Perception and Use of Remote Sensing Products for Monitoring Agriculture by Targeted End Users: Evidence from State Field Offices of the United States Department of Agriculture National Agricultural Statistics Service

Rick Mueller[1]
rick_mueller@nass.usda.gov

Jessica L. McCarty[2]
jmccarty@mtu.edu

Larry Beard[1]
larry_beard@nass.usda.gov

[1]Spatial Analysis Research Section, USDA/NASS/RDD
3251 Old Lee Highway, Room 305 ♦ Fairfax, VA 22030
(703) 877-8000 Phone

Project PI:
Matthew Hansen,
University of Maryland

Project Team:
David M. Johnson
Zhengwei Yang
USDA/NASS
Mark Carroll
Inbal Becker-Reshef
University of Maryland
Bernard Adusei
South Dakota
State University

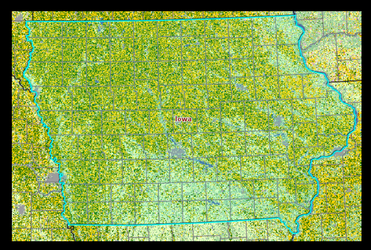
[2]Michigan Tech Research Institute (MTRI)
Michigan Technological University
3600 Green Court, Suite 100 ♦ Ann Arbor, MI 48105
(734) 913-6840 – Phone ♦ www.mtri.org

USDA NASS CropScape - U.S. Agriculture at a Glance - http://nassgeodata.gmu.edu/CropScape/

CropScape

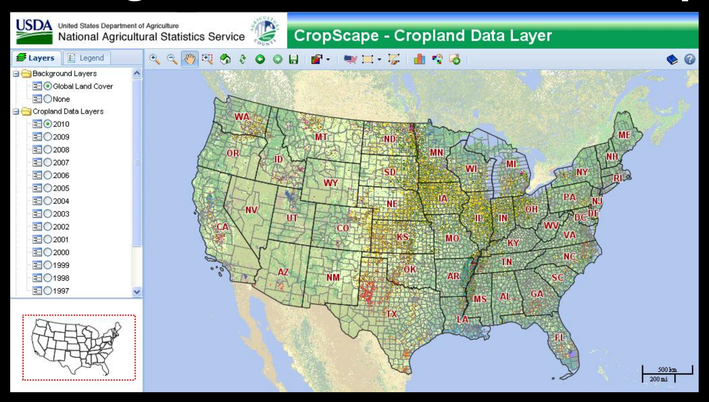
A web-based application that allows users with Internet access to display, analyze, & download crop specific categorized (CDL) imagery:

- Free
- Easy to use
- Multiple years are available
- No special software needed
- Integrated with Google Earth™



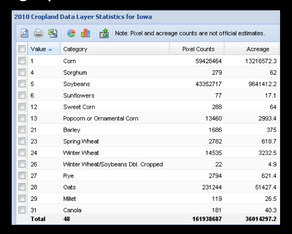
Area of Interest

CropScape makes it easy to select any state, county, agricultural statistics district, or user defined region for investigation. The selected area can be downloaded for use in GIS software apps such as ESRI's ArcGIS™, ENVI™ or ERDAS Imagine™

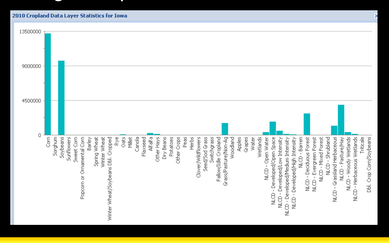


Agricultural Summaries

For an area of interest (e.g., Iowa) CropScape provides tabular & graphical summaries of land cover categories: pixel value, counts & area.



Value	Category	Pixel Counts	Acreage
1	Corn	59426464	13216572.3
4	Sorghum	279	62
5	Soybeans	43352717	9641412.2
6	Sunflowers	77	17.1
12	Sweet Corn	288	64
13	Popcorn or Ornamental Corn	13460	2993.4
21	Barley	1686	375
23	Spring Wheat	2782	618.7
24	Winter Wheat	14535	3232.6
26	Winter Wheat/Soybeans Dbl. Cropped	22	4.9
27	Rye	2794	621.4
28	Oats	231244	51427.4
29	Millet	119	26.5
31	Canola	181	40.3
Total	48	161938687	36014297.2



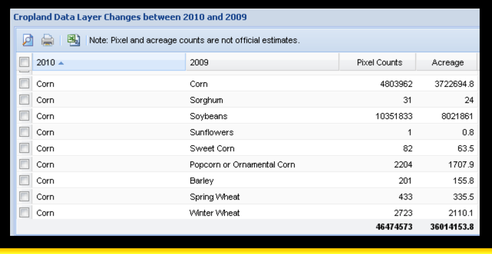
Cropland Data Layer

Using satellite imagery and farm data NASS annually produces the categorized land cover imagery, referred to as the Cropland Data Layer (CDL), depicting detailed information on crop types and locations.

