Large-scale Yield Mapping Using Moderate to High-Resolution Satellite Imagery

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3 elements for ultra-low cost, accurate crop monitoring

• Satellite Data
  – NASA/ESA missions
  – Big private satellites
  – Micro and nano-satellites
3 elements for ultra-low cost, accurate crop monitoring

• Satellite Data

• Computation (e.g., Google Earth Engine)
  – Power
  – Easy access to imagery
3 elements for ultra-low cost, accurate crop monitoring

• Satellite Data

• Computation (e.g., Google Earth Engine)

• Robust Algorithms
Translating satellite data into yields

- Training data are difficult and costly to obtain

Jain et al. 2013
Use crop models to simulate realistic yields on the ground

Simulations span multiple:

- Sites
- Years
- Sow dates
- Sow densities
- Soil moisture
- Cultivar choice
- N rate

Lobell et al. 2015
2) Convert simulated outputs to “observables”
3) Define regressions that link observables to yield

\[ \hat{\text{Yield}} = \beta_0 + \beta_1 \times \text{VI} \]

Where VI is vector of a VI on specified dates* and \( \beta \)'s are parameters of linear regression.
3) Define regressions that link observables to yield

\[ \hat{Yield} = \beta_0 + \beta_1 \ast VI \]

Where VI is vector of a VI on specified dates* and \( \beta \)'s are parameters of linear regression.

* dates will vary by pixel, depending on image availability
4) Apply on a per-pixel basis in Earth Engine
Two projects mapping wheat yields in the IGP of India

• Landsat to map mean wheat yield from 2000 to 2015 (30 m) across the IGP

• Skysat and Planet data to map field-level wheat yields (2-5 m) from 2014-15 to 2016-17 in Bihar, India
Translating satellite data into yields

- Resolution of readily-available imagery may be too coarse relative to the size of smallholder fields
Jain et al. in prep
Effect of Spreader Technology

Jain et al. in prep
Thanks!

- CSISA-CIMMYT Field Team