



ISSUE BRIEF

# CLIMATE-READY SOIL: HOW COVER CROPS CAN MAKE FARMS MORE RESILIENT TO EXTREME WEATHER RISKS

## Wisconsin

Wisconsin is known for its dairies and ranks second in the nation in milk production.<sup>1</sup> While livestock (including dairy) and poultry account for more than 60 percent of Wisconsin’s agricultural income, the state is also an important producer of a diverse range of crops, from corn, soybeans, and wheat to cranberries, apples, potatoes, and Christmas trees.<sup>2</sup> Climate change impacts have already begun to ripple through Wisconsin’s agricultural industry and will only intensify further, underscoring the need for farmers to build soil health using cover crops and other soil stewardship practices to better manage extreme weather risks in the years ahead.

### IMPORTANCE OF THE AGRICULTURAL SECTOR

Wisconsin ranks eighth in the nation in agricultural sector value, with its nearly 70,000 farms and ranches producing more than \$14 billion worth of agricultural products in 2013.<sup>3</sup> Although most of Wisconsin’s income is from livestock (over \$7 billion), crop sales have grown rapidly in recent years, nearly doubling from \$2.7 billion in 2007 to \$4.6 billion in 2012.<sup>4</sup> The state’s top crops are corn, soybeans, hay, and vegetables.<sup>5</sup> However, milk from cows is the top agricultural product, bringing in nearly \$5 billion to Wisconsin in 2012; other top livestock products include chickens, cattle, and turkeys.<sup>6</sup>

Table 1. Wisconsin’s Top 5 Crop Commodities by Value in 2014<sup>7</sup>

Commodity	Value
Corn	\$1.8 billion
Soybeans	\$795 million
Hay	\$732 million
Potatoes	\$274 million
Cranberries	\$138 million

Half of total corn/soybean acres planted with cover crops



Agriculture contributes an estimated \$30 billion in total income to the Wisconsin economy, with nearly \$9 billion from on-farm activity and approximately \$21 billion from food processing.<sup>8</sup> Moreover, agriculture and related industries employ more than 413,000 people in the state.<sup>9</sup> In addition to being an economic powerhouse at the state level, agriculture is important to local economies. More than one-quarter of total jobs in nearly one out of every five counties in Wisconsin is in agriculture.<sup>10</sup>

### EXTREME WEATHER AND CLIMATE CHANGE IMPACTS ON AGRICULTURE

Wisconsin farmers are no strangers to extreme weather and its impacts on crops. From 2012 to 2014, the state had 171 USDA county disaster declarations for drought, excessive rain, or flooding.<sup>11</sup> From 2010 to 2014, insured crop losses due to drought, heat, hot wind, extreme precipitation, and flooding events totaled nearly \$984 million.<sup>12</sup> In June 2008, heavy rain caused severe flooding in southern Wisconsin, causing \$300 to \$400 million in crop losses alone.<sup>13</sup> When the 2012 drought hit Wisconsin, corn production dropped by nearly 17 percent and soybean yields declined by 16 percent compared with the previous year.<sup>14</sup> Producers in the southern part of the state experienced the worst losses, and vegetable and fruit growers took the hardest hits: apple production dropped by 60 percent and cherry production by 90 percent.<sup>15</sup> Despite the decreased production of many crops, farm incomes remained high that year due to rising commodity prices following the widespread drought. The Federal Crop Insurance Program (FCIP) also paid out more than \$370 million that year, easing the financial burden on Wisconsin farmers.<sup>16</sup>

Additional information on this topic is available for download at [www.nrdc.org/water/climate-ready-soil.asp](http://www.nrdc.org/water/climate-ready-soil.asp)

For more information, please contact:

**Ben Chou**  
bchou@nrdc.org  
switchboard.nrdc.org/blogs/bchou

**Claire O'Connor**  
coconnor@nrdc.org  
switchboard.nrdc.org/blogs/coconnor

**Lara Bryant**  
lbryant@nrdc.org  
switchboard.nrdc.org/blogs/lbryant

[www.nrdc.org/policy](http://www.nrdc.org/policy)  
[www.facebook.com/nrdc.org](https://www.facebook.com/nrdc.org)  
[www.twitter.com/nrdc](https://www.twitter.com/nrdc)

