

USDA Data Show Cropland Reductions in Counties with Ethanol Plants from 1997-2012

Summary and Key Points

A recent study (Wright *et al.*) funded in part by the National Wildlife Federation (NWF) suggests that significant cropland expansion occurred in areas near ethanol plants between 2008 and 2012, purportedly replacing grassland and other wildlife habitat. The study's findings are at odds with data from the U.S. Department of Agriculture (USDA), which show U.S. cropland continues to shrink. However, the NWF study argues that the national aggregate trend toward less cropland hides "pockets of [land] conversion" occurring near ethanol plants.

To test the validity of this assertion, we disaggregated the USDA national cropland data and examined historical trends for all 180 individual counties where at least one grain ethanol plant was located in 2016. Key findings from our analysis include:

- Consistent with the national trend, cropland in counties surrounding ethanol plants generally fell between 1997 and 2012. In total, cropland in the counties with ethanol plants fell by 2.02 million acres, or 3.5 percent, between 1997 and 2012.
- Between 2007 and 2012 specifically (i.e., encompassing the period examined by the NWF study), total cropland in counties with ethanol plants fell by 454,000 acres, or 0.8 percent.
- On an individual county basis, 2012 cropland levels were below the levels recorded in 1997, 2002, or 2007 in the overwhelming majority (84 percent) of the counties with ethanol plants. The reduction in cropland for these 151 counties averaged 11.8 percent when compared to the highest level of cropland from 1997, 2002, or 2007. This greatly undermines the NWF study's assertion that cropland has significantly expanded in areas near ethanol plants.
- For the small minority (16 percent) of counties with ethanol plants where 2012 cropland was higher than the amount of cropland recorded in 1997, 2002, or 2007, the increase in cropland was minor (3.1 percent on average) and coincided with reductions in Conservation Reserve Program (CRP) land and pastureland.
- Most of the counties with ethanol plants where 2012 cropland exceeded 1997, 2002, or 2007 levels are located in the heart of the Corn Belt, not the western fringe. This provides support for the argument that expanded cropland in these counties replaced land with previous agricultural history (such as CRP or pasture)—not prairie or other native lands.

The major differences in the findings of our analysis and the Wright *et al.* study are primarily explained by flaws in their data and methodology. Specifically, they relied on error-prone satellite data, compared land use from only two points in time, and classified certain croplands (e.g., idle pasture and hay) as "grassland." In contrast, our analysis relies on land use data mandatorily reported to USDA by farmers and examines four points in time over a longer period.

The significant disagreement between USDA county-level data and the satellite data used by Wright *et al.* raises important questions and concerns about the validity of the NWF study's findings, as well as the reliability of USDA satellite data for land use change analysis.

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Introduction

The amount of land dedicated to crop production in the United States continues to shrink, falling steadily from 445.3 million acres in 1997 to 389.7 million acres in 2012, according to the U.S. Department of Agriculture (USDA).¹ This reduction in cropland has coincided with dramatic growth in the amount of grain used for fuel ethanol production, as corn use for ethanol has increased 850 percent between the 1997/98 and 2012/13 marketing years.²

However, a recent study by Wright *et al.*³ appears to contradict the USDA data showing reductions in cropland area. The study suggests that cropland actually expanded in areas near ethanol plants between 2008 and 2012, purportedly replacing native grassland that provides wildlife habitat and other environmental services. The authors assert that the long-term national trend toward less cropland masks "...the concentrated pockets of [land] conversion...happening around ethanol plants."⁴ The study implies that growth in ethanol production under the Renewable Fuel Standard (RFS) was the chief driver of these alleged conversions of native grassland to cropland in close proximity to ethanol facilities. The Wright *et al.* study's methods and conclusions are largely based on a previous analysis (Lark *et al.*⁵) of USDA Cropland Data Layer (CDL) satellite images from 2008-2012.

