Not your usual SPAM but the Spatial Production Allocation Model

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Spatial Production Allocation Model
- SPAM -

1. What is SPAM
2. Why SPAM
3. The SPAM process - visualization
4. Crop list and statistical data coverage
5. SPAM on the Web and sample results
6. Equations behind SPAM (dig deep)
7. Challenges, Issues & Validation
8. Users
1. What is SPAM

Drawing on a variety of inputs

- SPAM uses an entropy-based, data-fusion approach to
- “plausibly” assess cropping system distribution and performance at a
  - “meso-gridded” scale: 5-minutes globally
  - 30-seconds at country level (if data is available)
- with results centered around the year 2005
1. What is SPAM

Major input layers for SPAM:

- Proportion of production systems (irrigated, rainfed H/L/S)
- Crop prices
- Rural population density
- Cropland extent
- Irrigation map
- Crop suitability
- Existing crop distribution maps/information
2. Why SPAM

- Account for *spatial heterogeneity* of agricultural production to better inform policies, interventions, sustainability issues, ...
- Reveal *spatial patterns* of agricultural practices to maybe see untapped opportunities for intensification, diversification, infrastructure improvement, ...
- Take advantage of increasingly available information and lower cost software and processing power to explore *spatial dimensions of agriculture*
- *Satellite imagery* generally available for cropland overall, roads, transport, but *not crop specific* (at least in most developing countries)

.... continue
2. Why SPAM

- SPAM provides a *baseline* for
  - investment decisions in agriculture;
  - agricultural policies;
  - scenarios of new technologies and climate change;
- SPAM delivers parameters for *segmentation*;
- *Link* between macro and micro models;
- Food Security is of interest to donors, practitioners, policymakers – need knowledge of *where* to target interventions in sub-national/sub-regional areas;
- Agricultural Statistics are generally available, but resolution is mostly *too coarse* for detailed planning.
3. The SPAM process

42 crops simultaneously

other data: production systems, ... (crop)
3. Visualization of Downscaling

example: Ghana harvested area rice per region

![Map of Ghana with rice harvested areas]
3. Visualization of Downscaling ... continued

result 1: Northern Region – allocated irrigated area rice

some more data
3. Visualization of Downscaling ... continued
result 4: Northern Region – allocated subsistence area: 41998 (ha)
some more data
3. Visualization of Downscaling ... continued

result 2: Northern Region – allocated rainfed high area rice

41998 (ha)
3. Visualization of Downscaling

result 5: Northern Region – allocated rice area total (irrigated+ rainfed H + L+ subsistence)

41998 (ha)
4. SPAM2005 Crop List and ...

<table>
<thead>
<tr>
<th>Cereals</th>
<th>Pulses</th>
<th>Sugar C.</th>
<th>Fibres</th>
<th>Stimulants</th>
<th>Oil Crops</th>
<th>Fruits &amp; Veg.</th>
<th>Others</th>
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</tbody>
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4. and ... Statistical Area Coverage – subnational 1
4. and ... Statistical Area Coverage – subnational 2
5. SPAM on the Web ...

Home of the Spatial Production Allocation Model

Much more than a palindrome, MapSPAM shares results from the Spatial Production Allocation Model by HarvestChoice. This site is a platform where users can access SPAM data and contribute feedback to its development. Feel free to comment, and thank you for your visit.

Maize Total Harvested Area (ha)

Spatially disaggregated production statistics of circa 2005 using the Spatial Production Allocation Model (SPAM). Values are for 5 arc-minute grid cells.

