2012

Cropland Expansion into Prairie Pothole Wetlands, 2001-2010

Carol A. Johnston
South Dakota State University

Recommended Citation

Johnston, C.A. 2012. Cropland expansion into prairie pothole wetlands, 2001 2010. pp 44-46 In Glaser, A. (ed.) America's Grasslands Conference: Status, Threats, and Opportunities. Proceedings of the 1st Biennial Conference on the Conservation of America's Grasslands. August 15 17, 2011, Sioux Falls, SD. Washington, DC and Brookings, SD: National Wildlife Federation and South Dakota State University.

Cropland Expansion into Prairie Pothole Wetlands, 2001-2010

Presenter: Carol Johnston, South Dakota State University (carol.johnston@sdstate.edu)

With sharply increasing prices for corn, soybeans, and wheat during the last decade, the Prairie Pothole Region (PPR) of the eastern Dakotas is under substantial pressure for agricultural development. Development of cold- and drought-tolerant crop strains has reduced the risk from suboptimal climatic conditions, shifting U.S. corn and soybean expansion to the north and west (Reilly et al. 2003). Wet, sandy, or steep soils remain deterrents to cropping (Baker & Capel 2011), but increasing commodity prices have reduced the economic barriers to cropping these marginal lands (Rashford, Walker & Bastian 2011).

Grasslands in the PPR typically exist as small remnants embedded in a larger matrix of cropland. Many PPR grasslands are used for hay or grazing, land uses that can preserve native vegetation, promote wildlife habitat, and accommodate variation in flooding and high water tables. Converting these grasslands into croplands decreases the ecosystem services that they provide.

I sought to determine the rate of grassland conversion to cropland in the PPR of the eastern Dakotas using available land cover databases for 2001 and 2010: the National Land Cover Database (NLCD) (Homer et al. 2007) and the USDA Cropland Data Layer (CDL) (Johnson & Mueller 2010). The CDL has been prepared annually since 1997 for North Dakota and since 2006 for South Dakota. Both data sources are derived from satellite imagery, are well documented, and are subject to rigorous quality control. I examined patterns of grassland occurrence and loss within different ecoregions of the Dakotas (Bryce et al. 1998), and verified the land use classifications using National Agriculture Imagery Program (NAIP) images taken in 2003 (the earliest NAIP imagery available) and 2010.

How Much Grassland Was There in 2001?

Any land use trend requires a starting point, and I considered two possible sources of data to define 2001 grassland. I generated the first candidate grassland map by selecting “Grassland/herbaceous” (class 71) and “Pasture/hay” (class 81) from the 2001 NLCD (Fig. 10a), and the second candidate map by selecting “Fallow/idle cropland” and “Pasture/grass” classes from the North Dakota 2001 CDL (Fig. 10b). After comparison of the 2001 data layers with each other and with available aerial photos, I