To test the validity of the Wright *et al.* study's conclusion that significant cropland expansion occurred near ethanol plants from 2008 to 2012, we examined county-level land use data for counties with ethanol plants from the past four USDA Agriculture Census surveys. Through the Agriculture Census program, farmers and ranchers across the United States are required by law to provide data and information to USDA regarding land use, land cover, and many other operational factors.

Our analysis shows that counties with ethanol plants overwhelmingly experienced cropland reductions between 1997 and 2012, consistent with the national trend. On average, cropland fell 3.5 percent in these counties between 1997 and 2012. Between 2007 and 2012 specifically (i.e., encompassing the period examined by Wright *et al.*), cropland in counties with ethanol plants fell by an average of 0.8 percent. On a county-by-county basis, the overwhelming majority of counties with ethanol plants (84 percent) had lower levels of cropland in 2012 than in 1997, 2002, or 2007, raising important questions about the legitimacy of the NWF study's conclusions.

Lark *et al.* and Wright *et al.* Rely on Flawed Methodologies and Error-Prone Data

Serious questions have been raised about the accuracy of the land cover dataset and analysis used in Lark *et al.*, which is the basis for the Wright *et al.* study. Indeed, a recent paper by Dunn *et al.*⁶ examined the methods used by Lark *et al.* and found that the error associated with the CDL data is so great that it "limits drawing conclusions from it." Dunn *et al.* further concluded that "...the CDL does not provide sufficiently accurate information when used to assess land use change by comparing land classification information in the CDL between two years."

The Renewable Fuels Association also examined the satellite data used in the Lark *et al.* analysis, similarly finding that it had an extremely high rate of error and often failed to accurately distinguish between native/undisturbed grassland and certain cropland types (e.g., alfalfa, grass hay, fallow/idle cropland, managed pastureland).⁷ The satellite data also cannot reliably distinguish between native/undisturbed grassland and former cropland enrolled in the Conservation Reserve Program (CRP). Thus, the Lark *et al.* data underlying the Wright *et al.* analysis undoubtedly mischaracterize some crop switching (e.g., alfalfa, pasture or idle cropland switched to corn) as a conversion of “native grassland” to cropland.

The authors briefly acknowledge this problem with the satellite data, but gloss over its implications: “Notably, the NLCD does not distinguish undisturbed grassland (native prairie) ineligible for feedstock production under EISA from eligible grassland types including introduced grass pasture, introduced grass hay, and idle cropland planted to grasses under the Conservation Reserve Program (CRP).” This important admission provides cause for careful and skeptical interpretation of the Wright *et al.* findings. USDA itself recognizes the shortcomings of its CDL satellite data, stating, “Unfortunately, the grassland-related categories have traditionally *had very low classification accuracy* in the CDL.”⁸ USDA cautions users that the satellite data is “not ideal for separating grassy land use types.”⁹ Further, USDA states that it is continuing to search for data that would “...improve the identification of grassland and pasture categories within the CDL.”¹⁰