5. ... Sample results ... continued

Crop Distribution – Maize 2005

Area Harvested (ha)

MAIZ

- Red: 10 - 350
- Orange: 351 - 1000
- Yellow: 1001 - 2100
- Green: 2101 - 4500
- Light Green: > 4500

[Map of crop distribution with color-coded areas representing different harvest levels.]
5. ... Sample results

Crop Distribution – Vegetables 2005
6. Equations behind SPAM

Minimize difference between prior and allocated area share for all pixels, crops and production systems in a cross entropy equation

subject to constraints (limits) dictated by existing

- crop area statistics
- cropland area
- irrigated area
- suitable area

and solve in GAMS (General Algebraic Modeling System)

But first calculate the priors for each pixel, crop and production system as a function of potential revenue, irrigated area and agricultural land,

where potential revenue is a function of percentage of crop area, crop price, rural population density and potential yield.
7. Challenges & …

- Different sources -> ‘contradictory’ information
- Raster data not at same scale and similar time period
- Complete sub-national data, at least level 1, better level 2
- Conform national crops -> FAO/SPAM crops
- Consistencies between layers – constraints met
  
cropland >= stats, irr >= crop_irr, suit_land >= cropland >= stats
- Cropping intensities & production systems shares not consistent with data and model
- Produce more recent results (SPAM2010 in the making, SPAM2014?)
7. ... Issues & ...

- Unreliable, often carelessly processed/validated statistics
- Statistics do not match admin. area shape files
- Unreliable cropland extent/area intensity estimates
- Lack of data on cropping patterns and *systems* (e.g. cropping intensity – converting harvested to physical land footprint)
- Unsatisfactory data on location-specific biophysical conditions (e.g., soils) and economic behaviour (e.g., prices and risks)
- Lack of established validation data, methods, and protocols
- Unspecified reliability of results
- Consistency of approach has potential tradeoff with reliability (e.g. patchwork of best national data vs consistent regional data)

.... continue
Lack of established validation data, methods, and protocols ...

• Validation process by other CGIAR centers (e.g. IRRI, CIAT, ILRI, CIP, CYMMT). Each focuses on their mandate crops;

• Crop map view ‘parties’ attended by local experts and agronomists;

• Crowd-sourcing on a dedicated website (MapSPAM.info).
8. Users and Applications

- CGIAR centers such as IRRI, CYMMTT, CIP, CIAT, ILRI;
- FAO, World Bank, and universities;
- HarvestChoice, Agricultural Water Management, AgFutures; The Sustainability Consortium;
- Geoglam (USDA/U. Maryland), USAID FtF;
- Widely applied in country strategy work within IFPRI, regional priority settings such as ASARECA, CORAF, and in ReSAKSS, CAADP, AGRA.
11. Projects and Publications

- AGRODEP Library (http://www.agrodep.org/fr/node/1794)
- In East African Agriculture and Climate Change (https://books.google.com/books?id=cWB0AgAAQBAJ)
- Centre for Climate Change Economics and Policy (http://www.lse.ac.uk/CATS/Publications/Publications%20PDFs/Working-Paper-JoshE2013.pdf)
- Toward Climate-Resilient Development in Nigeria (https://books.google.com/books?id=8jpSSB7n1X4C)
- ESRI (http://www.arcgis.com/home/item.html?id=db028cfc90a342d7b2f16ac7a9ad779b)
- GEOGLAM (http://www.earthobservations.org/documents/geoglam/GEOGLAM_Implementation_Plan.pdf)
- GEOSHARE (http://www.ilsi.org/ResearchFoundation/CIMSANS/Pages/GEOSHARE-Workshop.aspx)
- FARMD Forum for Agricultural Risk Management in Development (https://www.agriskmanagementforum.org/content/additional-resources-geospatial-data-agriculture-risk-management)
- Irrigation Potential of African Infrastructure (http://www.infrastructureafrica.org/sectors/irrigation)
- USAID Feed the Future Innovation Lab for Small-scale Irrigation (http://borlaug.tamu.edu/projects-by-region/sub-saharan-africa/feed-the-future-innovation-lab-for-small-scale-irrigation)
- USAID Feed the Future Innovation Lab for Sustainable Intensification (http://gfc.ucdavis.edu/profiles)

Thank you!