Intensity analysis of land cover change in Extremadura (Spain): focusing on recent changes of agrosilvopastoral systems

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Introduction

- Silvo-pastoral systems, as dehesas and montados, cover large surfaces of SW Iberian Peninsula.
- However, during the last decades, these landscapes undergo contrasted processes of abandonment and intensification, consequence of land use and management changes.
Introduction

- Previous studies at **farm scale** (intensification vs. abandonment):
  - Tree loss
  - Shrubs encroachment
  - Bare soil

- What is happening at **larger scales**?
  - **Analysis of land cover change**
  - Land use and cover change modelling (next step)
**Material and methods: CORINE**

- **CORINE Land Cover:**
  - 1990
  - 2000
  - 2006

<table>
<thead>
<tr>
<th>Reclassification</th>
<th>CORINE classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silvo-pastoral</td>
<td>2.4.4. Agro-forestry areas. Annual crops or grazing land under the wooded cover of forestry species.</td>
</tr>
<tr>
<td>Sclerophyllous vegetation</td>
<td>3.2.3. Sclerophyllous vegetation.</td>
</tr>
<tr>
<td>Burnt</td>
<td>3.3.4. Burnt areas.</td>
</tr>
<tr>
<td>Pastures</td>
<td>2.3.1. Pastures. 3.2.1. Natural grassland.</td>
</tr>
<tr>
<td>Transitional shrubs</td>
<td>3.2.2. Moors and heathland. 3.2.4. Transitional woodland/shrub.</td>
</tr>
<tr>
<td>Forest</td>
<td>3.1.1. Broad-leaved forest. 3.1.2. Coniferous forest. 3.1.3. Mixed forest.</td>
</tr>
<tr>
<td>Agricultural</td>
<td>2. Agricultural areas (except 2.4.4. Agro-forestry areas)</td>
</tr>
<tr>
<td>Others</td>
<td>1. Artificial surfaces. 3.3.2. Bare rock Scree, cliffs, rocks and outcrops. 3.3.3. Sparsely vegetated areas. 4. Wetlands. 5. Water bodies.</td>
</tr>
</tbody>
</table>
Material and methods

We analyzed land cover changes with **two different perspectives:**

- **Direct analysis** of the transitions to and from silvo-pastoral areas.
- **Intensity Analysis** - Quantitative method that analyzes maps of land categories from several points in time. It examines the degree to which changes are **non-uniform** at three levels:
  - **Interval**: between periods (**slow** vs. **fast**)
  - **Category**: between categories in each period (**active** vs. **dormant** gainers or lossers)
  - **Transition**: transitions between one category and another (**avoids** vs. **targets** transition)
Material and methods: Intensity analysis

• Unified framework
• Useful to find the processes and causes of change.
• Computes the size and nature of **hypothesized errors** in the data that can explain non-uniform differences:
  - **Commission error**
  - **Omission error**
  - Larger hypothesized errors give stronger evidence against the uniform hypothesis.

[https://sites.google.com/site/intensityanalysis/](https://sites.google.com/site/intensityanalysis/)


Material and methods: DINAMICA EGO

http://csr.ufmg.br/dinamica/
http://csr.ufmg.br/dinamica/dokuwiki/doku.php?id=intensity_analysis
Results: Changes in Silvo-pastoral cover

<table>
<thead>
<tr>
<th>Change in Silvo-pastoral (1990-2006)</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistency</td>
<td>959228</td>
</tr>
<tr>
<td>Gain - intensification</td>
<td>3339</td>
</tr>
<tr>
<td>Gain - extensification</td>
<td>75444</td>
</tr>
<tr>
<td>Loss - abandonment</td>
<td>23586</td>
</tr>
<tr>
<td>Loss - intensification</td>
<td>20225</td>
</tr>
</tbody>
</table>

Change in Silvo-pastoral cover from 1990 to 2006, showing areas of persistency, gains and losses.
Results: flowchart

• Transitions from silvo-pastoral to transicional shrubs and vice versa were the dominant processes.
Results: Intensity analysis