Each pixel, measuring 30 or 56 sq. meters depending on the year, represents a land cover category such as corn, soybeans, wheat, rice, cotton, barley, potatoes, etc.

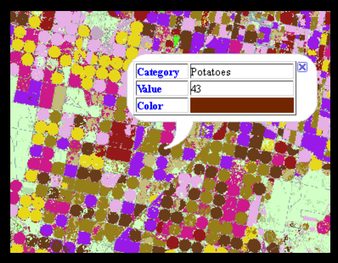
Change Analysis

CropScape can compare pixels across specified years. The results display as a table of pixel & acreage changes between two years of interest (e.g., Iowa corn - soybean rotation shown).



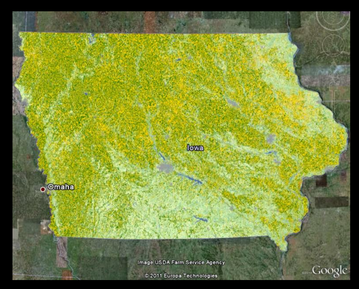
2010	2009	Pixel Counts	Acreage
Corn	Corn	4803962	3722694.8
Corn	Sorghum	31	24
Corn	Soybeans	10351833	8021861
Corn	Sunflowers	1	0.8
Corn	Sweet Corn	82	63.5
Corn	Popcorn or Ornamental Corn	2204	1707.9
Corn	Barley	201	155.8
Corn	Spring Wheat	433	335.5
Corn	Winter Wheat	2723	2110.1
		46474573	36014153.8

Close-up of circular pivot crop fields in Idaho. CropScape's query tool "Identify Crop at Pixel" identifies a potato field.



Google Earth™

CropScape can download the Cropland Data Layer directly into Google Earth for exploring the agricultural landscape.



CropScape provided by George Mason University Center for Spatial Information Science and Systems.

NASS Field Offices and CDL User Survey

NASS Field Offices

The role of the USDA NASS Field Office is to survey farm operators, ranchers, and agri-businesses to quantify the areal extent, animal count, and subsequent yield and expense of agricultural activities. Currently, a network of 46 field offices serves all 50 states and Puerto Rico through cooperative agreements with state departments of agriculture or universities. Statisticians within these Field Offices analyze the surveys with ground observations, objective yield measurements, and other data to produce state statistics ranging from crop-specific yields to farm prices and the Census of Agriculture. These statistics are reviewed at NASS headquarters and released to the public.

CDL User Survey

The CDL User Survey was designed by USDA NASS statistical and spatial analysts and academic researchers. The survey was sent to 19 NASS Field Offices in 2009 and 6 additional NASS Field Offices in 2010. Instructions with the survey asked that the Director and/or lead statistician complete the survey.

The CDL User Survey was a partial open-ended survey which contained categorical questions combined with several open-ended comment sections. A total of 27 questions were asked but due to multi-part questions and comments sections, survey respondents could have answered up to 42 questions. Survey respondents were not prompted with demographic questions related to education levels and/or official job titles but were asked which Field Office they represented. Respondents were guaranteed that answers would be kept confidential, therefore individual Field Offices are not identified by response.

Funded

Results

Perceived Strength in Spatial Accuracy but Unfamiliarity with Method

Of the 25 offices surveyed, the majority (87%) reported using the CDL remote sensing acreage indicators when setting state and/or county estimates. Currently, Field Offices rely on surveys and USDA administrative data that do not always record correct field geolocation.

Unfamiliarity with the remote sensing estimation process was of most concern to Field Offices, followed by the potential for classification error and/or cloud coverage in the satellite data resulting in inaccurate estimates (Figure 1).

