Land Use Land Cover Change in the Big Sioux River Watershed: Driving Forces, Connections and Consequences

Dinesh Shrestha, Dr. Darrell Napton
Department of Geography, South Dakota State University

Introduction

Between 2006 and 2011, increased demands on ethanol production resulted in high corn prices that accelerated the conversion of grassland to corn cropland and resulted on increased corn acreage in the Western Corn Belt (WCB) Plains Ecoregion. The conversion was mostly concentrated in North Dakota and South Dakota (SD), east of the Missouri River—resulting in the westward expansion of the WCB (Wright and Wimberley 2015, 4134; Olimb 2013). Other driving forces such as crop insurance subsidies and disaster payments encouraged farmers to (1) convert pasture, fallow and grassland to corn acreage, and (2) shift from other crops such as cotton to corn. In many cases, farmers adjusted crop rotation between corn and soybean to meet the corn demands (United States Department of Agriculture 2017). My research used NASS Cropland Data to characterize and determine the rates of land use land cover (LULC) change from 2006 to 2015 in the Big Sioux river (BSR) watershed. My research illustrates an increase of 22,000 acres of corn cropland; 375,000 acres of soybean cropland; 108,000 acres of other crops; and decrease of 437,000 acres of grassland and forests in the same time period from 2007 to 2015. These LULC changes are associated with various visible and invisible, and short and long term, environmental, economic, and health issues.

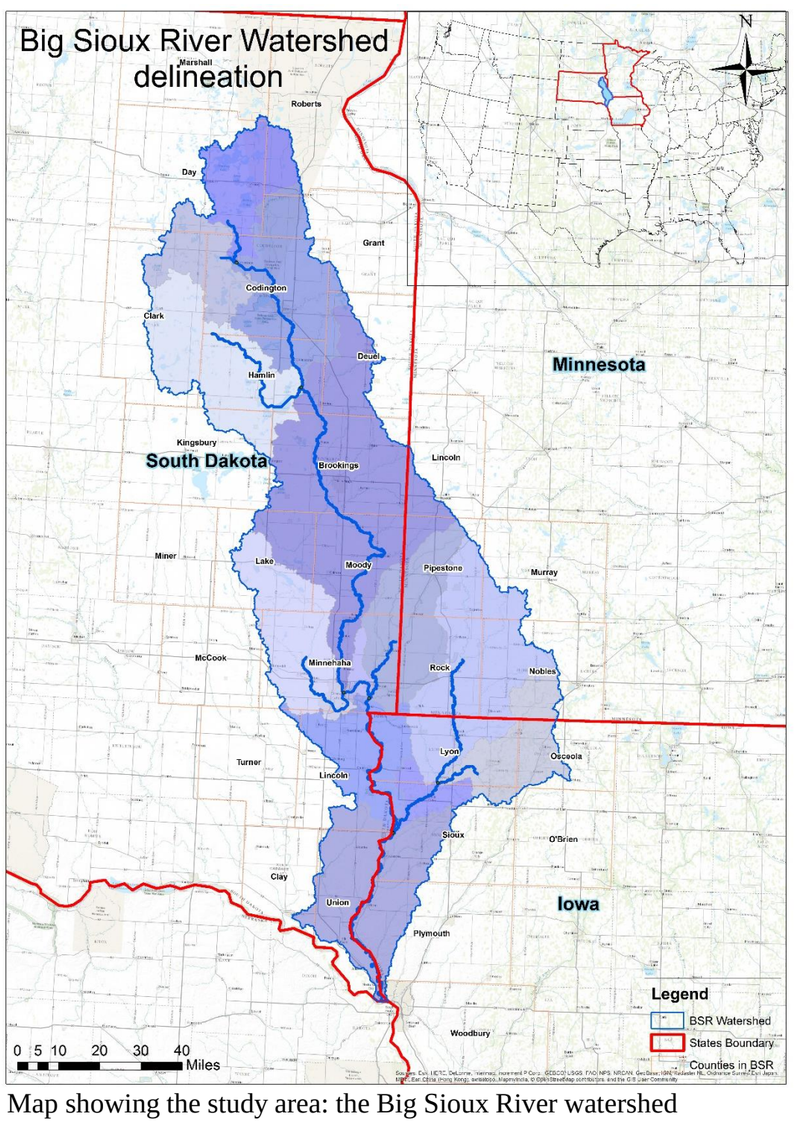
Objectives and Study Area

Objective:

- To study the LULC change in the BSR basin from 2007-15.
- To study the driving forces, connections, and consequences of the change.

