United States Department of Agriculture
National Agricultural Statistics Service

Crop Land Data Layer & Acreage Estimates

Presented by Audra Zakzeski
United States Department of Agriculture  
National Agricultural Statistics Service

Provide timely, accurate, and useful statistics in service to U.S. agriculture

A sample of surveys and programs:

<table>
<thead>
<tr>
<th>Census of Agriculture</th>
<th><strong>Crop Acreage</strong></th>
<th>Agricultural Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crops / Stocks</td>
<td>Crop Progress &amp; Condition</td>
<td>Farm Labor</td>
</tr>
<tr>
<td>June Area Survey</td>
<td>Agricultural Resource Management (ARMS)</td>
<td>Chemical Use</td>
</tr>
<tr>
<td>Cattle Inventory</td>
<td>Census of Horticulture</td>
<td>Bee &amp; Honey</td>
</tr>
</tbody>
</table>
What is a Crop Land Data Layer (CDL)?

A tool to identify agriculture type and location

Each pixel represents a type of crop or land cover

A sample:
2010 CDL Production Schedule

Acreage Report – Winter Wheat

Crop Production Report – Corn & Soybeans

Crop Production Report – CDL Cotton, Rice, & Peanuts

Small Grains Summary

Crop Production Report – All Crops
Inputs

Satellite Imagery - AWiFS & Landsat TM

Farm Service Agency – Common Land Unit

NLCD & Derivative products

NASS June Agriculture Survey
Software Suite

Ground Truth Preparation
• ESRI ArcMap

Image Preparation
• Leica Geosystems ERDAS Imagine 9.1

Image Classification
• See 5

Acreage Estimates
• SAS/IML Workshop
Satellite Images over time

May 18

June 21

July 15

Aug 27
Ground Truth – Land Cover

Agriculture Ground Truth
Provided by Farm Service Agency
Identifies known fields and crops

Divide known fields into 2 sets
½ used for training software
½ used for validating results

Non-Agriculture Ground Truth
USGS National Land Cover Dataset
Identifies urban infrastructure and non-agriculture land cover
Forest, grass, water, cities
Ancillary datasets help separate the agricultural landscape; determining agricultural potential.
16 Day MODIS NDVI composites are used to identify winter wheat fields or to fill in gaps where there is little satellite coverage.
Processing a CDL

Satellite Imagery
Ancillary Data
MODIS Data
Ground Truth

Sampling

See5

Decision Tree
Classification

2009 Washington Cropland Data Layer

Land Cover Categories (by decreasing acreage)

AGRICULTURE

Polebeans
Sunflowers
Soybeans

Milk

Ornamental Trees

Horticulture: Ornamentals, Fruits

Tree Nursery

Vegetables

Grains

Hay

Vegetables & Fruits

Grapes

Dry Beans

Lettuce

Beets

Broccoli

Lettuce

Onions/Cabbage/Vegetable Fruits

Hops

Strawberries

Collards

Other Small Grains

Oats

Shrubs

Urban/Detached

Wetlands

Barns

Perennial/Non-Wood

2009 Washington Cropland Data Layer
Validating CDLs

We measure the accuracy of each CDL

Compare

Classified pixels from CDL
Known pixels, not used for classifying imagery, from FSA

Track

Producer Accuracy & Errors of Omission - % of pixels from category missing
User Accuracy & Errors of Commission - % of pixels from category that are over classified

Cropland Data Layer

versus

Groundtruth – ½ saved for validation
### STATEWIDE AGRICULTURAL ACCURACY REPORT

#### Crop-specific covers only

<table>
<thead>
<tr>
<th>*Correct</th>
<th>Accuracy</th>
<th>Error</th>
<th>Kappa</th>
</tr>
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<tbody>
<tr>
<td>OVERALL ACCURACY**</td>
<td>645164</td>
<td>90.05%</td>
<td>9.95%</td>
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#### Cover Type

