this most fundamental scarce resource, call for new approach to its governance.

There is a need to provide information at the correct spatial and temporal resolution, level of detail and in a format suited to the user’s needs which is critical for both sustainable land management and policy formulation.

Past failure to meet these requirements has severely hindered progress in implementing the UNCCD and has handicapped stakeholders at all levels.

In effect most user’s requires the same type of information though the spatial resolution, timeliness, data collection methods and analysis procedure change from local to global scale.

The Government of Kenya through UNDP has been providing information about the state of desertification but users still luck the correct format information.
WHY REMOTE SENSING?

This project seeks to encourage more acceptance of Remote Sensing by demonstrating its unmatched capability in monitoring & assessing Desertification.

Merits: Panoptic Coverage, better visibility of features, repetitive monitoring and timely change detection data.
Villagers ‘burn forests to bring rain’

Residents of Taita Taveta have been asked to stop burning forests in the belief that it would
The main objective of this project is to monitor and assess desertification using remote sensing techniques.
SPECIFIC OBJECTIVES

- To determine the land use land cover classification of the three epoch Landsat images of Taita Taveta County.
- To provide the NDVI maps, compare mean annual rainfall data with annual sum NDVI graphically and determine the trend in Rain-Use Efficiency.
- To determine the trend, nature, rate location and magnitude of desertification.
- To identify hot spots (areas under conversion to desert like condition) using visual interpretation.
Taita Taveta County is one of the seven counties in the Coast Province. It is situated at latitude between $2^\circ46^i$ and $4^\circ10^i$ N and a longitude between $37^\circ36^i$ E and $39^\circ14^i$ E. It borders Kwale County to the southeast, Kilifi to the east, Makueni, Kitui and Tana River districts to the north, Kajiado to the northwest and the Republic of Tanzania to the west/south-west.

The district covers an area of 16965

Taita Taveta is on of the ASAL County with 89% of the district area characterized by semi-arid and arid conditions, with Only 2.5% of the county (located) in the highlands) can be classified as high potential area.

Major land use includes agriculture, ranching, wildlife conservation, forest and tourism.
METHODOLOGY

TOOLS USED

HARDWARE

* A laptop and HP LaserJet color printer

SOFTWARE

* **ArcGIS 10.1** - This was used to compliment the display and processing of the data
* **Idrisi Kilimanjaro** - This was used for the development of land use land cover classes and subsequently for change detection analysis of the study area.
* **Global Mapper 10.1** - used for Georeferencing of image and subsequently subset of the study area.
* Excel - was used in producing the bar graph.
* Microsoft word - was used basically for the presentation of the research.
* Quantum GIS
### DATASETS TABLE

<table>
<thead>
<tr>
<th>Data</th>
<th>Sensor</th>
<th>Data source</th>
<th>Spatial resolution</th>
<th>Temporal resolution</th>
<th>Time series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landsat imagery</td>
<td>ETM+</td>
<td>RCMRD (Regional Centre For Mapping Of Resources For Development (RCMRD))</td>
<td>30m</td>
<td>periodic</td>
<td>2004,2009 and 2014</td>
</tr>
<tr>
<td>NDVI data series</td>
<td>Spot vegetation</td>
<td>Endeleo website <a href="http://endeleo.vgt.vito.be">http://endeleo.vgt.vito.be</a></td>
<td>1km</td>
<td>decal</td>
<td>2004-2014</td>
</tr>
</tbody>
</table>
OTHER DATA INCLUDE:

- Rainfall data for the year 2004-2014
- Taita Taveta county shape files extracted from Kenya shape files.
- Land cover land use shape files.
STEP BY STEP OPERATIONS

Landsat images → Image pre-processing → Image processing (Supervised classification) → NDVI maps → Analysis (Post classification analysis, Animation and Statistical analysis)

NDVI data → NDVI maps → NDVI Trend → Relationship between NDVI and Rainfall (RUE)

Rain Fall data → Rainfall Trend
Mapped image
NDVI MAPS

NDVI Vegetation Index using 2004sep234b2 and 2004sep234b3

NDVI Vegetation Index using 2009sep234bb2 and 2009sep234bb3
NDVI Vegetation Index using 2014sepb345b2 and 2014sepb345b3
Mapped NDVI

