Supporting Elephant Conservation in Sri Lanka through MODIS imagery

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Introduction
Sri Lanka, an island country with a rich biodiversity and with about 20 million people.

Its environment has historically supported a big elephant population.

However, since last 150 years, environment has dramatically changed due to:
- expansion of informal settlements due to population increase,
- national development projects,
- government planned settlement programs, and
- land encroachments.

Presentation Flow
- Introduction
- Forest Cover of Sri Lanka. Where is Remains?
- The Human-Elephant Conflict
- The Use of Satellite Data Applicability Of MODIS
- Vegetation Monitoring and Elephant Conservation Analysis of NDVI
- Linking image interpretation with Elephant Conservation
- Conclusions and Future Study Steps

Introduction
The population increase in rural districts is critically affecting forest cover as well as the elephants and other wildlife.
Any major recent change in forest cover?

Forest cover is remaining without a major change. But, according to the government estimations, forest cover within National Parks and forest sanctuaries are gradually decreasing.

The Human-Elephant Conflict (HEC)

Sri Lanka has about 5,787 elephants, about 10% of the total number in Asia.

**Elephant density**
- India: 0.0008
- Thailand: 0.006
- Sri Lanka: 0.088

When this large number of elephants struggle for food, especially in dry seasons, human-elephant conflict becomes a critical issue for villagers as well as elephants.

The Human-Elephant Conflict

Number of reasons can be identified as causes to ignite of HEC.

- A. Proximity of village-forest-elephant habitat
- B. Changes in long-term rainfall pattern
- C. Dryness in regions of elephant habitat
- D. Increased human and other development activities closer to forests
- E. Behavioral changes of wild elephants

In this study, we have focused on first three facts due to the main objective of the study, "the application of satellite images".

A. The Proximity of Village-Forest-Elephant Habitat

This is the most important and unavoidable fact in an small island country with a big human and elephant population.

- An electric fence stands between villages and roaming wild elephants

B. Changes in Long-term Rainfall Pattern

- The negative trend in long-term rainfall changes have identified by number of researchers.
- They have found moderate to remarkable negative change in long-term rainfall pattern in some districts in Sri Lanka.
- Five dry-zone districts have identified under this negative trend, including Anuradhapura and Hambantota where HEC is serious.
C. Dryness in Regions of Elephant Habitat

The relationship between dry weather and increase of elephant deaths has lengthily discussed in many studies.

Here, instead of direct monitoring of elephants, the greenness of the environment is considered to monitor elephant movements.

For the justification of use of MODIS, various satellite systems were compared.

<table>
<thead>
<tr>
<th>Satellite</th>
<th>Recurrent Swath</th>
<th>Spatial Resolution depending on the band</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landsat TM</td>
<td>16 days</td>
<td>160 km, 2.5 m to 60 m</td>
</tr>
<tr>
<td>SPOT 4-5</td>
<td>2-3 days</td>
<td>56km, 2.5 to 0.5m</td>
</tr>
<tr>
<td>ALOS</td>
<td>40 days</td>
<td>19km, 12 m</td>
</tr>
<tr>
<td>Terra/Aqua/MODIS</td>
<td>16days</td>
<td>2980km, 250 to 1600 m</td>
</tr>
</tbody>
</table>

MODIS system

The MODIS sensors onboard Terra and AQUA satellites are successfully covering the complete earth surface every 1-2 days.

The MODIS Mission

Terra passes north to south across the equator in the morning, Aqua passes south to north across the equator in the afternoon.

The sensor capabilities

- **Orbit**: 705 km, 10:30 a.m. descending node (Terra) or 1:30 p.m. ascending node (Aqua), sun-synchronous, near-polar, circular
- **Swath Dimensions**: 2330 km (cross track) by 10 km (along track at nadir)
- **Spatial Resolution**:
  - 250 m (bands 1-2)
  - 500 m (bands 3-7)
  - 1000 m (bands 8-36)
- **Design Life**: 6 years

Vegetation Monitoring & Elephant Conservation

**NDVI Analysis**

The study area includes Udawalawa National Park, a popular spot for wild elephant viewing.

HECs are severe in this region, and only second to north-central Sri Lanka’s incidents.

Three NDVI data sets (maps) were produced with 9 greenery classes.
### NDVI Analysis

Over 0.4 NDVI can be counted as high in green and is dominating in January 31st and March 28th images. The July 28th image is falling into dry season and central part of the region has turned into NDVI value less than 0.4.

![Graph showing NDVI values](image)

1. **High Rainfall & NDVI:**
   - Increase possible elephant movements into villages

### Conclusions

- This study discussed about the forest cover of Sri Lanka, Human Elephant Conflict (HEC), and capability of identifying green area changes using MODIS data.
- Number of reasons (facts) for recent increase of HEC was identified.
- A link was established between those facts and NDVI maps produced from MODIS.
- The NDVI calculated for wet and dry weather showed changes in green area which can be used to identify possible corridors of elephant movements.

### Future Study Steps

- Production of NDVI maps for Elephant roaming regions under wet, semi-wet and dry climate conditions
- Integration with a GIS database (village locations, available water resources, weather data, and etc)
- Building hotspots of HEC
- Establishment of potential elephant corridors

### Thank You