ISSUE BRIEF

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

Texas

Half of total corn/soybean acres planted with cover crops

297,000 METRIC TONS OF GHGs CAPTURED ANNUALLY

19 BILLION GALLONS OF WATER STORED

Agriculture is big business in the Lone Star State, with an estimated annual economic worth of $120 billion.[1] While Texas is perhaps best known for its cattle, poultry, and other livestock, it is also a significant producer of crop commodities like cotton and corn. Recent droughts and floods, which have caused billions of dollars in losses, demonstrate that farms in Texas also are highly vulnerable to extreme weather and climate impacts. Hotter temperatures and decreased rainfall due to climate change will only exacerbate farming risks.[2] However, greater adoption of soil stewardship practices like cover crops and no-till farming on Texas farms can dramatically improve soil health and enable farmers to better weather future drought and flood events.

IMPORTANCE OF THE AGRICULTURAL SECTOR

Texas's 248,900 farms and ranches produced more than $26 billion of products in 2013.[3] In 2014 the state's total agricultural sector production value was approximately $30 billion, the third-highest state total in the nation. Additionally, the state exported $6.5 billion in agricultural commodities in 2012, with cotton, beef, and other animal products leading the way.[4] While Texas is the United States' top producer of livestock, poultry, and related products, it is also among the top 10 states in total crop production.

Table I. Texas's Top 5 Crop Commodities by Value in 2014[5]

Commodity	Value
Cotton	$2.1 billion
Corn	$1.3 billion
Hay	$978 million
Sorghum	$553 million
Wheat	$432 million

In 2013 more than 519,000 people were directly employed by farms or in agricultural support activities.[6] Overall, the state estimates that one out of every seven working Texans, or 14 percent of the working population, is in an agriculture-related job.[7]

In 2012 approximately 8 percent of the state's gross domestic product (GDP) involved economic activities related to agricultural production.[8] While other industries may account for greater proportions of the state's GDP, many areas of the state depend heavily on agriculture to support the local economy. The top five counties in agricultural sales had receipts of nearly $6 billion in 2012, or almost one-quarter of the state's total agricultural sales.[9] Further, agriculture-related jobs accounted for 50.5 to 86.5 percent of all private-sector employment in these five counties.

EXTREME WEATHER AND CLIMATE CHANGE IMPACTS ON AGRICULTURE

As demonstrated by record-breaking droughts and floods in recent years, agriculture in Texas is highly vulnerable to extreme weather and climate impacts. From 2012 to 2014, the state had 1,931 USDA county disaster declarations for drought, flooding, excessive rain, or excessive heat.[10] From 2010 to 2014, insured crop losses due to drought, heat, hot wind, extreme precipitation, and flooding events exceeded $5.1 billion.[11]

In recent years, Texas has experienced both widespread and severe droughts and record flooding. In 2011, record-low rainfall coupled with record-high temperatures led to extreme or exceptional drought conditions covering up to 96 percent of the entire state.[12] Millions of acres of crops received insufficient rainfall to germinate planted seeds, and reduced water supplies and lack of local hay resulted in significant culling of livestock herds.[13] In total, drought

Additional information on this topic is available for download at www.nrdc.org/water/climate-ready-soil.asp

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conditions caused an estimated $5.2 billion in direct agricultural losses and an additional $3.5 billion in indirect losses to agricultural industries.[14] Drought conditions lingered in Texas until May of 2015, when record-breaking heavy rainfall led to flooding in major cities.[15] While this nearly eliminated drought in the state, this rainfall was not entirely beneficial to farmers. The severe storm systems that brought the heavy rains also contained hail that damaged crops, and excessive flooding that followed will likely negatively impact cotton and wheat yields when the numbers are in for 2015.[16]

Increasing temperatures and greater precipitation extremes are only expected to worsen in the future, further threatening Texas's farms and ranches. In the next several decades, temperatures are expected to increase by 2°F to 4°F, and by the end of the century, summer temperatures could increase by 5°F to 9°F.[17] Additionally, the number of days with temperatures exceeding 100°F is projected to quadruple by 2050.[18] The increase in extreme heat will not only have a direct impact on crop yields but also reduce the productivity and threaten the well-being of agricultural workers. Yields of cotton and corn, the state's most valuable crop commodities, will likely decrease by up to 6 percent and 22 percent, respectively, over the coming decades due to extreme heat alone.[19] In addition, farm laborers are among the most vulnerable workers to extreme heat stress, which can lead to exhaustion or heatstroke. At temperatures above 85°F, workers in high-risk sectors like farming experience productivity losses of as much as one hour per day.[20]

