New tool gets handle on cropland CO2 emissions

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For the first time, farmers have data that tracks at the county level on-site and off-site energy use and carbon dioxide emissions associated with growing crops in the United States.

This information is vital for examining changes in cropland production and management techniques and could play an even bigger role as more land is devoted to bioenergy crops, said Oak Ridge National Laboratory's Tristram West, lead author of a paper published on line in the Journal of Environmental Quality.

"By looking at changes in energy consumption and CO2 emissions that take place with conventional and alternative crop production, we can do a better job of measuring the effects of various carbon sequestration strategies," West said. "This information can also contribute to future policy directions for energy use and agricultural production."

West and co-authors at the University of Tennessee, Kansas State University and ORNL looked at data from 1990 to 2004 and calculated energy consumption and CO2 emissions from fossil fuel combustion associated with U.S. cropland production. For this project they used a combination of independent survey data, national inventory data, established energy consumption parameters for field-scale operation budgets and CO2 emissions coefficients.

The researchers used a number of other resources, including the University of Tennessee's Agriculture Budget System, which consists of more than 3,500 conventional and alternative management practices for corn, soybean, wheat, sorghum, barley, oat, rice, cotton and hay. As of 2006 these nine crops accounted for about 96 percent of total crop production in the U.S.

On-site energy use and emissions result from fossil fuel combustion that occurs on the farm. Off-site energy and emissions result from fossil fuel combustion linked to the production and transport of fertilizers, pesticides and seeds. Off-site emissions also include those from power plants that produce electricity used on the farm.

The researchers were particularly interested in variations in energy consumption that occur when field management strategies change. For example, they found that the adoption of reduced tillage practices from 1990 to 2004 resulted in a net fossil emissions reduction of 8.8 million metric tons of CO2. Above-average rainfall in 1993 caused fields to be flooded in Minnesota, Iowa, Missouri, Kansas and Nebraska. As a result, farmers planted fewer crops and CO2 emissions fell.

"Changes in agriculture policy and extreme weather events influence agricultural land use and subsequent energy consumption and CO2 emissions associated with crop production," West said.

Looking at the nation's total CO2 picture, less than 2 percent of the 6,090 million metric tons is the result of farming activities. Electricity generation is the largest source of emissions followed by transportation, industrial, residential and commercial use.

Among the findings was that energy use and emissions do not always change proportionately with the area of cropland in production. Instead, they vary by crop and management practices. Researchers also found that on-site emissions can be reduced by half for some crops if farmers change from conventional tillage to no-till.

This study did not take into account nitrogen oxide emissions from the use of nitrogen fertilizers. It did, however, consider CO_2 emissions from the production of fertilizer. Those are included in the off-site estimates.

Another key aspect of the project is that the data provide a spatial distribution of carbon flux, which will allow researchers to compare this information to atmospheric measurements that are part of the North American Carbon Program (www.nacarbon.org/nacp/).

The authors conclude the paper by saying, "Through continued analyses, we will have a better understanding of how carbon dynamics in U.S. agriculture are being impacted by changes in land cover and land management."

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