Global budget

1990-2000

2000-2006

Interval level

- Agrosilvopastoral
- Sclerophyllous
- Burnt
- Pastures
- Transitional shrub
- Forest
- Agricultural
- Others

Area (ha)

- 0
- 500000
- 1000000
- 1500000

- Gain
- Persistency
- Loss

- 2000-2006
- 1990-2000

Annual Change % of_intervals_domain
Intensity Analysis: Category level GAIN

1990-2000

- Agrosilvopastoral
- Sclerophyllous
- Burnt
- Pastures
- Transitional shrub
- Forest
- Agricultural
- Others

Change intensity (% of category extent)

2000-2006

- Agrosilvopastoral
- Sclerophyllous
- Burnt
- Pastures
- Transitional shrub
- Forest
- Agricultural
- Others

Change intensity (% of category extent)

Intensity Analysis:

- Category level
- GAIN
- Observed uniform change
- Omission error
- Commission error

Observed change

Uniform change

Change size (% of areal extent)

Change size (% of areal extent)

Size change (% of areal extent)

Size change (% of areal extent)
Intensity Analysis: Category level LOSS

### 1990-2000

#### Change intensity (% of category extent)

- Agrosilvopastoral
- Sclerophyllous
- Burnt
- Pastures
- Transitional shrub
- Forest
- Agricultural
- Others

#### Size change (% of areal extent)

- Agrosilvopastoral
- Sclerophyllous
- Burnt
- Pastures
- Transitional shrub
- Forest
- Agricultural
- Others

### 2000-2006

#### Change intensity (% of category extent)

- Agrosilvopastoral
- Sclerophyllous
- Burnt
- Pastures
- Transitional shrub
- Forest
- Agricultural
- Others

#### Size change (% of areal extent)

- Agrosilvopastoral
- Sclerophyllous
- Burnt
- Pastures
- Transitional shrub
- Forest
- Agricultural
- Others

Legend:
- **Observed change**
- **Uniform change**
Intensity Analysis: Transition level GAIN

1990-2000

Transition intensity
(% of losing category at initial time)

To agrosilvopastoral from

Sclerophyllous
Burnt
Pastures
Transitional shrub
Forest
Agricultural
Others

2000-2006

Transition intensity
(% of losing category at initial time)

To agrosilvopastoral from

Sclerophyllous
Burnt
Pastures
Transitional shrub
Forest
Agricultural
Others

Transition size
(% of losing category at initial time)

To Agrosilvopastoral from

Sclerophyllous
Burnt
Pastures
Transitional shrub
Forest
Agricultural
Others

Legend:
- Observed change
- Uniform change

Transition size
(% of losing category at initial time)
Integrity Analysis: Transition level LOSS

**1990-2000**

- **Sclerophyllous**
- **Burnt**
- **Pastures**
- **Transitional shrub**
- **Forest**
- **Agricultural**
- **Others**

Transition intensity (% of gaining category at final time)

**2000-2006**

- **Sclerophyllous**
- **Burnt**
- **Pastures**
- **Transitional shrub**
- **Forest**
- **Agricultural**
- **Others**

Transition intensity (% of gaining category at final time)

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**Transition size (% of areal extent)**

- **Sclerophyllous**
- **Burnt**
- **Pastures**
- **Transitional shrub**
- **Forest**
- **Agricultural**
- **Others**

**Transition size (% of areal extent at the)**

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**Legend**

- Observed change
- **Avoids**
- **Targets**
- Uniform change
- Observed uniform change
- Omission error
- Commission error
Conclusions

• Silvo-pastoral systems *increased their area* between 1990 and 2006.

• However, silvo-pastoral systems were a *dormant gainer and loser* category in comparison with other ones.

• Lost from silvo-pastoral systems:
  
  o **In the 90s**: abandonment (becoming shrublands).
  
  o **Between 200-2006**: abandonment (becoming shrublands and forests) and *intensification* (conversion to grasslands). Also, conversion to *burned areas*. 
Conclusions

• Describing land cover changes with simple statistics and flowcharts is useful to understand these processes.

• The Intensity analysis simplify this, as it unifies different measurement of the changes, taking clase size and period length into account.
Obrigada pela sua atenção!

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