



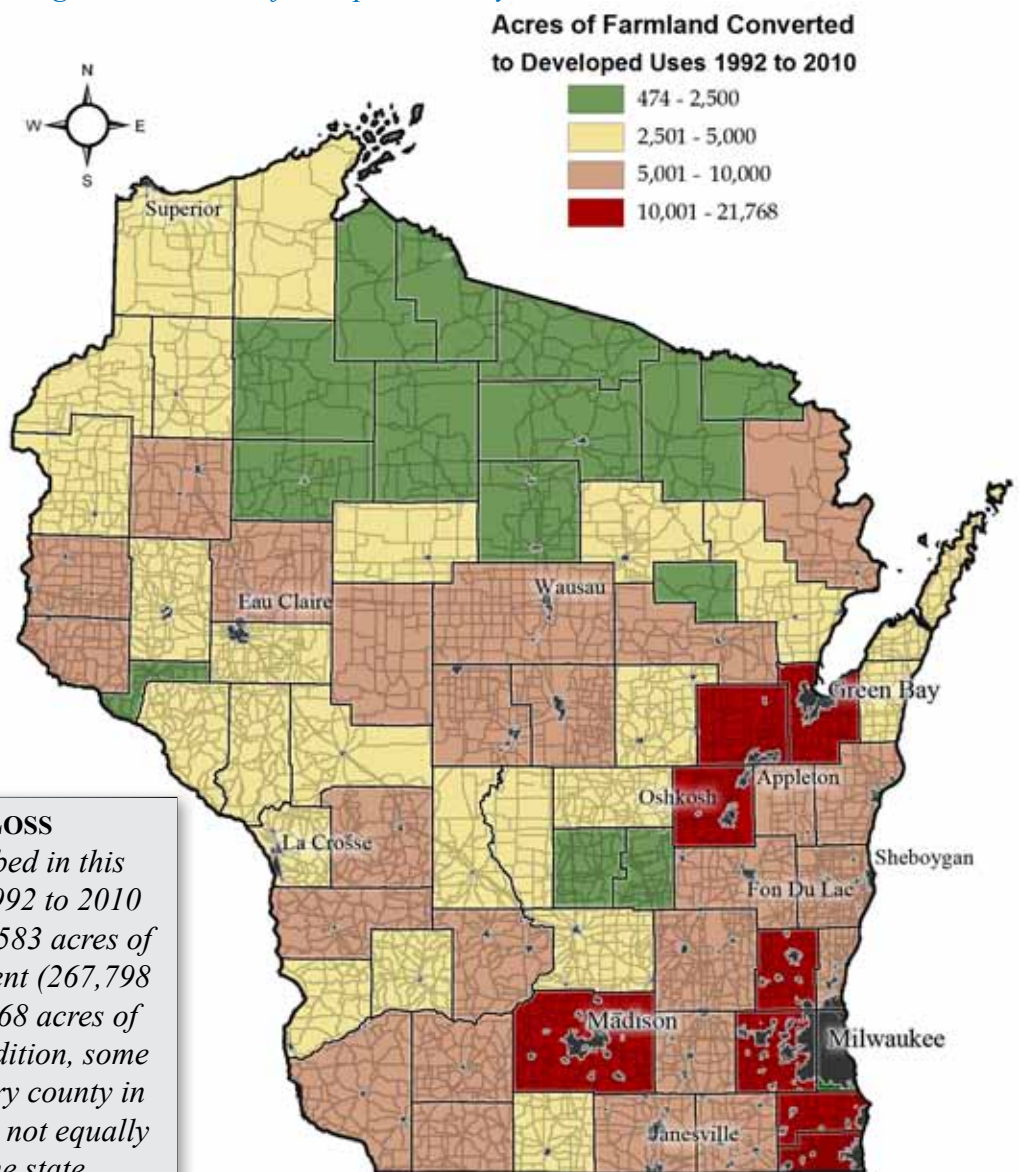
In 2009 the Natural Resources Inventory (NRI) conducted by the USDA in partnership with Iowa State University reported that more than 41 million acres of farmland in the United States were converted to developed uses from 1982 to 2007. This statistic underscores the concerns felt by many that the loss of farmland to urban development threatens the many benefits provided by the rural landscape; such as food production, wildlife habitat, and water infiltration. Wisconsin has not been immune to these changes in the landscape as the 2010-2011 biennial report on the Farmland Preservation Program by the Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP) cited an average loss of 22,500 acres of farmland to urban development annually from 2002 to 2007<sup>a</sup>.