Summertime precipitation is projected to decrease by as much as 5 percent over the next 30 to 40 years and 20 percent by the end of the century.[21] The projections for winter precipitation are direr: a 15 to 20 percent reduction in the coming decades and a 20 to 25 percent decrease by the end of the century.[22] Additionally, precipitation that does occur is expected to fall in heavier events separated by longer dry spells.[23] More extreme heat coupled with more consecutive dry days will increase evaporation and reduce water supplies, while also increasing demand for irrigation. These drought conditions likely will further increase withdrawals from already depleted groundwater supplies like the Ogallala Aquifer and increase conflicts with rapidly growing urban areas over dwindling water supplies.[24,25] Although many Texas farmers rely on the Ogallala Aquifer for irrigation, water levels in parts of the state's Panhandle region have declined by more than 150 feet.[26] Without improved stewardship, the Ogallala Aquifer may no longer be able to provide the water needed for irrigation; in fact, some areas already are unable to support large-volume withdrawals.[27]

COVER CROPS CAN HELP COMBAT THE PRESSURES OF CLIMATE CHANGE ON TEXAS AGRICULTURE

Practices that build soil health, like cover cropping, can help Texas farmers to become more resilient to extreme weather and climate risks. Cover crops increase the water-holding capacity of soil, allowing farmers to capture more water from heavy rainfall events as well as to store water for increasingly hot and dry summers.[28] In fact, increasing soil organic matter on just half of the state's corn and soybean acres using cover crops (and other soil stewardship practices, like no-till farming and compost application) could help store an additional 19 billion gallons of water—enough to provide almost 600,000 people with water for one year.[29] Cover crops can also help farmers cope with the increased weed pressures associated with the shifting growing season by suppressing weed growth and breaking weed cycles.[30] Further, cover crops have been shown to increase yields: during the 2012 drought, they demonstrated their ability to build agricultural resiliency by providing the greatest yield benefit in areas that were hardest hit by extremely dry weather.[31,32]

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.[33,34] Growing cover crops on just half of Texas's corn and soybean acres could reduce greenhouse gas emissions by nearly 297,000 metric tons each year—the equivalent of taking almost 62,500 cars off the road.[35]

While Texas has the most cover crops planted in the nation (more than 900,000 acres in 2012), only about 3 percent of total cropland in the state uses cover crops.[36] Farmers have a significant opportunity to use cover crops and other soil stewardship practices to improve the health of soils, thereby combating climate change and making their farms more resilient to future droughts and floods.

SOIL HEALTH REVITALIZES A FAMILY FARM IN ROGERS, TEXAS[37]

Jonathan and Kaylyn Cobb know firsthand how taking care of the soil can reap benefits for a farm. The Cobbs are fourth-generation farmers in central Texas who nearly gave it up after repeatedly failing to turn a profit on commodity crops because of ever-increasing and more expensive inputs. Once they realized the value of healthy soil, which better holds water, nutrients, and carbon, they began managing it as a living resource, planting a mix of cover crops and adopting no-till farming to protect and nurture the soil. As a result, they experienced a rapid increase in soil carbon levels and saw their productivity increase. They also noticed greater wildlife diversity than ever before. The Cobbs have also diversified the family's farm, introducing livestock to take advantage of the grazing opportunities provided by cover crops. These changes not only have resulted in environmental benefits, but also have led to higher income per acre from fewer acres.

ENDNOTES

1 Texas A&M AgriLife, *The Food and Fiber System and Production Agriculture's Contributions to the Texas Economy*, November 2014, extensionagrilifeorg.c.presscdn.com/wp-content/uploads/2014/12/FoodFiber2014.pdf.

2 Dennis Ojima et al., "Chapter 19: Great Plains," *Climate Change Impacts in the United States: The Third National Climate Assessment*, U.S. Global Change Research Program, 2014, 444, doi:10.7930/J0D798BC.

3 Calculated using Quick Stats 2.0 from *2012 Census of Agriculture*, National Agricultural Statistics Service, U.S. Department of Agriculture (USDA), 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_184iT0R0x3, accessed August 23, 2015.

4 Texas Department of Agriculture (TDA), "Texas Ag Stats," 2015, www.texasagriculture.gov/About/TexasAgStats.aspx, accessed July 1, 2015.

5 USDA, "2014 State Agriculture Overview: Texas," www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=TEXAS, accessed July 1, 2015.

