Ecosystem services assessment in complex agricultural landscapes using farmers’ perception

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Actual challenge of agricultures... Trying to ‘square the circle’...
A multidisciplinary question ...

Ecology
  Landscape ecology
  Socio-ecology ...

Economy
  Socio-economy ...

Agronomy
  Forestry
  Livestock ...

Conservation

Ecosystem services

Production

?
Ecological intensification...

3 aspects:

- **Intensification**
  - Specialized low diversity model
    - (Geertz, 1963)

- **Diversification**
  - Increase biodiversity
    - What
    - How
      - Conservation Agriculture
        - Agroecology ...
          - (field boundaries, livestock ...)
          - (Cassman, 1999, Matson et al, 1997; Altieri, 2002 ...)

- **Expansion**
  - Spare expansion of agriculture into natural ecosystems and marginal land
  - Why
    - Reduce negative externalities of conventional intensive agriculture
Ecological intensification ...

**Intensification**

Highly diversified model / land pressure

- Ruthenberg, 1976; Conelly and Chaiken, 2000)

**Diversification**

- Biodiversity monitoring
- Management of ecosystem services
  - Economic levers
    - (Local species valorization, Quality/certification ...)

**Expansion**

- Saturation of available space for agriculture

**Why**

- Improve local sustainability
  - (soil fertility, well-being...)
- Control the expansion of agriculture at the expense of natural ecosystems
Research questions of the unit ...

Determinants of landscape organization?

Ecosystem Services required and provided?

Complex mosaic of ecosystems and biota, how do they interact?

... 

Does a biodiverse landscape provide resilience and risk mitigation?
Research questions / PhD ...

Determinants of landscape organization?

Ecosystem Services required and provided?

Complex mosaic of ecosystems and biota, how do they interact?

**Pest regulation:** *Sesamia calamistis (Noctuidae)*

*Sorghum, Maize & Sugar cane stem borer*

Does a biodiverse landscape provide resilience and risk mitigation?
Methodology ...

**Assumption**  Local actors shape the landscape (Baudry, 2000) ... and observe it

**Hypothesis**  
Variability in landscape heterogeneity  
⇒ variation in services provision (time & space)  
⇒ in actors relative perception

**Approach**  
Use of local knowledge network to access to biophysical knowledge  
Inspired from Chambers (1994) + fauna observatory network (LPO etc.)
Study site

The Nyanza province, Kenya

High potential of production
1200 - 2000 mm / year, 2 rainy seasons
Altitude 1100 – 1600 m
600 hab/km²
Variability of Landscapes

<table>
<thead>
<tr>
<th>Ethnic: Indian, Luo, Luhya</th>
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<tbody>
<tr>
<td>Land use</td>
</tr>
<tr>
<td>Topography ⇒ erosion, flooding</td>
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<tr>
<td>Soil types</td>
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<thead>
<tr>
<th>Farming systems</th>
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<tbody>
<tr>
<td>Sugar cane</td>
<td>60 – 80</td>
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<tr>
<td>Sugar cane, diary and vegetable</td>
<td>10 – 20</td>
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<tr>
<td>Fallow land</td>
<td></td>
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<tr>
<td>Food crop</td>
<td>0.2 – 0.25</td>
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<tr>
<td>Food crop and vegetable</td>
<td>0.4 – 0.8</td>
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<tr>
<td>Food crop, vegetable and sugar cane</td>
<td>0.8 – 1.6</td>
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<tr>
<td>Food crop</td>
<td>0.2 – 0.6</td>
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<tr>
<td>Food crop and rice</td>
<td>1.2 – 2.0</td>
</tr>
<tr>
<td>Sugar cane</td>
<td>0.6 – 1.2</td>
</tr>
<tr>
<td>Food crop</td>
<td>1.0 – 2.0</td>
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<tr>
<td>Food crop and sugar cane (contract)</td>
<td>1.0 – 2.0</td>
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<tr>
<td>Rice et sugar cane</td>
<td>1.2 – 2.0</td>
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<tr>
<td>Food crop and vegetable</td>
<td>0.6 – 1.0</td>
</tr>
<tr>
<td>Sugar cane, Food crop and vegetable</td>
<td>2.0 – 4.0</td>
</tr>
</tbody>
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Intra unit variability

Spot

11 contiguous farms

Number of parcels vs. farm area

Cumulated hedge length vs. farm area
Hedges types

- Scattered: Tree or bush
- Dense: Tree rows
- Impenetrable: Multi-stratum
Spatial organization

Spatial organization

Transmission rules ...

The case of the Luo population

Legend
- Homestead garden
- Field
- Euphorbia hedge
- Farm limit
- Final housing
- Son hut
- Animal enclosure

Step 1

Step 2

Step 3

Landscape round with farmer ...

Symbolic delimitation

Windbreak, fruit,...

Strategies diversion / fence

Hedge

Euphorbia

Guava

Napier

sisal

Hedge function loss
⇒ fruit, firewood

Diservice vs. neighbors
⇒ impact land-use
Conclusion

Landscape organization at the farm level

Hierarchy: Social > Economic > technical determinants

- Production: food and fuelwood
- Regulation: water flows (slope) and climate

Services in regard to pest control and regulation

From farm to landscape level

⇒ mobilization of knowledge network
  Illustration: sharing vs. exploring different situations (wage employment)
⇒ Experimental design: landscape variability vs. knowledge network

Resilience?

Landscape organization = result of adaptation
⇒ Time to be considered in observation
Thank you for your attention