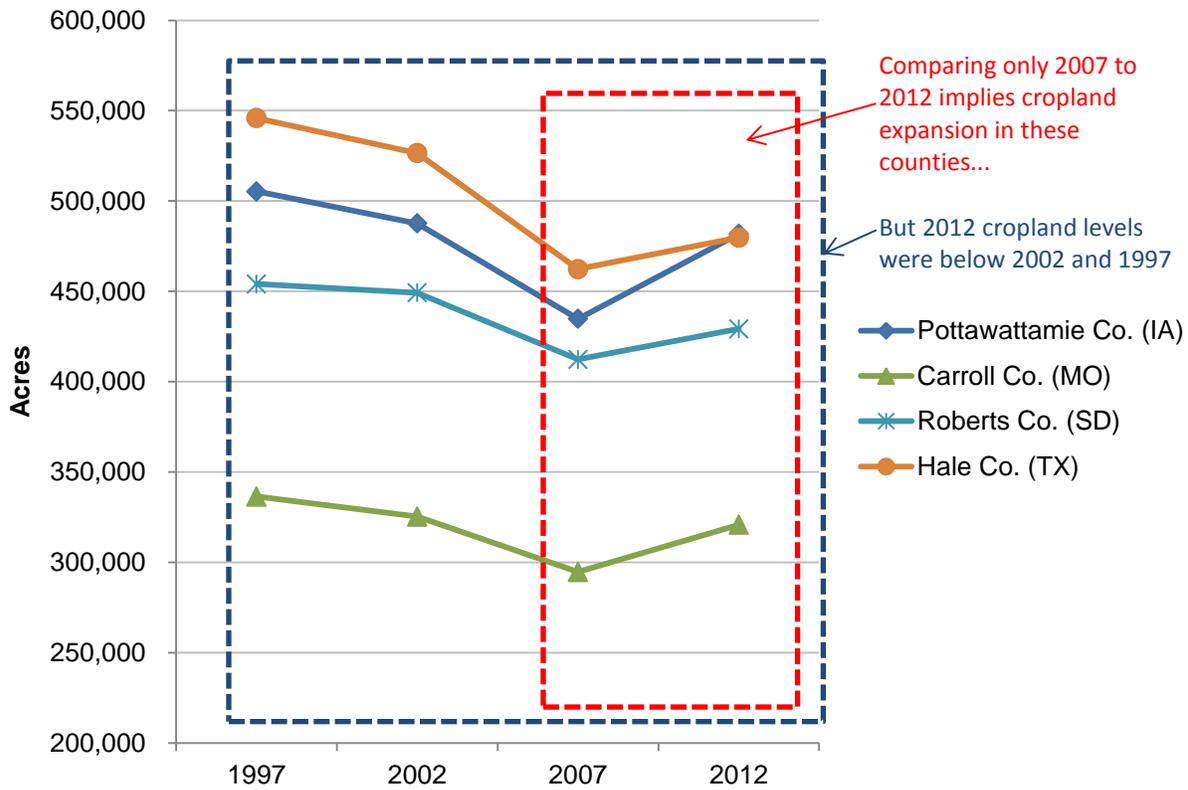
Another major shortcoming of the Wright *et al.* and Lark *et al.* analyses is their “snapshot” approach to comparing land cover from just two fixed points in time. Land cover transitions and reversions typically occur over long cycles, and comparing land cover at only two fixed points over a relatively short time interval disregards the uses of the land before and after the chosen time period (and potentially during the intervening years as well). Wright *et al.* ignore the historical uses of land near ethanol plants prior to 2008; they essentially assume the land cover was in a steady state prior to the first satellite imagery “snapshot” being taken.

When combined with the high rate of error inherent in the CDL satellite data, the “snapshot” approach to estimating land cover change employed by Lark *et al.* and Wright *et al.* is especially problematic. Consider an example where a tract of land was engaged in wheat production in 2003 but had transitioned to idle cropland or grass hay production by the time the first satellite snapshot is taken in 2008. Due to the high rate of misclassification in the CDL for these land types, this tract could have easily been misclassified by Lark *et al.* and Wright *et al.* as “native grassland.” If this tract switched back to a crop like corn by the time of the second snapshot in 2012, the Wright analysis would suggest this land was converted from “native grassland” to cropland, implying that the land was in a steady state of land cover (grassland) prior to the conversion to corn.

Using only two points in time for this type of analysis overlooks longer-term historical uses of the land for crop production. The problems inherent in this approach are shown in **Figure 1**, which examines cropland area trends in four counties with ethanol plants in four different states. If 2007 cropland levels in these counties are compared only to 2012 levels, one would be left with

the impression that cropland in these counties expanded beyond historical levels between 2007 and 2012. However, the USDA data clearly show that while 2012 cropland levels in these counties were slightly higher than 2007 levels, they were below cropland levels recorded in 2002 and 1997. A longer view undermines the notion that the increase in cropland in these counties between 2007 and 2012 came from the conversion of non-agricultural native lands.

