Remote Sensing For Crop Area Estimation: An Overview

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Remote Sensing Approaches to Crop Area Estimation

- Stratification for sampling
  - Efficient, cost effective
- Pixel counting
  - Speed
  - Requires knowledge and devises
- Regression and calibration estimators
  - Efficient, cost effective
  - Require knowledge and devises
Relative efficiency of the use of remote sensing data at the estimator level, in 2000 (area frame with segments) and in 2002 (point frame)

\[
Re \ l.Ef = \frac{Var (\hat{Y}_{ground})}{Var (\hat{Y}_{regr})}
\]

- Relative efficiencies for 2005 and 2006 higher than the ones obtained with points in 2002
- But lower than the ones obtained in 2000 with segments

<table>
<thead>
<tr>
<th></th>
<th>Area</th>
<th>Point</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2000</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durum wheat</td>
<td>2.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Soft wheat</td>
<td>2.6</td>
<td>1.2</td>
</tr>
<tr>
<td>Barley</td>
<td>1.7</td>
<td>1.0</td>
</tr>
<tr>
<td>Colza</td>
<td>1.4</td>
<td>0.9</td>
</tr>
<tr>
<td>Maize</td>
<td>6.0</td>
<td>1.1</td>
</tr>
<tr>
<td>Sunflower</td>
<td>2.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Soy been</td>
<td>8.6</td>
<td>1.2</td>
</tr>
<tr>
<td>Sugar beet</td>
<td>7.6</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Remote sensing will be economical if its cost is smaller than the cost of additional segments:

\[(n_1 - n) p > R\]

Where:
- \(n\) is the original sample size,
- \(n_1\) is the sample size that allows the ground survey estimate to reach the same precision of the regression estimate
- \(p\) is the unitary variable cost (cost of ground survey, digitisation and quality control),
- \(R\) is the cost of the remote sensing part of the project (image acquisition and processing).

Remote sensing is cost-effective if the relative efficiencies are higher than:

\[1 + \frac{R}{np}\]
High Resolution Imagery

- **As Ground Truth**
  - As aid in collecting, or as a replacement
  - If replacing:
    - Photo Interpretation necessary
    - May be biased, wrong
  - In Area Frame
  - In Regression

- **Entire Area Coverage**
  - Limited area available
  - Disaster, crop disease
Timing analysis

- Stratification for sampling
  - probably a year in advance
  - usable for a long time
- Pixel counting
  - quick but probably biased
  - not repeatable
- Regression and calibration estimators
  - Require independent set of ground data
  - Usually takes longer to obtain estimates
Ground Data

• Administrative Data
  – Field level signup
  – Dynamic

• National Land Cover Database
  – 5-10 yr cycle
  – Non-agric, forests, roads, cities....

• June Area Segments
  – Statistical – stratified sample
Timing example US

- **May**
  - Winter wheat preliminary
  - Pixel counting, time series of pixel estimates
- **June**
  - Winter wheat preliminary
  - Regression
- **August**
  - Winter wheat final
  - Row crops
  - Regression
- **October**
  - Row crops final
  - Regression