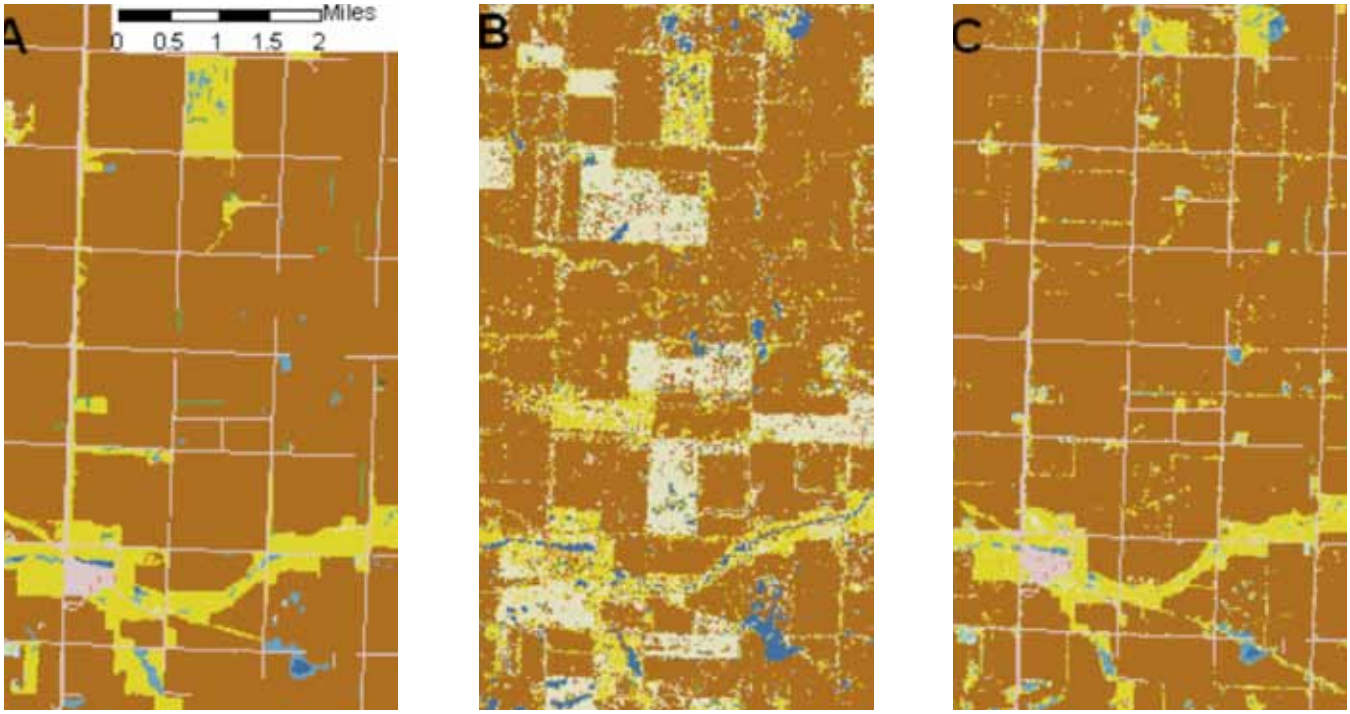

Figure 10: Comparison of grassland mapped in the vicinity of Cathay, North Dakota, extracted from: (A) 2001 NLCD, (B) 2001 CDL, and (C) 2010 CDL. Note loss of grasslands along the southern border of the image between 2001 and 2010. Dark yellow = grassland, light yellow = fallow/idle cropland (CDL only), brown = cropland, pink = developed.

concluded that the NLCD provided a truer rendering of 2001 grassland. The "Fallow/idle cropland" class in the 2001 CDL encompassed some grasslands as well as fallow croplands that were not grasslands (Fig. 10b). None of the databases used distinguished between native and non-native grasslands, and some of the grassland areas were highly managed (e.g., for alfalfa hay).

The area of grassland mapped by the NLCD within the Dakota PPR was 28,650 square miles, 34.3% of the total area. Large, continuous blocks of grassland occurred on steep and stony lands of the Missouri Coteau and Prairie Coteau Escarpment (Figure 11), and on sandy soils of the Beach Ridges and Sand Deltas in North Dakota. Grasslands were uncommon in the highly cultivated Lake Agassiz Plain and Northern Black Prairie ecoregions of North Dakota, and the Glacial Lake Basin ecoregion in the northern James River Valley of South Dakota. Elsewhere, grasslands were interspersed among croplands in fragmented landscapes (Figures 10, 11).

How Much Grassland Was Converted to Cropland by 2010?

By 2010, cropland had replaced 16.9% (4,838 mi2) of the 2001 grassland. Three crops constituted the vast majority of this new cropland in about equal proportion: corn, soybeans, and wheat.