Figure 1.
Cropland Area in Select Counties with Ethanol Plants, 1997-2012



Source: USDA

USDA Ag Census Data Show Cropland Reductions in Counties with Ethanol Plants

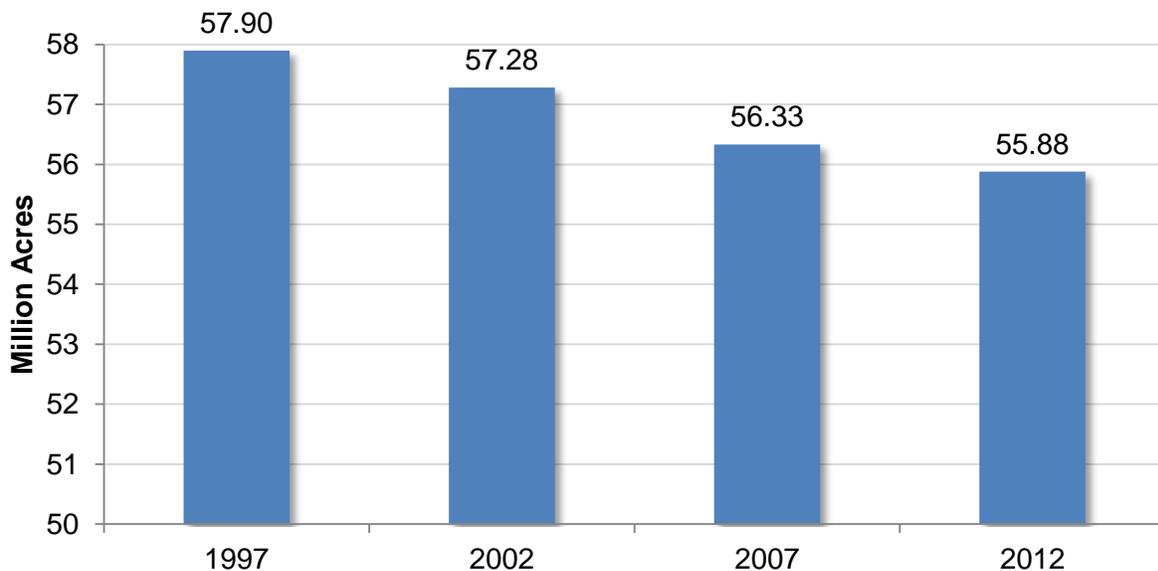
To test whether cropland has truly expanded and replaced grassland in areas immediately surrounding ethanol plants as argued by Wright *et al.*, we examined USDA historical county-level cropland data from the Agriculture Census in 1997, 2002, 2007, and 2012 for the individual counties in which at least one grain ethanol plant was located in 2016.¹¹ A total of 200 grain ethanol plants were located in 181 counties across the United States in 2016. One county with one ethanol plant was eliminated from the analysis because cropland data was not available for this county for all four years examined. Thus, this analysis scrutinizes individual county-level cropland data for 180 counties in which 199 grain ethanol plants were located in 2016. County-level data on corn acres planted, conservation program acres, and pastureland acres were also examined for counties with ethanol plants. The overwhelming majority (if not all) of the grain ethanol plants existing in 2016 were in operation or under construction in 2012 when the most recent Agriculture Census was conducted.

While Wright et al. used satellite data to examine 50- and 100-mile feedstock “draw areas” around each ethanol plant, this analysis examines counties as the representative feedstock draw areas. Certainly, many ethanol plants will source feedstock from a draw area that extends beyond the boundaries of the county in which the plant is located. However, Wright *et al.* suggests most of the purported cropland expansion occurred within a 25-mile radius of the ethanol plant, and land conversion rates decline with each successively larger concentric circle around the plant. Thus, examining county-level data enabled us to check whether cropland actually did expand in the areas closest to the ethanol plants, where Wright *et al.* argue land conversion was most extensive.