Study Area:

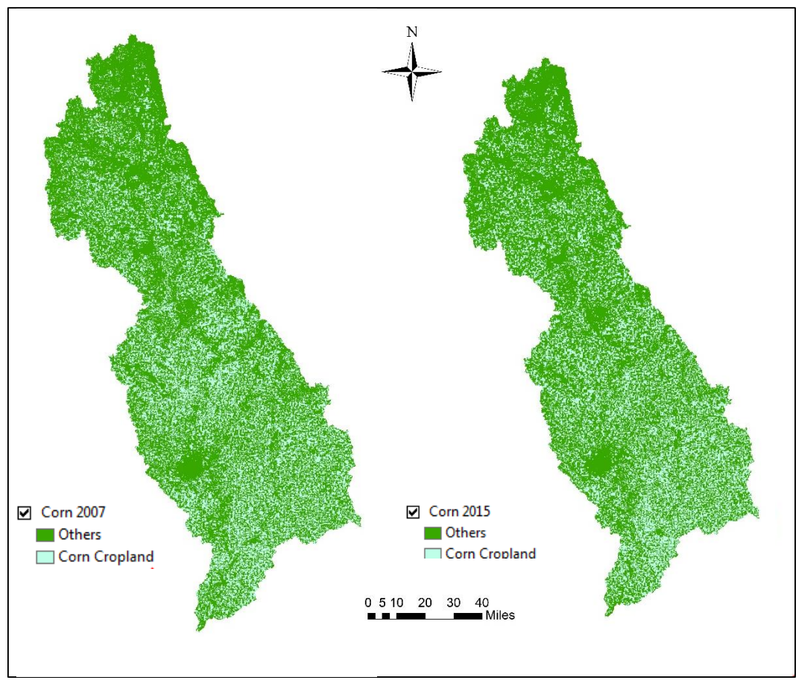
- The five most valuable agricultural products in South Dakota are cattle, corn (maize), soybeans, wheat, and hogs.
- In the SD, land use changes are mainly characterized by the conversion of rangeland, pastureland, and grassland to agricultural land uses. These changes are concentrated in the eastern part of the state.
- The Big Sioux River that drains most parts of eastern South Dakota is a 420 miles long river that begins in Robert County, SD and flows south until it meets up with the Missouri River in Sioux City, Iowa. It is approximately 5799 sq. miles in area.