## WISCONSIN FARMLAND LOSS

The purpose of this report is to provide local decision makers with an alternative source of county level farmland loss statistics. The approach described here involves using GIS software to overlay two different sets of land cover data, or more simply described as maps representing urban and farmland areas, from 1992 and 2010 for the entire state of Wisconsin. By overlaying these datasets from different time periods it is then possible to produce a county by county estimate of farmland conversion to developed uses.

<sup>a</sup> DATCP figures were developed based on the results of the 2007 NRI, which is the most recent data available.

Figure 1. Results of the Spatial Analysis



### TOTAL FARMLAND LOSS

*The spatial analysis described in this report identified that from 1992 to 2010 Wisconsin lost a total of 396,583 acres of farmland to urban development (267,798 acres of cropland and 126,768 acres of pasture or grassland). In addition, some farmland is being lost in every county in Wisconsin, but the effects are not equally distributed throughout the state.*

## FARMLAND PRESERVATION STATISTICS

Compared with other Midwestern states Wisconsin has taken a proactive policy approach to addressing the threat of urban development to farmland through the Working Lands Initiative that was authorized by the state legislature in 2009. However, as all 72 counties in Wisconsin try to respond to Chapter 91 statute to develop or update their farmland preservation plans there remains a critical data gap as the NRI does not provide county level statistics on farmland loss. This leaves decisions makers with only one national dataset, the NASS Census of Agriculture, to determine the rate of farmland loss in Wisconsin counties. Unlike the NRI that is based on the analysis of land cover change at 800,000 sampling points nationwide that are selected to create a representative picture of farmland loss at the state scale; the Census of Agriculture uses a survey methodology to ask landowners to provide information on a number of agricultural trends, including how much land they own or cultivate for agricultural production. The Census of Agriculture is a great resource for tracking trends within agriculture in the U.S., but its utility for tracking farmland conversion to urban development has been questioned (Thompson & Prokopy, 2009; Kline, 2000). The primary concern is that variations in the self-reported measures of how much acreage a landowner holds in their farm operation or in total harvested acreage is difficult to attribute directly to farmland being converted to urban development.

Table 1. WI Farmland Loss by the Numbers

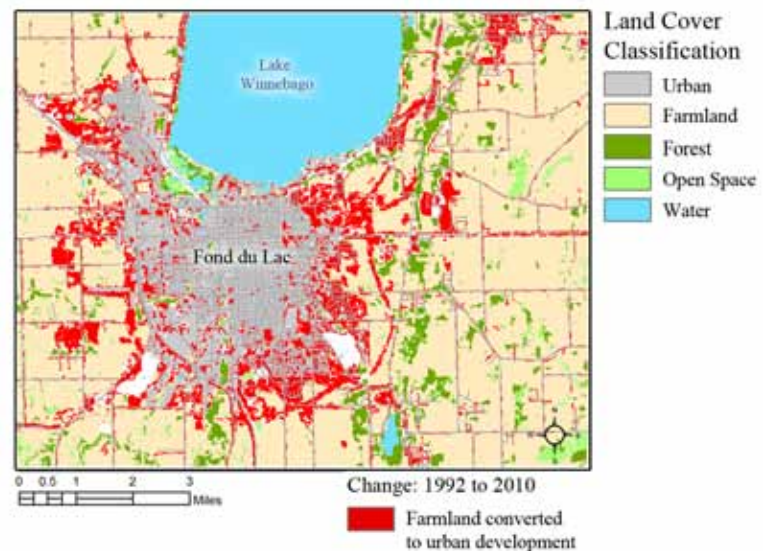
Source	Timeframe	Total Farmland Conversion	Annual Rate of Farmland Conversion
NRCS National Resources Inventory	1982 to 2007	(loss) 520,500 acres	(loss) 20,820 ac / yr.
NASS Census of Agriculture: Land in Farms	1992 to 2007	(loss) 364,424 acres	(loss) 26,030 ac / yr.
<b>*Spatial Analysis Results</b>	1992 to 2010	(loss) 396,583 acres	(loss) 22,032 ac / yr.

\*Note: Analysis method described below.