NOVEMBER 2015  
IB:15-II-L

Temperatures in Wisconsin have already risen, but increases vary regionally and seasonally. By mid-century, annual average temperatures are expected to increase by 4°F to 9°F, especially during the winter and in the northwestern part of the state.<sup>17</sup> Extreme heat is also likely to become more common. Currently the state sees an average of about one day per year when temperatures exceed 95°F. However, Wisconsin could see 4 to 17 extremely hot days (over 95°F) per year by mid-century and 11 to 59 extremely hot days by the end of the century.<sup>18</sup>

As the growing season increases by up to a full month in central and northwestern Wisconsin,<sup>19</sup> a shift toward the planting of more high-yielding commodity crops like corn and soybeans could occur. The dairy and livestock industries are likely to be negatively impacted, however, as milk production declines at higher temperatures. As the cost of keeping cattle cool increases, more farmers may shift away from dairies and into crop production.<sup>20</sup> Without adequate protection for soil, these shifts in cropping practices could exacerbate environmental concerns and make Wisconsin farmers even more vulnerable to erosion from extreme weather events.<sup>21</sup> More extreme heat will also reduce labor productivity in “high risk” sectors like agriculture, where workers spend significant time outdoors.<sup>22</sup>

Across Wisconsin between 1950 and 2006, average annual precipitation increased by 10 percent overall and by 21 percent during fall seasons.<sup>23</sup> These trends are likely to continue, with increased precipitation during the spring, fall, and winter but decreased precipitation in the summer.<sup>24</sup> Drier summers in conjunction with hotter temperatures are likely to increase the chance of drought.<sup>25</sup> Wetter spring conditions could negatively impact agriculture by delaying planting, reducing yields, and compacting soil.<sup>26</sup> Heavy rainfall events have already increased in frequency and magnitude and are most likely to become both more common and more intense in the future.<sup>27</sup> These precipitation changes are expected to more than double the rate of soil erosion by 2050.<sup>28</sup> Overall, higher temperatures and precipitation changes could reduce corn yields by up to 15 percent by mid-century and by nearly 60 percent by the end of the century.<sup>29</sup>

## **COVER CROPS CAN HELP COMBAT THE PRESSURES OF CLIMATE CHANGE ON WISCONSIN AGRICULTURE**

Cover crops, which are planted to protect and improve soil health, have been shown to increase soil’s water-holding capacity, allowing farmers to capture more water from heavy rainfall events and store that water for increasingly hot summer days.<sup>30</sup> In fact, using cover crops (and other soil stewardship practices, like no-till farming and compost application) to increase soil organic matter on just half of Wisconsin’s corn and soybean acres could help store nearly an additional 60 billion gallons of water—enough to meet the needs of almost 1.9 million people for a year.<sup>31</sup>

Cover crops can also help farmers cope with the increased weed pressures associated with a shifting growing season, as well-managed cover crops can be used to suppress unwanted weeds.<sup>32</sup> Further, cover crops have been shown to increase yields: during the 2012 drought, cover crops demonstrated their ability to build agricultural resiliency by providing the most yield benefit in areas that were hardest hit by extremely dry weather.<sup>33,34</sup>

Cover crops can also help to reduce emissions of greenhouse gases that contribute to climate change by sequestering carbon and reducing the need for synthetic fertilizers, whose production and transport result in more greenhouse gas emissions.<sup>35,36</sup> Growing cover crops on half of Wisconsin’s corn and soybean acres could reduce greenhouse gas emissions by 1.1 million metric tons per year—the equivalent of taking more than 232,000 cars off the road.<sup>37</sup>

Even though cover crops provide multiple benefits, only slightly more than 5 percent of cropland in Wisconsin is currently planted with cover crops.<sup>38</sup> Many more acres of cover crops can be planted in the state; this and more widespread adoption of other soil stewardship practices can help build the health of soils and better equip Wisconsin farmers to deal with extreme weather risks.

### **TEACHING FARMERS THE VALUE OF COVER CROPS<sup>39</sup>**

Based in Spring Valley, Wisconsin, the nonprofit Midwest Organic & Sustainable Education Service (MOSES) is teaching farmers how to make cover crops work within organic operations. Farmer Harriet Behar is an organic specialist at MOSES who has been growing cover crops on her 216-acre organic farm for years, mainly for weed suppression and soil health. In July 2015, the organization hosted a field day for local farmers, demonstrating 14 different kinds of cover crops on Behar’s farm. MOSES also published a guide on choosing cover crops for upper Midwest farmers. Behar and MOSES also participate in the National Wildlife Federation’s Cover Crop Champions program.

