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Agricultural Land Use Change in the Corn Belt
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THE CONVERSION of grass-like land to row crops (in our case, corn or soybeans) and general land use change in the Corn Belt region has important water quality implications. Additional agricultural production can increase nutrient runoff into the Upper Mississippi River Basin, thereby increasing the size of the Gulf of Mexico hypoxic zone. We use two data sources from the National Agricultural Statistical Services (NASS) to obtain detailed land use information in the Corn Belt from 2006 to 2014. We also identify and analyze any similarities and discrepancies between both data sources.

Focusing on the Corn Belt, we use NASS survey data and Cropland Data Layers (CDL) to obtain corn and soybean acres for twelve states: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota and Wisconsin. The NASS survey website provides county-level data for acres of both corn and soybeans planted from 2006 to 2014, and we convert CDL data to obtain comparable information at the same level.\(^1\,^2\,^3\)

We utilize ten CDL categories for our land use comparison: corn, soybean, alfalfa, other hay/non alfalfa, switch grass, idle cropland, grass/pasture land, grassland herbaceous, grass/pasture, and pasture/hay. The corn and soybean categories are used to study changes in row crop acreage, and the remaining eight categories are aggregated into a grass-like category, used to study grass-like land changes. NASS survey does not provide county-level data on planted acres of alfalfa, hay, haylage and pastureland, thus as an alternative source for grass-like land data, we turn our attention to Conservation Reserve Program (CRP) acres. In particular, USDA Farm Service Agency offers CRP enrollment information at a county level.\(^4\)

We first study land use change from 2006 to 2014 by computing total corn and soybean acreage in the Corn Belt. CDL reports roughly 122.2 and 137.5 million combined corn and soybean acres in 2006 and 2014, respectively. NASS survey data reports 128.5 and 135 million combined corn and soybean acres in 2006 and 2014, respectively. For row crop acreage, we observe a larger difference between data sources in 2006 than we do in 2014. In 2006, NASS survey data reports 6.3 million more acres than CDL, and NASS reports 2.5 million less acres than CDL in 2014. According to NASS survey data, total corn and soybean acreage increased by roughly five percent from 2006 to 2014, but CDL data shows roughly a 12 percent increase in the same period. While total acreage from both sources seems closer in 2014, the large difference in 2006 is reflected in the large percentage change differences from 2006 to 2014.

Focusing on land use change from each data source, we calculate\(^5\)
the percentage change in corn and soybean acreage from 2006 to 2014. We illustrate the relative change in corn and soybean acreage in 2014 relative to 2006 in Figures 1 and 2.

NASS survey does not provide information on every county, as shown by the white areas in Figure 1. Major relative differences in acreage occur in the outer portions of each map, as shown by the darker areas. In particular, we notice larger increases in corn and soybean acreage in North and South Dakota in both maps, as shown by darker green areas. Moreover, CDL data shows a larger increase in Minnesota relative to NASS survey data, however, both show an increase in the northwestern part of the state. Overall, there is less variability in corn and soybean acreage in the inner portion of the map (e.g., Iowa, Illinois, Indiana, and portions of Wisconsin), as shown by lighter colors.

We expect CDL data to report more grass-like acres, as it includes land beyond that enrolled in CRP. In other words, we use CRP data as a proxy for grass-like land, but we are aware that it does not include all types of grass in the region. We compute the relative change in grass-like and CRP acreage in 2014 relative to 2006 following the same process as for corn and soybean acreages, as shown in Figures 3 and 4.

Figure 3 illustrates major decreases in grass-like land in Illinois, Indiana, and around the Minnesota/North Dakota border, consistent with
increases in corn and soybean acreage in those areas (see Figure 2). Missouri, Ohio, and Wisconsin show an overall decrease in grass-like acreage, also consistent with an increase in corn and soybean acres (see Figure 2). We also observe decreases in grass-like land in southern Iowa and northern Michigan. In Iowa, this coincides with an increase in corn and soybean acres (see Figure 2). In the Dakotas, we observe decreases in grass-like land primarily in the eastern portions of the states, which is again consistent with changes shown in Figure 2. The western portion of South Dakota shows an increase in grass-like acres (Figure 3) and in corn and soy bean acres (Figure 2).

Figure 4 shows that CRP acres have decreased in 2014 relative to 2006 in the majority of counties. We observe major changes in the Dakotas, Minnesota, Wisconsin, Michigan, Missouri, Kansas, and Nebraska. Overall, both NASS survey (Figure 1) and CDL (Figure 2) data show increases in corn and soybean acres that coincide with decreases in CRP acres (Figure 4). Some counties in Iowa, Illinois, Indiana, Ohio and the southern portion of Missouri show increases in CRP acres.

Both data sources show increases in grass-like land in Wisconsin, most counties in Minnesota and the Minnesota and North and South Dakota borders, and several counties in Kansas and Nebraska. Both maps suggest that Iowa has decreased grass-like land in the southern portion of the state. While CRP acres have decreased in most of the region, CDL data shows increases in grass-like land in the north-central part of Iowa, the majority of Nebraska, and several counties in the Dakotas, Kansas, and Michigan. In the northeastern part of Minnesota, CDL data shows a substantial increase in grass-like acres, while NASS survey shows an increase or no change in CRP acres.

We also compute the correlation between corn and soybean acreage in both datasets in 2014. The Pearson correlation is 0.98, suggesting that corn and soybean acreage are highly correlated between both data sources. Furthermore, we look at spatial differences in corn and soybean acreage between both data sources in 2014.

As shown in Figure 5, we observe smaller variations between data sets in Iowa, Illinois, Indiana, and most of Ohio, as depicted by lighter colors. We observe larger data discrepancies in the outer portions of the map, specifically, some counties in the Dakotas, Minnesota, Wisconsin, Michigan, Missouri, and Kansas, as depicted by darker green or darker blue colors.

Footnotes
1 http://quickstats.nass.usda.gov/. We exclude data where location is denoted as “Other”, since it cannot be linked to a specific county.
2 http://www.nass.usda.gov/research/Cropland/metadata/meta.htm have meta information about state CDLs. For Michigan, CDL is available from 2007, not 2006.
3 From CDL, we acquire counts of pixels attributed to certain land use types for 2006 and 2014 and convert these counts to area units according to the resolution in the raster CDL files.