Nearly 100% of the Field Offices agreed that the CDL produced accurate estimates of major commodities (corn, soybeans, wheat, rice, and cotton) while 65% of the Field Offices indicated that the CDL is not as accurate for less common crops that are regionally important like barley, sugarcane, alfalfa, or sorghum.

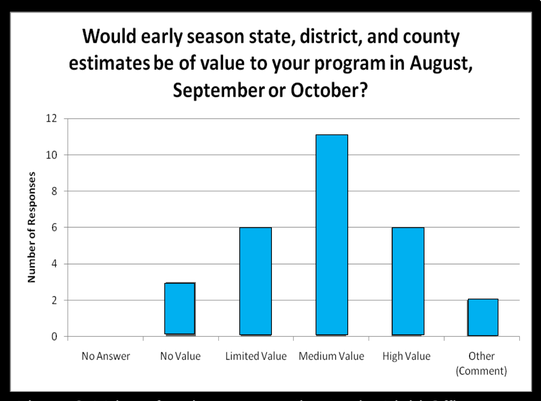


Figure 2. Value of early season estimates by Field Offices.

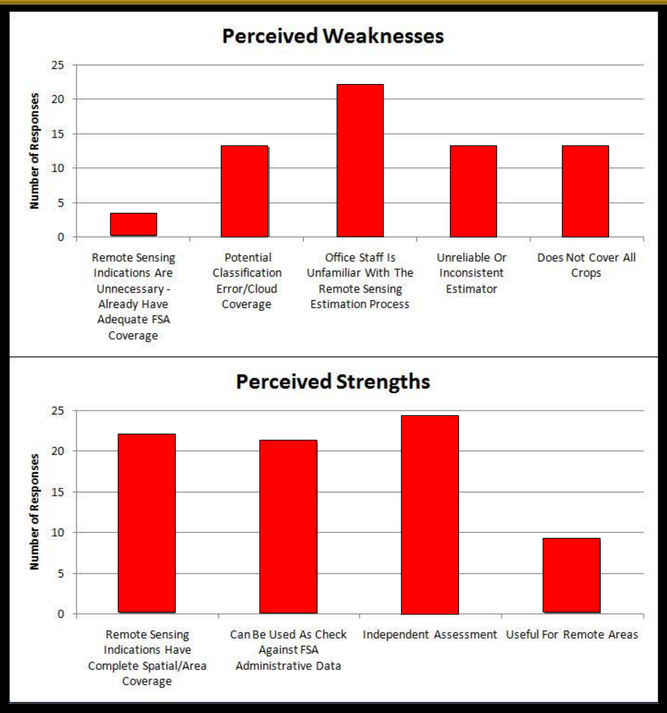


Figure 1. Perceived weaknesses and strengths of the USDA NASS Cropland Data Layer remote sensing indicators by a sample of USDA NASS State Field Offices.

Updates Throughout Growing Season

Over two-thirds of Field Offices indicated that updated state-level remote sensing indications throughout the growing season would be valuable for updating the official crop reports. With USDA 's seasonal reporting requirements in the months of August, September and October, Field Offices were also asked if additional early season estimates at these times, at county and district levels, would be of value. 21% of the Field Offices found limited *or* high value in early season estimates while 39% indicated these early season estimates would be of medium value (Figure 2).

Need for Mapping Utility

- Approximately 83% of the Field Offices wanted to implement a mapping utility to integrate CDL products and near-real time satellite-based rapid response products.
- 72% of respondents indicated that NDVI images would be of interest to their personnel.
- 96% of respondents indicated that rapid response remote sensing products – vegetation indicator and natural disaster products delivered within days of satellite overpass and processing of captured image(s) – would be useful for floods, droughts, and other extreme weather events.
- Several Field Offices commented that drought information would be useful for ongoing policy debates concerning irrigation for agriculture and available water resources and that rapid response products of water stress and/or drought conditions could be incorporated into monthly presentations to outside groups and the weekly crop progress reports released to the public.
- The Field Office responses specifically called for in-house mapping utilities and training for use of such software applications.

Conclusion

This study was targeted at internal NASS Field Offices. The results showed:

- General knowledge of the CDL product
- Perception of accuracy and usefulness were highly dependent on the crops grown per state
- Ability to use & understand remote sensing products
- High interest for training on both GIS and remote sensing software and products and rapid response remote sensing products that could be used in both outreach to producers and the public and for refining statistical estimates
- The CropScape portal serves as a mechanism toward meeting these needs.