## ENDNOTES

- 1 U.S. Department of Agriculture (USDA), “2014 State Agriculture Overview: Wisconsin,” [www.nass.usda.gov/Quick\\_Stats/Ag\\_Overview/stateOverview.php?state=WISCONSIN](http://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=WISCONSIN), accessed August 20, 2015.
- 2 Ibid.
- 3 Calculated using Quick Stats 2.0 from *2012 Census of Agriculture*, National Agricultural Statistics Service, USDA, [quickstats.nass.usda.gov/?source\\_desc=CENSUS](http://quickstats.nass.usda.gov/?source_desc=CENSUS); and Economic Research Service, USDA, “Farm Income and Wealth Statistics,” [www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/farm-finance-indicators-state-ranking.aspx#P306c61b678334197bd741313545e8e5e\\_5\\_184iTOR0x3](http://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/farm-finance-indicators-state-ranking.aspx#P306c61b678334197bd741313545e8e5e_5_184iTOR0x3), accessed August 23, 2015.
- 4 USDA, “Table 2. Market Value of Agricultural Products Sold Including Landlord’s Share and Direct Sales: 2012 and 2007,” *2012 Census of Agriculture: Wisconsin State and County Data*, Volume 1, Geographic Area Series, Part 49, 2014, [www.agcensus.usda.gov/Publications/2012/Full\\_Report/Volume\\_1,\\_Chapter\\_1\\_State\\_Level/Wisconsin/](http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/Wisconsin/).
- 5 Ibid.
- 6 Ibid.
- 7 Ibid.
- 8 Steven Deller, *Contribution of Agriculture to the Wisconsin Economy: Updated for 2012* (2014), 2, University of Wisconsin – Madison/Extension, [wp.aae.wisc.edu/wfp/wp-content/uploads/sites/5/2014/09/Impact-of-Agriculture-2012-FINAL.pdf](http://wp.aae.wisc.edu/wfp/wp-content/uploads/sites/5/2014/09/Impact-of-Agriculture-2012-FINAL.pdf).
- 9 Ibid.
- 10 Steven Deller and David Williams, *The Economic Impacts of Agriculture in Wisconsin Counties*, University of Wisconsin – Extension, 2011, 16-17, [anre.uwex.edu/files/2015/02/EconomicImpactsOfAg\\_2011.pdf](http://anre.uwex.edu/files/2015/02/EconomicImpactsOfAg_2011.pdf).
- 11 Calculated using 2012-2014 “Disaster Designation Information” from Farm Service Agency, USDA, “Disaster Assistance Program,” [www.fsa.usda.gov/programs-and-services/disaster-assistance-program/index](http://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/index), accessed April 15, 2015.
- 12 Calculated using 2010-2014 data from Risk Management Agency, USDA, “Cause of Loss Historical Data Files,” [www.rma.usda.gov/data/cause.html](http://www.rma.usda.gov/data/cause.html) accessed April 16, 2015. Causes of loss include drought, excess moisture/precipitation/rain, excess sun, failure of irrigation supply, flood, heat, hot wind, hurricane/tropical depression, and inability to prepare land for irrigation.
- 13 Faith A. Fitzpatrick et al., “Flood of June 2008 in Southern Wisconsin,” U.S. Geological Survey Scientific Investigations Report 2008-5235, 2008, [pubs.usgs.gov/sir/2008/5235/pdf/sir20085235.pdf](http://pubs.usgs.gov/sir/2008/5235/pdf/sir20085235.pdf).
- 14 Yilang Peng, “A Year of Gains and Losses: How the 2012 Drought Affected Wisconsin Agriculture,” *Madison Commons*, March 12, 2013, [www.madisoncommons.org/?q=node/1720](http://www.madisoncommons.org/?q=node/1720).
- 15 Ibid.
- 16 Claire O’Connor, “Soil Matters: How the Federal Crop Insurance Program Should Be Reformed to Encourage Low-Risk Farming Methods With High-Reward Environmental Outcomes,” Natural Resources Defense Council, 2013, [www.nrdc.org/water/soil-matters/](http://www.nrdc.org/water/soil-matters/).
- 17 Wisconsin Initiative on Climate Change Impacts (WICCI), *Wisconsin’s Changing Climate: Impacts and Adaptation*, 2011, 27, [www.wicci.wisc.edu/report/2011\\_WICCI-Report.pdf](http://www.wicci.wisc.edu/report/2011_WICCI-Report.pdf).