## SPATIAL ANALYSIS METHODOLOGY

The analysis was conducted using ArcGIS (ver. 9.2) and is intended as an alternative approach for assessing the rate and spatial distribution of farmland loss in Wisconsin. Instead of relying on survey data (Census of Agriculture) or land use sampling procedures (NRI) this approach uses land cover datasets that are developed using remote sensing techniques. These datasets identify different land cover types, such as urban, farmland, or forest for the entire state of Wisconsin represented in a series of tiles, each approximately a quarter acre in size (or 900 square meters). By overlaying the tiles from a current dataset (2010 NASS Cropland Data Layer) with an earlier dataset (1992 Wisconsin DNR WISCLAND Dataset) we are able to assess changes in land cover that allow us to determine if land classified as farmland in 1992 has been converted to urban land cover in 2010.

Figure 2. Initial 1992 / 2010 Overlay (Step 3)





A brief description of the steps used to conduct this analysis is provided below; however, for a more detailed description of the method used to conduct this analysis refer to Thompson and Prokopy (2009).

**STEP 1:** Create consistent land use classifications for the 1992 WISCLAND dataset and the 2010 NASS Cropland Data Layer.

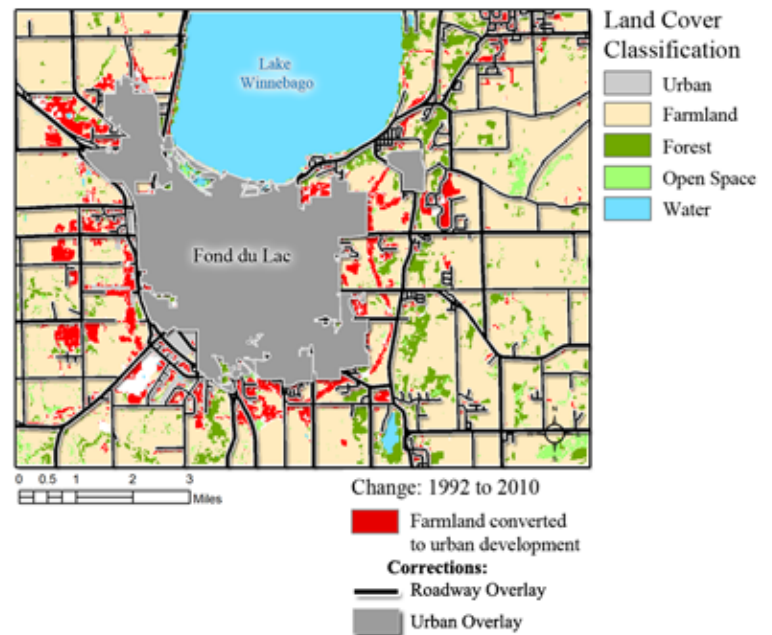
**STEP 2:** Integrate 2006 NLCD Impervious Cover layer with 2010 CDL to improve tracking of urban areas identified using aerial photograph comparisons.

**STEP 3:** Overlay modified 2010 CDL layer on 1992 WISCLAND layer to identify areas where land use classification has changed from farmland to urban or developed uses.

**STEP 4:** Clean the results by creating a buffer that removes existing roadways and urban areas from the dataset. This step is critical to correct for differences in the methods used to create the 1992 and 2010 datasets.

**STEP 5:** Extract the final results for each county.

Figure 3. Data Cleaning (Step 4)



The results of the initial overlay (Step 3) displayed in Figure 2 show a few of the issues associated with overlaying land cover datasets. Specifically, it is possible to see that roadways and areas within existing urban areas show up as farmland conversion. To correct this problem a data cleaning procedure (Step 4) shown in Figure 3 uses roadway and urban area overlays to remove these areas from the final farmland conversion results.

Table 2. Counties with the Highest Rate of Conversion

DNR Region	County	*Acres Farmland Converted to Developed Uses 1992 to 2010	U.S. Census 1990 to 2009 Population Change
SE	Waukesha	21,768	78,439
SC	Dane	20,466	124,272
NE	Outagamie	16,516	36,645
NE	Brown	14,974	52,725
NE	Winnebago	11,817	23,050
SE	Racine	10,357	25,567
SE	Washington	10,357	35,353
SE	Kenosha	10,077	37,201
SC	Grant	9,382	-301
WC	Vernon	9,274	3,707

## TESTING THE RESULTS

In order to compare the spatial analysis ‘farmland converted’ and the NASS Census of Agriculture ‘land in farms’ results a correlation analysis was conducted with population change (from the U.S. Census) using the statistics software SPSS. This analysis revealed an extremely strong, significant relationship ( $r = .833$ ) between the spatial analysis results and the population change variable that was not seen with the Census of Agriculture ‘land in farms’ variable ( $r = -.122$ ). These findings suggest that the spatial analysis is providing local decision makers with a better estimate of farmland conversion to urban development than the Census of Agriculture, which is not specifically designed to track this change.