NDVI Vegetation Index using 2004sep234b2 and 2004sep234b3

NDVI Vegetation Index using 2009sep234bb2 and 2009sep234bb3

-0.13 +
-0.13 -0.08
-0.07 -0.02
-0.01 - 0.03
0.04 - 0.09
0.10 +

-0.29 +
-0.29 - -0.19
-0.18 - -0.08
-0.07 - 0.03
0.04 - 0.14
0.15 +
<table>
<thead>
<tr>
<th>Land use/land cover</th>
<th>2004</th>
<th>2009</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area (Km²)</td>
<td>% coverage</td>
<td>% change</td>
</tr>
<tr>
<td></td>
<td>12.852</td>
<td>0.082</td>
<td>0.00</td>
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<tr>
<td>Water Bodies</td>
<td>619.785</td>
<td>3.95</td>
<td>0.00</td>
</tr>
<tr>
<td>Dense Vegetation</td>
<td>361.077</td>
<td>2.30</td>
<td>0.00</td>
</tr>
<tr>
<td>Forest</td>
<td>8999.647</td>
<td>57.36</td>
<td>0.00</td>
</tr>
<tr>
<td>Barren Land</td>
<td>5695.448</td>
<td>36.30</td>
<td>0.00</td>
</tr>
<tr>
<td>Shrubs</td>
<td>15688.8</td>
<td>100.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Total area</td>
<td>15688.8</td>
<td>100.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>
### NDVI Changes

<table>
<thead>
<tr>
<th>Year</th>
<th>Area covered by vegetation (Km²)</th>
<th>Percentage area coverage (%)</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>569.455</td>
<td>3.357</td>
<td>0.00</td>
</tr>
<tr>
<td>2009</td>
<td>1664.183</td>
<td>9.81</td>
<td>6.453</td>
</tr>
<tr>
<td>2014</td>
<td>412.42</td>
<td>2.431</td>
<td>-7.379</td>
</tr>
</tbody>
</table>
The total area of study was computed and obtained as 15688.8 Km²

- Agriculture activities were decreased from 3.95% to 1.76% for the period of 10 years.
- Water bodies covered only 0.082 per cent of the study area land in 2004 and decreased to 0.069 per cent in 2009 but increased to 0.15 per cent in 2014.
- Barren land covered 57.36 % of the total area; this decreased to 36.66 per cent in 2009 but increased to 61.84% in 2014.
- Shrubs/less dense vegetation decreased from 36.30% to 29.9% in a period of 10 years.
Percentage area coverage of land use/cover

- Water bodies
- Dense vegetation
- Forest
- Barren land
- Shrubs

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<th>2004</th>
<th>2009</th>
<th>2014</th>
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<tr>
<td>Water bodies</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Integrated annual NDVI

$y = 0.1248x - 246.35$

$R^2 = 0.2818$
Annual Rainfall Trend

Annual rainfall

\[ y = 22.706x - 45138 \]

\[ R^2 = 0.5321 \]
Trend in Rain-use efficiency.

$$y = -0.0001x + 0.2717$$  
$$R^2 = 0.0278$$
Hot spot and bright spot
Hot sport and bright spot.
Hot spot area in 2014
Contributors

Climatic factors
- limited water supply
- Variation in rainfall with longer dry spell.

Human factors
- Charcoal Production
- Poor Irrigation Practices
- Overgrazing/ Ranching
- Deforestation
Repeated coverage of satellite imageries provides an efficient tool for monitoring desertification for a region like Taita Taveta County.

The results obtained from the study reveals that the Landsat, rainfall and NDVI data can successfully monitor and identify areas under the several process of desertification response to climate change and anthropogenic activities over a long period of time.

The study revealed different signs of desertification and land degradation in the study area as judged by change in patterns of land use and land cover types, these changes indicated: increase of barren land and decrease of vegetation cover inside the study area.
Recommendation.

Based on the findings of the study, the following recommendations are suggested:

* Periodic monitoring of severity and extent of land degradation is needed.
* New policies and practices of agricultural extension should be adapted to alert farmers to the threat posed by land degradation.
* Some measures are needed to retard land desertification in the study area.

In order to make full use of multi-temporal satellite imageries the following points should be taken care of:

* Imagery of high ground resolution is necessary to achieve accurate monitoring of desertification and further analysis of the Hot spot areas.
* Areas under desertification should be studied more closely by either use of ground techniques or images of higher resolution to obtain more detailed information on the nature of land desertification so as to determine proper rehabilitation measures.
Challenges

- Existence of Cloud cover on Landsat images.
- Slow process of cropping and loading images.
THANK YOU