- 18 “Heat in the Heartland: Climate Change and Economic Risk in the Midwest,” *Risky Business: The Economic Risks of Climate Change in the United States*, Risky Business Project, 2015, 39, [riskybusiness.org/midwest-report/pdf](http://riskybusiness.org/midwest-report/pdf).
- 19 WICCI 2011 at 27.
- 20 Union of Concerned Scientists, “Confronting Climate Change in the U.S. Midwest: Wisconsin,” July 2009, [www.ucsusa.org/sites/default/files/legacy/assets/documents/global\\_warming/climate-change-wisconsin.pdf](http://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/climate-change-wisconsin.pdf).
- 21 Chris Hubbuch, “Crop Boom Threatens Land in Birthplace of Soil Conservation,” *LaCrosse Tribune*, November 12, 2013, [lacrosetribune.com/news/local/crop-boom-threatens-land-in-birthplace-of-soil-conservation/article\\_d2f86c88-4b50-11e3-9832-001a4bcf837a.html](http://lacrosetribune.com/news/local/crop-boom-threatens-land-in-birthplace-of-soil-conservation/article_d2f86c88-4b50-11e3-9832-001a4bcf837a.html).
- 22 “Heat in the Heartland,” at 18.
- 23 WICCI, “Wisconsin’s Changing Climate,” at 15.
- 24 “Heat in the Heartland,” at 12.
- 25 Ibid.
- 26 Ibid., at 97.
- 27 WICCI, “Wisconsin’s Changing Climate,” at 28, 32.
- 28 Ibid., at 7.
- 29 “Heat in the Heartland,” at 19.
- 30 Humberto Blanco-Canqui et al., “Addition of Cover Crops Enhances No-Till Potential for Improving Soil Physical Properties,” *Soil Science Society of America Journal* 75, no. 4 (2011): 1471-1482.
- 31 Ibid.
- 32 E.A. Nord et al., “Integrating Multiple Tactics for Managing Weeds in High Residue No-Till Soybean,” *Agronomy Journal* 103, no. 5 (2011): 1542-1551.
- 33 Sustainable Agriculture Research and Education (SARE), “2015 Cover Crop Survey Analysis,” [www.sare.org/Learning-Center/From-the-Field/North-Central-SARE-From-the-Field/2015-Cover-Crop-Survey-Analysis](http://www.sare.org/Learning-Center/From-the-Field/North-Central-SARE-From-the-Field/2015-Cover-Crop-Survey-Analysis), accessed August 7, 2015.
- 34 SARE, “2012 Cover Crop Survey Analysis,” [www.sare.org/Learning-Center/From-the-Field/North-Central-SARE-From-the-Field/2012-Cover-Crop-Survey-Analysis](http://www.sare.org/Learning-Center/From-the-Field/North-Central-SARE-From-the-Field/2012-Cover-Crop-Survey-Analysis), accessed August 7, 2015.
- 35 Kenneth Olson, Stephen A. Ebelhar, and James M. Lang, “Long-Term Effects of Cover Crops on Crop Yields, Soil Organic Carbon Stocks and Sequestration,” *Open Journal of Soil Science* 4 (2014): 284-292
- 36 Todd W. Andraski and Larry G. Bundy, “Cover Crop Effects on Corn Yield Response to Nitrogen on an Irrigated Sandy Soil,” *Agronomy Journal* 97, no. 4 (2005): 1239-1244.
- 37 See Appendix for explanation of methodology.
- 38 USDA, “Table I. Historical Highlights: 2012 and Earlier Census Years,” and “Table 50. Land Use Practices by Size of Farm: 2012,” *2012 Census of Agriculture: Wisconsin State and County Data*, Volume 1, Geographic Area Series, Part 49, 2014, [www.agcensus.usda.gov/Publications/2012/Full\\_Report/Volume\\_1,\\_Chapter\\_1\\_State\\_Level/Wisconsin/](http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/Wisconsin/).
- 39 Midwest Organic & Sustainable Education Service (MOSES), “Organic Field Day, July 21, 2015,” [mosesorganic.org/events/organic-field-days/cover-crops/](http://mosesorganic.org/events/organic-field-days/cover-crops/) and “How to Choose Cover Crops,” 2015, [mosesorganic.org/wp-content/uploads/Publications/Fact\\_Sheets/Cover-Crops.pdf](http://mosesorganic.org/wp-content/uploads/Publications/Fact_Sheets/Cover-Crops.pdf).