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S.D. well-managed soils capture carbon

South Dakota State University | Updated: 07/09/2012

In a study of South Dakota agricultural practices during the past 25 years, a team of 10 scientists at South Dakota State University have documented modern farming practices measurably increase the yield potential of the soil and capture carbon in the environment.

Because of the practices, the result is literally a cleaner, more economically vibrant environment, the study contends.

This, first-of-its-kind study was based on more than 95,000 soil samples collected from farmer's fields across eastern and central South Dakota between 1985 and 2010, according to David Clay, Ph.D., SDSU professor of plant science and one of the lead researchers on the project.

The study specifically determined the South Dakota surface carbon sequestration potential and associated partial carbon footprint for corn-based ethanol production. Findings support the theory that many of the surface soils in the region became carbon sinks when seeded with corn.

"The soil organic carbon contents in surface soils have increased 24 percent! These increases directly boost the soil's yield potential, while reducing agricultural impact on the environment," Clay said.

In a direct comparison between yields in 1985 and in 2010, corn yields are 60 percent higher, soybean yields are 19 percent higher, and wheat yields are 53 percent higher. These yield increases have resulted in more than $2 billion in addition corn, soybean and wheat sales.

Over this time period, no-till adoption has also increased. For example, in central South Dakota, no-tillage adoption increased from 5 percent in 1986 to 73 percent in 2009. During the same time, clean tillage decreased from 25 percent in 1985 to 1 percent in 2008.

Another scientist Gregg Carlson, Ph.D., SDSU professor of plant science, said the study shows that South Dakota fields used to produce corn, wheat and soybeans become carbon sinks as opposed to carbon dioxide sources. "The carbon stored in South Dakota's 12 million acres of cropped land over this 25-year study period is equal to the carbon emitted from 17.8 billion gallons of gasoline," Carlson said.

Doug Malo, Ph.D., professor of soil science at South Dakota State University, said, "The increase in surface soil organic carbon levels is an excellent example of how the Land Grant mission in collaboration with federal and private industry partners works together

to enhance the economic and environmental well-being of the clientele we serve, which are the people of South Dakota."

"Since 1984, more than 6,000 undergraduate students from South Dakota have received basic soil and soil management training from SDSU. Numerous research projects have documented the values and improved yields associated with increased soil organic carbon levels. Countless research field days and Extension meetings have demonstrated the benefits of conservation and no-tillage. Government conservation programs have been implemented, and soil sustaining consulting recommendations have all worked together to create a paradigm shift in South Dakota agriculture. It has resulted in the level of surface soil organic carbon levels increasing," Malo said.

Carbon sinks are natural or artificial reservoirs that accumulate and store some carbon-containing chemical compound for an indefinite period. The process by which carbon sinks remove carbon dioxide from the atmosphere is known as carbon sequestration.

Public awareness of the significance of carbon sinks has grown since passage of the Kyoto Protocol, which promotes their use as a form of carbon offset. A carbon sink ultimately removes carbon dioxide from the environment. Growing levels of greenhouse gasses such as carbon dioxide are thought to cause global warming.

The creation of agricultural-based carbon sinks are attributed to the adoption by farmers of minimum and no-tillage farming practices that were researched and promoted by the College of Agriculture and Biological Sciences at South Dakota State University, and at the USDA's Natural Resource and Conservation Service.

Soil carbon sequestration is influenced by many factors, including the amount of carbon contained in the soil, mineralization rates, tillage and the amount of non-harvested carbon returned to the soil, according to Clay.

"Prior to 1984 our average surface soil organic carbon levels had declined about 60 percent when compared to original values when the land was homesteaded," Malo said. This study documented that over the past 25 years surface carbon amounts have increased due to changing agricultural practices.

The study also found that the partial carbon footprint of corn decreased with increasing sequestered carbon. The study suggests that carbon is being sequestered in many Northern Great Plains surface soils. These results are attributed to: 1) carbon mining that occurred following homesteading, 2) gradual crop yield increases which increased nitrogen holding capacity to the soil; and, 3) wide-scale adoption of reduced tillage and then no-tillage methods. Subsequently, calculations and producer soil samples suggest that surface soils of this region are a carbon sink. The results are different than a general perception that annually cropped soils in the Northern Great Plains are losing carbon. These findings have ramifications relative to water quality and soil resilience.

Barry Dunn, Ph.D., dean of Agriculture and Biological Sciences at South Dakota State University, said the discovery is stunning. "Their unbiased scientific research could change how agriculture is perceived in the world around us."

"But the impacts of this research aren't just about changing perceptions. This work may also have important economic impacts as well. When combined with carbon life-cycle analysis conducted by our research team and researchers at the South Dakota School of Mines and Technology, findings from this research shows that South Dakota farmers have some of the lowest energy footprints in the world. In addition, ethanol produced in South Dakota may meet the California advance renewable fuel standard. Meeting this fuel standard has the potential to dramatically increase the value of South Dakota ethanol in a highly competitive marketplace," Dunn said.

Funding for this critical research was provided by the South Dakota Corn Utilization Council, the South Dakota Soybean Research and Promotion Council, Monsanto, the Agricultural Experiment Station in the College of Agriculture and Biological Sciences at South Dakota State University, the United States Department of Agriculture and the National Aeronautical Space Administration (NASA).