Mapping flowering plants and landscape structure

Tobias Landmann\textsuperscript{1}, David Makori\textsuperscript{1}  
Macharia Kabiro\textsuperscript{1}, Sospeter Makau\textsuperscript{2}

\textsuperscript{1} Earth Observation Unit & \textsuperscript{2} Commercial Insects Group  
International Center of Insect Physiology and Ecology (icipe)  
Nairobi, KENYA, email: tlandmann@icipe.org
Landscape matrix, Bee health, ESS

Land use

ESS

Nutrition

Availability of melliperous plants

Bee Health

Bee keeping products (i.e. honey)

Human well being, pollination and Biodiversity
• How much natural (or relatively unmanaged) forage is needed for honey and pollination services?

• **Land use** patterns have changed
  – less forage material available for bee colonies

• **GIS/GPS** _vital_ for mapping diseases
Deforestation and changes in LU

2002-2009, Kenya
Landscape (LS) indicators & variables

- LS **Phenology**: Abundance and distribution & of flowering plants
- LS **Structure**: Cropland vs. natural mosaic “adjacency”
- LS **Dynamics**: Deforestation, *expansion* of croplands
Solution?

- Derive and implement **integrative** geospatial approaches – by i.e. linking different data sets

  - how?
  - what sites?
  - what exactly?
  - scales?
  - needs?
## Integrative, multi data, scale solution

<table>
<thead>
<tr>
<th>Products</th>
<th>Site specific</th>
<th>Regional</th>
<th>Utility</th>
<th>Where</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floral cycle, abundance</td>
<td></td>
<td></td>
<td>Apiary managers, farmers, AU IBAR, researchers</td>
<td>Mwingi (Ke), kakamega (Ke.), Tolay (Et); sites in Madagascar &amp; Burkina F.</td>
</tr>
<tr>
<td>LS structure</td>
<td></td>
<td></td>
<td>Apiary managers, farmers, AU IBAR, researchers</td>
<td>Mwingi (Ke), kakamega (Ke.), Tolay (Et); sites in Madagascar &amp; Burkina F.</td>
</tr>
<tr>
<td>Deforestation and land productivity</td>
<td>✔️</td>
<td>✔️</td>
<td>Apiary managers, farmers, researchers</td>
<td>Eastern &amp; western Africa</td>
</tr>
<tr>
<td>LU/LC dynamics</td>
<td></td>
<td></td>
<td>Apiary managers, farmers, researchers</td>
<td>kakamega (Ke.), Tolay (Et); sites in Madagascar &amp; Burkina F.</td>
</tr>
<tr>
<td>GIS mapping of disease infections</td>
<td>✔️</td>
<td></td>
<td>Apiary managers, farmers, researchers</td>
<td>All local sites</td>
</tr>
<tr>
<td>Bee diversity modelling</td>
<td></td>
<td></td>
<td>Apiary managers, farmers, researchers</td>
<td>Eastern &amp; western Africa</td>
</tr>
</tbody>
</table>
Floral cycle & abundance at key sites in Africa

Air- and space-borne imaging & *in situ*

Interpretation & algorithm

“Green” tree

Flowering intensity

Bare soil
Floral cycle & abundance at key sites - crowdsourcing

Farmers and Apiary managers supply geo-tagged photos

Systematic collection of photos, data entries

Data interpretation & use
1. Cross verification, assimilation (RS)
2. Spatial & temporal distribution maps
Floral cycle & abundance at key sites - spectral profiling and hemispherical photos
Deforestation (2000-2012) over key project sites: Kakamega, Ke

Forest loss ☹
Forest gain ☀
Both 🤔
Deforestation (2000-2012) over key project sites: Mt. Kenya
Deforestation (2000-2012) over key project sites: Madagascar
Reg. indicators – veg. productivity
Comparing veg. productivity & deforestation data

- Vegetation productivity loss
- Forest loss
- Forest gain
Products have their limitations, i.e.

- **Deforestation** over Africa – only forest sites
- **Vegetation productivity** loss, includes deforestation but also degradation and LC transformation

- **Floral cycle & abundance**, LS structure and LU/LC change site specific
  - Up-scaling will be investigated
Open questions

- Which **sampling design** for floral monitoring using smartphones/apps, etc?
- How to best link landscape matrix to **Bee Health indicators**, *i.e.* honey flow, pollen quality, quantity?
- How can **quantification of pollination effects** been done?
- **Utility** for working & research agenda?
Thank you for your attention!

EO Unit in icipe, member of GEO