The pattern of loss in Roberts County, South Dakota and Richards County, North Dakota, along the state border, is representative of the changes observed (Figure 11). Substantial grassland area remained on the steep Prairie Coteau at the western edge of Roberts County, but flatter lands below the Prairie Coteau escarpment were more susceptible to conversion. For example, nearly 3 sections of land west of Interstate 29 in Richland County (T129N, R49W) were converted from grassland to corn and soybeans (Figure 11). Inspection of the NAIP imagery verified that this was grassland in 2003 and cropland in 2010.

Conclusions

Conversion of grassland to cropland is occurring at a rapid pace in the PPR of the Dakotas. Improved agricultural technologies are reducing cultivation constraints, and land area devoted to pasture and hayland is declining

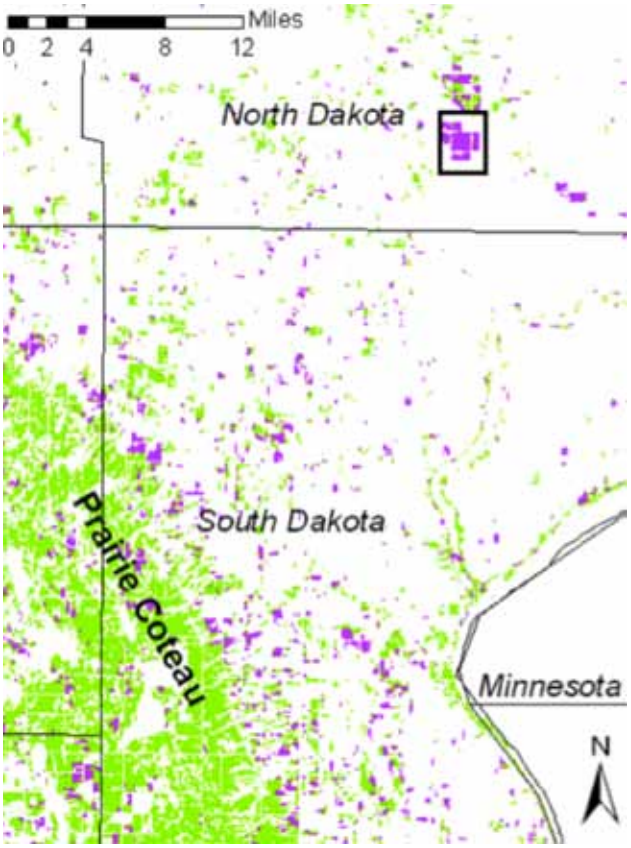

Figure 11: Grassland (green) and grassland-converted-to-cropland (purple) in southern Richland County, ND and Northern Roberts County, SD. black rectangle encloses A 1, 717 acre area converted from grassland to corn and soybeans.

as livestock operations are concentrated into feedlots or eliminated altogether. Some grassland conversion may also be due to the expiration of Conservation Reserve Program (CRP) contracts. In 2009, 2.8 million acres of CRP contracts expired nationwide, and that number increased to 4.5 million acres in 2010 (Thiesse 2010). Unfortunately, privacy concerns prevent distribution of detailed spatial data showing CRP lands. Regardless of the reason for grassland conversion, agricultural intensification will have serious ramifications for the future of this important natural resource.

References

Baker, N.T. & Capel, P.D. (2011) Environmental factors that influence the location of agriculture of crop agriculture in the conterminous United States. pp. 72. U.S. Geological Survey Scientific Investigations Report 2011–5108, Indianapolis, IN.

Bryce, S., Omernik, J.M., Pater, D.E., Ulmer, M., Schaar, J., Freeouf, J., Johnson, R., Kuck, P. & Azevedo, S.H.

(1998) Ecoregions of North Dakota and South Dakota. U.S. Geological Survey Northern Prairie Wildlife Research Center Online, Jamestown, ND. http://www.npwrc.usgs.gov/resource/habitat/ndsdeco/index.htm

Homer, C., Dewitz, J., Fry, J., Coan, M., Hossain, N., Larson, C., Herold, N., McKerrow, A., VanDriel, J.N. & Wickham, J. (2007) Completion of the 2001 National Land Cover Database for the Conterminous United States. *Photogrammetric Engineering & Remote Sensing,* **73**, 337-341.

