INTEGRATING CENSUS DATA WITH HYPER-TEMPORAL NDVI DATA, TO PREPARE DETAILED CROP INTENSITY AND CROP GROWING PERIOD MAPS

Kees de Bie
Addis Abeba
October 2014
Any information on cropland sub-types/systems would be a great advance for many!! … *tired of legends with 36 forest types and just 1 class representing cropland*”

**Translated**: We must know: *what crop is grown where, when and how.*

Only then, proper “monitoring”, “yield estimation”, “planning”, etc. is possible.

---

**Thus: we have to improve maps and data that report:**

- Where *area agricultural fields*?
- Where *are which crops cultivated*?
- What *are the practiced crop calendars*?
Introduction: Can hyper-temporal imagery make the difference?

Hyper-Temporal NDVI-data are “information-rich” and can be ‘imploded’ through “unsupervised” classification to reflect the dynamics and response of land cover, as influenced by soil/terrain/climate/weather/land use/…

SPOT-VGT:
NDVI (DN-values)
(May’98 – Dec’13; 36 images/year; downgraded resolution)

Greener
Introduction: Example on the use of hyper-temporal imagery

Needed for:

- Anomaly studies
- Crop performance
- Land use change
- Biodiversity
- Degradation
- Water management
- Land management
- Yield gap studies

Source: Tabular Annual Agricultural Statistics (MoA: ha of maize per district)

Product: Mapped Agricultural Statistics through the use of hyper-temporal imagery (Modis)

Explained variability ($R^2$) is 72%
Typically, also in Ethiopia, all official crop statistics are displayed by administrative areas.
Ethiopia Maps that do report where fields are ...
Is there anything better???

No: just more confusion and no link to WHEN WHAT is grown!!

Global Cropland comparison between FAO - IIASA

© Steffen Fritz (IIASA)
MoA (1998): 18 major agro-ecological zones of Ethiopia based on length of growing period [rainfall, evapotranspiration, soil moisture] and thermal zones [temperature and elevation].
MoA (2005): classified the 18 zones into 32 major zones based on temperature, moisture and elevation conditions of an area.


Note: they reflect supplying conditions!!
(gradients are divided in parts)

Future?


Based on Feedback, ATA considers producing a 2nd version of prepared crop calendars that incorporate more granular timings based on:
- More detailed agro-ecology classification
- Regional variation
The Moist Zone is fragmented areas across Ethiopia.

It covers areas with 1 or 2 cropping seasons, that each have highly varying start and end dates.

ATA concluded wisely that mapping in more detail is required.
My advise: do not map supply but observed responses!!

Classifying 15 years of Hyper-Temporal SPOT-NDVI imagery provided

“Crop Production System” zones

(like before, gradients are divided in parts)

60 Crop Production System (CPS) zones (of areas above 800 masl)

Classes are based on long duration NDVI-behavior and reflect response of vegetation to:

- Climate, Weather, Soil, Terrain, Elevation [length growing season, temperature, moisture]

AND

- Land use [direct/indirect human impacts like: practiced crop calendars]
A small selection of CLS-zones to illustrate the presence of GRADIENTS.
Comparing *supply* based versus *response* based maps

The 7 largest CPS-zones in the *Moist* Agro-Ecology Zone

Resolution: 1 km²

Scale: 1:1.000.000
Describing the CPS-zones

The 50% percentile line (median value of all readings for that 10-day period, i.e., for all pixels allocated to that class and all 15-year repeats [1999-2013])

The 25% percentile line

The 5% percentile line

The CPS-Zone generally suffers from high variability in greenness at that time (start of season issue)

The ‘Greenness’ value below which we do not expect any cropping (= 100 / assumed value)

The estimate of the crop-growing period (not the full growing-season), based on ‘when’ the dotted line crosses the 50% percentile line (simplified to 10-day periods). Periods less than 50d are removed.

34% Cereals 210d <10% F.

TWBMS: 8-16-10-0-0

Long-duration Normal Actual Annual

NDVI-Profiles of the 7 largest CPS-zones in the Moist Agro-Ecology Zone.
The 3 large CPS-zones in the Moist Agro-Ecology Zone

→ clear differences in the length of the growing season

**Note**: Classes capture parts of GRADIENTS. Variability within zones is minimized and between zones maximized.
Assuming that CPS-zones are correlated with the crop statistics, we can (through regression) allocate those statistics to zones. 30 CPS-zones (out of 60) have cereals. Explained variability ($R^2$) is 75%.
Prepared Cropping Intensity map of all 5 Cereals (areas above 800masl; 1km² pixels)

- Teff: 0-16%
- Wheat: 0-16%
- Barley: 0-12%
- Maize: 0-12%
- Sorghum: 0-9%
- 5 Cereals: 0-39%

Explained variability ($R^2$) is 60-75%
Conclusions

**Where are agricultural fields?**

Requires detailed interpretation of high resolution imagery: ongoing

**Where are which crops cultivated?**

Use imagery that reflect ‘response’ in space and time, and re-use existing CSA-statistics

**And what are the practiced crop calendars?**

Re-use existing primary data and/or use crowd-sourcing techniques to capture data plus the XY of the location

**Area Frame Analysis: CSA, EU, FAO**

- **GOAL:** To improve the quality and reliability and timeliness of agricultural statistics.
- **Output:** Detailed (5m!) and accurate land cover information to contributes at improving analysis result.
- **METHODOLOGY:** To produce a land cover database to improve the Area Frame statistical analysis, but also to provide a standardized, multi-purpose product.

**USE THE ‘FIELDS’ MAP AS MASK TO ALLOCATE CROP STATS TO CPS-ZONES**

- Anomaly studies
- Crop performance
- Land use change
- Biodiversity
- Degradation
- Water management
- Land management
- Yield gap studies

**USE ‘NDVI-PROFILES’ AS GUIDE**
THANK YOU