Figure 4. Wisconsin DNR Regions



### SUMMARY AND CONCLUSIONS

The spatial analysis approach shown here demonstrates that available land cover datasets (even with their imperfections) can provide critical information for local decision makers. It is also important to recognize that this analysis focuses solely on the loss of farmland; however, forests and other open spaces in Wisconsin are also being lost as urban areas expand into the rural landscape.

### ACKNOWLEDGEMENTS

Analysis and document prepared by Aaron Thompson, Ph.D., Assistant Professor and Land Use Specialist, UW-Extension Center for Land Use Education, 2012.

### REFERENCES

- DATCP. 2011. Wisconsin Farmland Preservation Program 2010-2011 Biennial Report, Department of Agriculture, Trade and Consumer Protection, Madison, WI. [http://datcp.wi.gov/Environment/Working\\_Lands\\_Initiative/index.aspx](http://datcp.wi.gov/Environment/Working_Lands_Initiative/index.aspx)
- Kline, J.D., 2000. Comparing states with and without growth management analysis based on indicators with policy implications comment. *Land Use Policy* 17, 349–355.
- Thompson, Aaron and Prokopy, Linda. 2009. Tracking Urban Sprawl: Using Spatial Data to Inform Farmland Preservation Policy. *Land Use Policy* 26, 194 – 202.
- US Department of Agriculture. 2007. Census of Agriculture. Accessed February 2012. <http://www.agcensus.usda.gov/index.php>
- US Department of Agriculture. 2010. Wisconsin Cropland Data Layer. Accessed August 2011. [http://www.nass.usda.gov/Statistics\\_by\\_State/Wisconsin/Publications/Cropland\\_Data\\_Layer/index.asp](http://www.nass.usda.gov/Statistics_by_State/Wisconsin/Publications/Cropland_Data_Layer/index.asp)

Table 3. Farmland Loss by County

County	Acres	County	Acres	County	Acres
<b>DNR Region 1: Southeastern</b>					
Kenosha	10077	Racine	10357	Washington	10357
Milwaukee	1216	Sheboygan	5399	Waukesha	21768
Ozaukee	6011	Walworth	7383		
<b>DNR Region 2: South Central</b>					
Columbia	4842	Green	4009	Richland	2635
Dane	20466	Iowa	6424	Rock	7558
Dodge	8816	Jefferson	6748	Sauk	7334
Grant	9382	Lafayette	5530		
<b>DNR Region 3: West Central</b>					
Adams	4670	Jackson	4160	Portage	5531
Buffalo	2877	Juneau	4214	St. Croix	8373
Chippewa	5247	La Crosse	4460	Trempealeau	3556
Clark	5270	Marathon	9003	Vernon	9274
Crawford	3870	Monroe	7327	Wood	5073
Dunn	4426	Pepin	883		
Eau Claire	3641	Pierce	5867		
<b>DNR Region 4: Northeastern</b>					
Brown	14974	Manitowoc	7203	Shawano	6312
Calumet	5552	Marinette	5289	Waupaca	4758
Door	3867	Marquette	2252	Waushara	4121
Fond du Lac	7999	Menominee	474	Winnebago	11817
Green Lake	2348	Oconto	4463		
Kewaunee	2671	Outagamie	16516		
<b>DNR Region 5: Northern</b>					
Ashland	1149	Forest	844	Price	1377
Barron	6468	Iron	580	Rusk	2363
Bayfield	3766	Langlade	2714	Sawyer	1760
Burnett	3003	Lincoln	2158	Taylor	2978
Douglas	3063	Oneida	829	Vilas	1148
Florence	539	Polk	3863	Washburn	3027

- U.S. Department of Agriculture. 2009. Summary Report: 2007 National Resources Inventory, Natural Resources Conservation Service, Washington, DC, and Center for Survey Statistics and Methodology, Iowa State University, Ames, Iowa. 123 pages. [http://www.nrcs.usda.gov/technical/NRI/2007/2007\\_NRI\\_Summary.pdf](http://www.nrcs.usda.gov/technical/NRI/2007/2007_NRI_Summary.pdf)
- Wisconsin Department of Natural Resources. WISCLAND Land Cover Dataset, Wisconsin Initiative for Statewide Cooperation on Landscape Analysis and Data. Accessed August 2011. <http://dnr.wi.gov/maps/gis/datalandcover.html>