Johnson, D.M. & Mueller, R. (2010) The 2009 Cropland Data Layer. *Photogrammetric Engineering and Remote Sensing,* **76,** 1201-1205.

Rashford, B.S., Walker, J.A. & Bastian, C.T. (2011) Economics of grassland conversion to cropland in the Prairie Pothole Region. *Conservation Biology,* **25**, 276-284.

Reilly, J., Tubiello, F., McCarl, B., Abler, D., Darwin, R., Fuglie, K., Hollinger, S., Izaurralde, C., Jagtap, S., Jones, J., Mearns, L., Ojima, D., Paul, E., Paustian, K., Riha, S., Rosenberg, N. & Rosenzweig, C. (2003) U.S. agriculture and climate change: new results. *Climatic Change,* **57**, 43-67.

Thiesse, K. (2010) What's Ahead for the CRP Program? *Corn & Soybean Digest.* http://cornandsoybeandigest.com/issues/what-s-ahead-crp-program

Land Use Consequences of Crop Insurance Subsidies

Presenter: David A. Hennessy, Iowa State University (hennessy@iastate.edu)

Other authors: Ruiqing Miao and Hongli Feng, Iowa State University

It is estimated that net conversion of Northern Great Plains rangeland was about 0.09% per year between 1997 and 2007, but the conversion rate in some counties just east of the Missouri River in the Dakotas may have been much higher, in the order of 0.6% per year (Claassen et al. 2011). It is important to recognize the technology and market environment surrounding these land use choices. The advent of herbicide-tolerant insect-resistant corn and soybean varieties since 1996 has reduced chemical, labor and management time costs associated with cropping while also likely increasing yields. In facilitating low-till cultivation, they may also have eased any conservation compliance constraints and reduced energy costs. In addition, seed companies have had success in introducing drought-tolerance into their product (Yu and Babcock 2010, Carena *et al.* 2009). Since 2006, historically high corn and other commodity prices have also incentivized conversion incentives, have driven up land rents, and have made the Conservation Reserve Program alternative less attractive. In the past three decades also, but especially since the mid-1990s, government subsidy rates to crop insurance products have grown. These subsidies are in proportion to the crop price so the per-acre subsidy has grown markedly since 2006.

The question we ask is to what extent crop insurance subsidies are responsible for conversion of yield-risky, low-quality, environmentally fragile grassland into cropping? The motivations for asking this question are two-fold. One is that these subsidies enhance average returns to cropping at the expense of pasture and other uses, and so are likely to draw acres toward cropping. The other is that the subsidies are in proportion to risk. Non-cropped land of greatest environmental concern tend to be yield-risky and of low innate productivity. Such subsidies may well provide a larger subsidy to land of greatest environmental concern when compared with other land under the same subsidy program.

A long literature has looked at any insurance connection with land conversion, e.g., Young, Vandeveer and Schnepf (2001), Goodwin, Vandeveer and Deal (2004), GAO (2007), and Claassen *et al.* (2011). The consensus has been that while crop insurance subsidies have incentivized to cropping, the effect is not large. However there are gaps in the literature. Data availability issues have meant that the focus has been largely at the U.S. county level, but decisions are made at the farm level and much is lost concerning risk management when farm-level data are aggregated. The inquiries were not focused on the most marginal cropping region, the cropping fringe in Western Great Plains. Inevitably, given data used, limited and coarse measurements of insurance subsidy size were employed. Also, policy has changed markedly since the more analytic earlier studies, e.g., Goodwin et al. data concerned 1985-'93. Finally, Claassen et al. is the only study to cover the markedly different production environment that has emerged over the five years up to 2010.