<table>
<thead>
<tr>
<th>Cover Type</th>
<th>Attribute Code</th>
<th>*Correct Pixels</th>
<th>Producer's Accuracy</th>
<th>Omission Error</th>
<th>Kappa</th>
<th>User's Accuracy</th>
<th>Commission Error</th>
<th>Cond'l Kappa</th>
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<tr>
<td>Corn</td>
<td>1</td>
<td>13258</td>
<td>84.61%</td>
<td>15.39%</td>
<td>0.8438</td>
<td>90.54%</td>
<td>9.46%</td>
<td>0.9039</td>
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<td>Sorghum</td>
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<td>0</td>
<td>0.00%</td>
<td>100.00%</td>
<td>0.0000</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
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<td>Soybeans</td>
<td>5</td>
<td>0</td>
<td>0.00%</td>
<td>100.00%</td>
<td>0.0000</td>
<td>0.0000</td>
<td>100.00%</td>
<td>0.0000</td>
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<tr>
<td>Sweet Corn</td>
<td>12</td>
<td>5671</td>
<td>74.53%</td>
<td>25.47%</td>
<td>0.7436</td>
<td>87.17%</td>
<td>12.83%</td>
<td>0.8707</td>
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<td>Mint</td>
<td>14</td>
<td>475</td>
<td>69.55%</td>
<td>30.45%</td>
<td>0.6953</td>
<td>81.76%</td>
<td>18.24%</td>
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<td>Barley</td>
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<td>3229</td>
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<td>0.5269</td>
<td>77.49%</td>
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<td>Spring Wheat</td>
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<td>58526</td>
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<td>15.00%</td>
<td>0.8393</td>
<td>87.80%</td>
<td>12.20%</td>
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<td>Winter Wheat</td>
<td>24</td>
<td>250405</td>
<td>95.94%</td>
<td>4.06%</td>
<td>0.9446</td>
<td>95.30%</td>
<td>4.70%</td>
<td>0.9361</td>
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<tr>
<td>Other Small Grains</td>
<td>25</td>
<td>85</td>
<td>9.00%</td>
<td>91.00%</td>
<td>0.0898</td>
<td>30.36%</td>
<td>69.64%</td>
<td>0.3029</td>
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<td>Rye</td>
<td>27</td>
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<tr>
<td>Oats</td>
<td>28</td>
<td>3</td>
<td>0.53%</td>
<td>99.47%</td>
<td>0.0052</td>
<td>6.25%</td>
<td>93.75%</td>
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<td>Speltz</td>
<td>30</td>
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<td>100.00%</td>
<td>0.0000</td>
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<td>n/a</td>
<td>n/a</td>
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<tr>
<td>Canola</td>
<td>31</td>
<td>269</td>
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<td>61.79%</td>
<td>0.3819</td>
<td>66.92%</td>
<td>33.08%</td>
<td>0.6689</td>
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<td>Safflower</td>
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<td>100.00%</td>
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<tr>
<td>Rape Seed</td>
<td>34</td>
<td>0</td>
<td>n/a</td>
<td>n/a</td>
<td>0.0000</td>
<td>100.00%</td>
<td>0.0000</td>
<td>0.0000</td>
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<tr>
<td>Mustard</td>
<td>35</td>
<td>494</td>
<td>61.83%</td>
<td>38.17%</td>
<td>0.6180</td>
<td>75.30%</td>
<td>24.70%</td>
<td>0.7529</td>
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<tr>
<td>Alfalfa</td>
<td>36</td>
<td>27815</td>
<td>85.17%</td>
<td>14.83%</td>
<td>0.8471</td>
<td>91.30%</td>
<td>8.70%</td>
<td>0.9100</td>
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<tr>
<td>Other Hays</td>
<td>37</td>
<td>8786</td>
<td>42.27%</td>
<td>57.73%</td>
<td>0.4165</td>
<td>83.41%</td>
<td>16.59%</td>
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<td>Camelina</td>
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<td>100.00%</td>
<td>0.0000</td>
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<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Sugarbeets</td>
<td>41</td>
<td>286</td>
<td>83.87%</td>
<td>16.13%</td>
<td>0.8387</td>
<td>99.65%</td>
<td>0.35%</td>
<td>0.9965</td>
</tr>
<tr>
<td>Dry Beans</td>
<td>42</td>
<td>4822</td>
<td>77.36%</td>
<td>22.64%</td>
<td>0.7722</td>
<td>77.05%</td>
<td>22.95%</td>
<td>0.7705</td>
</tr>
<tr>
<td>Potatoes</td>
<td>43</td>
<td>16223</td>
<td>90.74%</td>
<td>9.26%</td>
<td>0.9058</td>
<td>96.82%</td>
<td>3.18%</td>
<td>0.9676</td>
</tr>
<tr>
<td>Other Crops</td>
<td>44</td>
<td>9</td>
<td>4.35%</td>
<td>95.65%</td>
<td>0.0435</td>
<td>39.13%</td>
<td>60.87%</td>
<td>0.3912</td>
</tr>
<tr>
<td>Misc. Veggies. &amp; Fruits</td>
<td>47</td>
<td>513</td>
<td>38.69%</td>
<td>61.31%</td>
<td>0.3865</td>
<td>87.10%</td>
<td>12.90%</td>
<td>0.8708</td>
</tr>
<tr>
<td>Watermelon</td>
<td>48</td>
<td>0</td>
<td>0.00%</td>
<td>100.00%</td>
<td>0.0000</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Onions</td>
<td>49</td>
<td>2937</td>
<td>91.38%</td>
<td>8.62%</td>
<td>0.9135</td>
<td>95.08%</td>
<td>4.92%</td>
<td>0.9506</td>
</tr>
<tr>
<td>Lentils</td>
<td>52</td>
<td>4083</td>
<td>75.86%</td>
<td>24.14%</td>
<td>0.7574</td>
<td>80.41%</td>
<td>19.59%</td>
<td>0.8030</td>
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<tr>
<td>Peas</td>
<td>53</td>
<td>9554</td>
<td>76.09%</td>
<td>23.91%</td>
<td>0.7581</td>
<td>82.74%</td>
<td>17.26%</td>
<td>0.8252</td>
</tr>
</tbody>
</table>