It is beyond dispute that corn acreage increased steadily between 1997 and 2012 in the areas surrounding ethanol plants. In the 180 counties with ethanol plants, corn acres grew from 19.64 million acres in 1997 to 23.54 million acres in 2012, a 20 percent increase. However, the USDA data clearly underscore that the increase in corn acres in these counties (and nationally) was achieved via crop switching (i.e., corn substituting for other crops), rather than cropland expansion and conversion of non-agricultural land.

In aggregate, cropland in the counties with ethanol plants fell by 2.02 million acres, or 3.5 percent, between 1997 and 2012 (**Figure 2**). Between 2007 and 2012 alone (i.e., encompassing the period examined by Wright *et al.*), total cropland in these counties fell by a total of 454,000 acres, or 0.8 percent. Thus, the reduction in cropland in counties with ethanol plants between 1997 and 2012 is consistent with the national trend during the same period, albeit with a lesser rate of decline.

Figure 2.
Total Cropland in Counties with Ethanol Plants



Source: USDA

Certainly, Wright *et al.* would argue that looking at *aggregate* cropland trends in counties with ethanol plants still masks potential conversions in certain areas surrounding certain ethanol plants (Wright has particularly focused on the western fringe of the Corn Belt in earlier work¹²). Thus, we also examined cropland trends individually in the 180 counties with grain ethanol plants. Our analysis shows that 2012 cropland levels were below the levels recorded in 1997, 2002, or 2007 in the overwhelming majority (84 percent) of the counties with ethanol plants (see Appendix). This is consistent with the national trend and stands in stark contrast to the assertion by Wright *et al.* that cropland expansion was common in areas immediately surrounding ethanol plants between 2008 and 2012.

For the small minority (16 percent) of counties with ethanol plants where 2012 cropland was higher than the amount of cropland recorded in 1997, 2002, or 2007, the increase in cropland was minor and coincided with reductions in CRP land and pastureland. In fact, for nearly all of these counties, the reductions in CRP and pastureland were greater than increases in cropland. This suggests that in the rare cases where cropland expanded in areas close to ethanol plants, it replaced land with an agricultural history (e.g., previous cropland enrolled in CRP or pasture), not native prairie or other undisturbed land types.

Notably, many of the counties with ethanol plants where cropland expanded between 1997 and 2012 are in the heart of the Corn Belt, not on the western fringe where prairie grassland and other native land types are more common. More than half of the counties with ethanol plants where cropland expanded are located in Illinois, Indiana, Iowa, and Missouri. This provides additional support for the argument that expanded cropland in these counties replaced land with previous agricultural history, such as CRP or pasture, rather than prairie or other native lands. Indeed, Wright *et al.* themselves note that "...native prairie covers less than 1.5% of Iowa and Missouri, combined...", lending credence to the argument that any cropland expansion in these states likely came from other lands with agricultural production history.

Specifically between 2007 and 2012 (i.e., encompassing the period examined by Wright *et al.*), no more than 340,000 acres of potentially "new" cropland were brought into production in counties with ethanol plants.¹³ This is equivalent to just 0.6 percent of the total cropland in the 180 counties with grain ethanol plants, and equivalent to just 8 percent of the Wright *et al.* study's inflated estimate of 4.2 million acres of "arable non-cropland" converted to crops between 2008 and 2012 in areas close to ethanol plants. Further, it is likely that some amount of the cropland appearing as "new" cropland in 2012 (i.e., because it exceeded the amounts of county-level cropland recorded in 1997, 2002, and 2007) was engaged in crop production at some point prior to 1997, meaning it isn't in fact "new" cropland at all.

Conclusion

Beyond the sensational headlines and soundbites surrounding the Wright *et al.* study, there lies an important admission by the authors. They acknowledge that increased demand for grain from the ethanol sector has been met primarily through more efficient use of existing cropland, a finding recently corroborated by Babcock.¹⁴ Wright *et al.* admit that "...our results are consistent with an argument that U.S. ethanol development has been achieved more so by corn

intensification—including crop switching, yield improvements, and continuous-corn production—than by corn extensification” [i.e., land conversion].