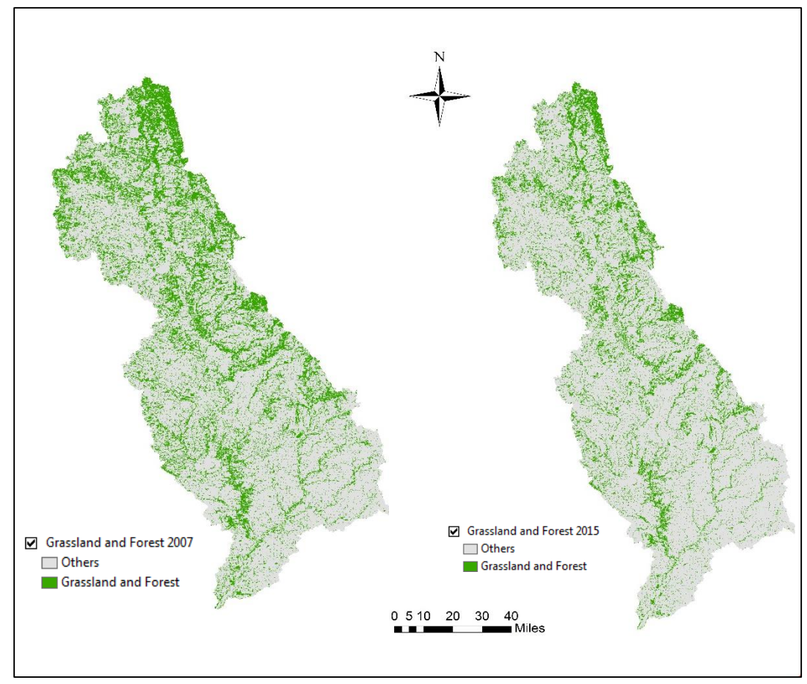


Map showing the study area: the Big Sioux River watershed

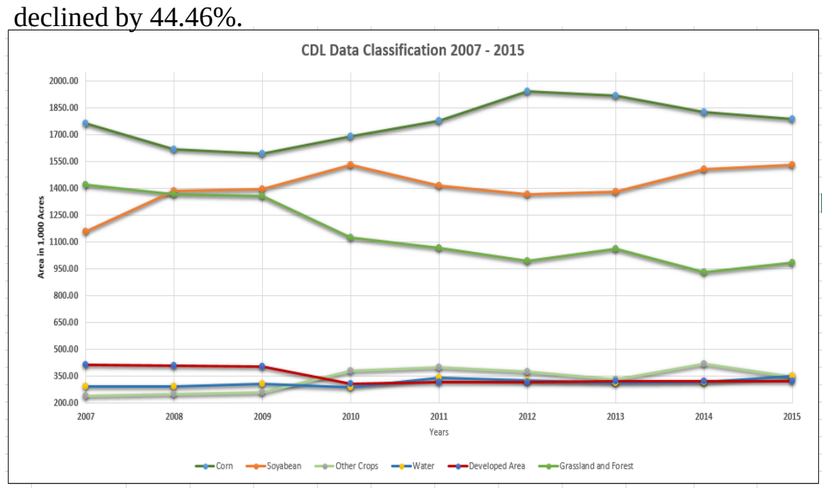
Methods and Results

Maps showing the land use/land cover change in the Big Sioux River from 2007 to 2015. The CDL dataset representing the watershed area was reclassified first. The reclassification was based on the attribute tables and the guidelines in the CDL metadata. Then, a comparison was made to estimate the conversion of one class type to/from another.





Maps showing (left) the comparison of corn cropland in 2007 and 2015, and (right) the comparison of grassland and forests during the same period in the BSR watershed. The corn cropland was 1765,000 acres which was increased by 1.21% in 2015, whereas the grassland and forest declined by 44.46%.



CDL data classification form 2007-2015. The CDL data was reclassified in 6 major groups: (1) Corn, (2) Soybean, (3) Other Crops, (4) Water/Wetlands, (5) Developed, and (6) Grassland and Forests. The areas are in acres. The graph shows that there has been a significant increase (252,000 acres) in corn cropland from 2010 to 2012 and is gradually decreasing.

Table 1: Contingency table for LULC change from 2007 to 2015. The table shows the proportion of land converting to/from other class types.

		2015	2015	2015	2015	2015	2015	
		Corn	Soybean	Other Crops	Water/ Wetlands	Developed	Grassland and Forest	Total
2007	Corn	21.55	8.80	1.78	0.28	0.29	0.64	33.34
2007	Soybean	5.78	14.19	1.13	0.12	0.23	0.43	21.87
2007	Other Crops	1.51	1.65	1.05	0.06	0.04	0.22	4.53
2007	Water/ Wetlands	0.33	0.15	0.28	4.29	0.05	0.48	5.58
2007	Developed	0.84	0.75	0.18	0.19	4.90	0.98	7.84
2007	Grassland and Forest	3.64	3.32	2.13	1.62	0.59	15.53	26.83
	Total	33.65	28.87	6.54	6.56	6.10	18.29	100.00

The contingency table shows the conversion of land form to/from other class types between the years 2007 and 2015. 0.64% of corn cropland were converted to grassland and forests whereas 3.64% of grassland and forests were converted to corn, resulting an increase of corn land by 1.21% (approx. 22,000 acres). The table also shows the loss (from corn to soybean) was greater than the gain (from soybean to corn). However, there were increases in corn and soybean acreage; 22,000 and 375,000 acres respectively. There was a loss of 437,000 acres of grassland and forests.

Conclusion and Discussion

- The study shows the year when there was a gain in corn cropland, there was a loss in soybean cropland. This gives an impression of rotation of corn and soybean cropland. However, there was a net gain of corn and soybean acreage and loss of other crops and grassland from 2007 to 2015.

- The Federal's declaration of making the U.S more energy independent, California's authorization of ethanol to be added to gasoline increased the demand on corn. High corn prices increased demands on corn production. Farmers used nitrogen fertilizers to supply adequate nitrogen to corn which otherwise would be supplied by soybean during crop rotation. This rotation of corn followed by corn lead to elevated use of nitrogen which when leached to ground/river water has a potential to lead to occurring of methemoglobinemia (blue baby syndrome) in babies, and various health concerns such as thyroid and bladder cancer to adults, eutrophication of rivers and formation of hypoxic zones in the coastal regions.

- Other driving forces such as crop insurance subsidies and disaster payments encouraged farmers to (1) convert pasture, fallow and grassland to corn acreage, and (2) shift from other crops such as cotton to corn (United States Department of Agriculture 2017). This increased corn acreage and met biofuel demands, and boosted economy, whereas degraded soil health and lead to soil erosion.

Data Sources

- Cropland Data Layer: United State Department of Agriculture (National Agriculture Statistics Service) https://www.nass.usda.gov/Research_and_Science/Cropland/SARS1a.php
- DEM data: USDA, Geospatial Data Gateway https://gdg.sc.egov.usda.gov/GDGOrder.aspx

References

- Olimb, S. 2013. Land conversion risk assessment: cropland/grassland conversion 2008-2012. *World Wildlife Fund*
- United States Department of Agriculture 2017. Economic Research Service. Corn. Accessed March 05, 2017. https://www.ers.usda.gov/topics/crops/corn/background/
- Wright, Christopher K., and Michael C. Wimberly. 2013. Recent land use change in the Western Corn Belt threatens grasslands and wetlands. *Proceedings of the National Academy of Sciences* 110 (10): 4134-4139.

PhDPosters.com
Your Research Poster, Printed For Less