*Correct Pixels represents the total number of independent validation pixels correctly identified in the error matrix.*
Regression-based Acreage Estimator

Acreage not just about counting pixels

The Goal: Identify areas with defined acreage totals to compare CDL pixel counts
Current Solution: June Agriculture Survey Segments

June Ag Segment
Farmers within segment report 220 acres of corn

Vs.

Crop Land Data Layer
Pixel Counting estimates 180 acres of corn
Regression-based Acreage Estimator

Acreage not just about counting pixels

Simple Linear Regression

Regression used to relate categorized pixel counts to the ground reference data

- \((X)\) – Cropland Data Layer (CDL) classified acres
- \((Y)\) – June Agricultural Survey (JAS) reported acres

Outlier segment detection - removal from regression analysis

Using regression results in estimates reduces error rates over using JAS alone
Crop acreage reported by Ag Statistics Board

JAS – Crop acreage estimated from June Ag Survey

Reg+ – Crop acreage estimated using CDL & Regression techniques

Pix – Number of pixels in CDL

CV – Coefficient of Variation

Things to note:

- Remote Sensing techniques (CDL & Regression) produce acreage estimates with smaller variability

- Pixel counting tends to underestimate crop acreage
Corn Planting Intensity
5 years vs. 9 years
Illinois

Years Planted to Corn

1 2 3 4 5

1999-2007

2003-2007
Thank You
Any Questions?

Hosted @ NRCS Geospatial Data Gateway & http://www.nass.usda.gov/research/Cropland/SARS1a.htm