6 Bureau of Economic Analysis, U.S. Department of Commerce, "Interactive Data—Regional Data: GDP & Personal Income," www.bea.gov/iTable/index_regional.cfm, accessed April 13, 2015.

7 TDA, "Texas Ag Stats."

8 Texas A&M AgriLife, *The Food and Fiber System*.

9 Economic Research Service, USDA, "State Fact Sheets: Texas," www.ers.usda.gov/data-products/state-fact-sheets/state-data.aspx?StateFIPS=48&StateName=Texas, accessed July 27, 2015.

10 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, accessed April 15, 2015.

11 Calculated using 2010-2014 data from Risk Management Agency, USDA, "Cause of Loss Historical Data Files," 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.

12 John W. Nielsen-Gammon, *The 2011 Texas Drought: A Briefing Packet for the Texas Legislature*, October 31, 2011), 27, climatexas.tamu.edu/files/2011_drought.pdf.

13 Blair Fanning, "Updated 2011 Texas Agricultural Drought Losses Total $7.62 Billion," *AgriLife Today*, March 21, 2012, today.agrilife.org/2012/03/21/updated-2011-texas-agricultural-drought-losses-total-7-62-billion/.

14 Susan Coombs, Texas Comptroller of Public Accounts, "The Impact of the 2011 Drought and Beyond," February 6, 2012, comptroller.texas.gov/specialrpt/drought/96-1704-Drought.pdf.

15 Wei Du and Tom Jeffery Sr., "From Drought to Flood—The Sudden Exchange of One Hazard for Another in Texas," *Insurance Journal*, June 11, 2015, www.insurancejournal.com/blogs/corelogic/2015/06/11/371525.htm.

16 Gordon Dickson, "For North Texas Farmers, It Really Is Too Wet to Plow," *Star-Telegram*, May 19, 2015, www.star-telegram.com/news/local/article21385941.html.

17 USDA, *Climate Change and Agriculture in the United States: Effects and Adaptation*, 2013, 29-30, www.usda.gov/oce/climate_change/effects_2012/CC%20and%20Agriculture%20Report%20(02-04-2013)b.pdf.

18 Ojima et al., "Chapter 19: Great Plains."

19 "Climate Change and the Economy: Texas," *Risky Business: The Economic Risks of Climate Change in the United States*, Risky Business Project, 2014, 3, riskybusiness.org/uploads/files/Texas-v2.7.pdf.

20 Ibid.

21 USDA, *Climate Change and Agriculture*, at 31.

22 Ibid.

23 Ojima et al., "Chapter 19: Great Plains," at 445.

24 The Ogallala Aquifer is also known as the High Plains Aquifer.

25 Ojima et al., "Chapter 19: Great Plains," at 448.

26 U.S. Geological Survey, "Water Level and Storage Changes in the High Plans Aquifer, Predevelopment to 2013, and 2011-2013," 2014, ne.water.usgs.gov/ogw/hpwlms/files/HPAq_WLC_pd_2013_SIR_2014_5218_pubs_brief.pdf.

27 Nicole C. Brambila, "Drying Times: Could the Rapidly Depleting Ogallala Aquifer Run Dry?" *Lubbock Avalanche-Journal*, August 9, 2014, lubbockonline.com/local-news/2014-08-09/drying-times-could-rapidly-depleting-ogallala-aquifer-run-dry#.VfMKyxFVhBc.

28 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.

29 Ibid.

30 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.

31 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, accessed August 7, 2015.

32 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, accessed August 7, 2015.

33 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.

34 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.

35 See Appendix for explanation of methodology.

36 USDA, "Table 1. Historical Highlights: 2012 and Earlier Census Years," and "Table 50. Land Use Practices by Size of Farm: 2012," *2012 Census of Agriculture: Texas State and County Data,* Volume 1, Geographic Area Series, Part 43, 2014, www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/Texas/.

37 Jonathan and Kaylyn Cobb, "Guest Post: Healthy Soil Keeps Family Farmers on the Land," *Switchboard*, Natural Resources Defense Council, January 7, 2015, switchboard.nrdc.org/blogs/coconnor/Guest_post_healthy_soil.html. Chris Clayton, "Soil Health Improvements," *Progressive Farmer*, June 2014, dtnpf-digital.com/article/Soil_Heath_Improvements/1711022/209296/article.html. Troy Smith, "The Value of Integrating Cover Crops and Livestock," *Cow/Calf Producer*, June 2015, www.cattlenetwork.com/advice-and-tips/cowcalf-producer/cover-crops-and-cattle?ss=advice_and_tips,cow/calf_producer.