Unfortunately, this finding has been overshadowed by the emotional publicity around the study. Rather than focusing on the dramatic improvements in the grain sector’s productivity and efficiency, coverage of the study has focused on the dubious land use change results that are based on error-prone satellite data and an overly narrow comparison of two snapshots in time. Our analysis used a broader time series of USDA county-level data reported by the farmers and ranchers who actually live and work on the land. It reveals that cropland in individual counties with ethanol plants generally fell between 1997 and 2012, following the long-term national trend.

¹ U.S. Department of Agriculture, Census of Agriculture. [Online] Available at <https://www.agcensus.usda.gov/> [March 30, 2017].

² U.S. Department of Agriculture, Economic Research Service, U.S. Bioenergy Statistics, Table 5-Corn supply, disappearance and share of total corn used for ethanol. [Online] Available at <https://www.ers.usda.gov/data-products/us-bioenergy-statistics/us-bioenergy-statistics/#Feedstocks> [March 29, 2017].

³ Wright CK, Larson B, Lark TJ, and Gibbs HK, Recent grassland losses are concentrated around ethanol refineries. *Environ Research Lett.* **12**:04401-04416 (2017).

⁴ Public News Service, Study: Ethanol Production Destroying Habitat. [Online] Available at <http://www.publicnewsservice.org/2017-03-27/environment/study-ethanol-production-destroying-habitat/a56985-1> [March 27, 2017].

⁵ Lark TJ, Meghan Salmon J and Gibbs HK, Cropland expansion outpaces agricultural and biofuel policies in the United States. *Environ Res Lett.* **10**:44003–44014 (2015).

⁶ Dunn JB, Merz D, Copenhaver KL, and Mueller S, Measured extend of agricultural expansion depends on analysis technique. *Biofuels, Bioprod. Bioref.* **11**: 247-257 (2017).

⁷ Cooper G, University of Wisconsin Study Based on Shaky Foundation of Faulty Data and Conclusions. [Online] Available at <http://ethanolrfa.org/2015/04/university-of-wisconsin-study-based-on-shaky-foundation-of-faulty-data-and-conclusions/> [March 27, 2017].

⁸ U.S. Department of Agriculture, National Agricultural Statistics Service, CropScape and Cropland Data Layers, FAQ’s. [Online] Available at https://www.nass.usda.gov/Research_and_Science/Cropland/sarsfaqs2.php [March 26, 2017].

⁹ *Id.*

¹⁰ *Id.*

¹¹ Private Renewable Fuels Association data were used to identify 182 counties where 200 grain ethanol plants were located in 2016. For each county, U.S. Department of Agriculture, Census of Agriculture, Quick Stats Tool was queried for “Farms & Land & Assets: Ag Land: Cropland: Acres”; “Farms & Land & Assets: Ag Land: Pastureland: Acres”; “Farms & Land & Assets: Govt Programs: Area: Conservation & Wetlands – Acres”; and “Field Crops: Corn: Area Planted” for 1997, 2002, 2007, and 2012.

¹² Wright CK and Wimberly MC, Recent land use change in the Western Corn Belt threatens grasslands and wetlands. *Proc Natl Acad Sci* **110**:4134–4139 (2013).

¹³ 340,000 acres is the total difference between 2012 cropland area and highest cropland area level recorded in 1997, 2002, or 2007 for the counties where 2012 cropland area exceeded 1997, 2002, and 2007 levels.

¹⁴ Babcock BA, Extensive and intensive agricultural supply response *Ann. Rev. Res. Econ.* **7** 333–48 (2015)

Appendix

Counties with grain ethanol plants, percent change in cropland area (2012 cropland area vs. highest recorded cropland area in 1997, 2002, or 2007)

