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CLIMATE FRIENDLY FARMING™

Carbon Sequestration

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WSU Center for Sustaining Agriculture and Natural Resources
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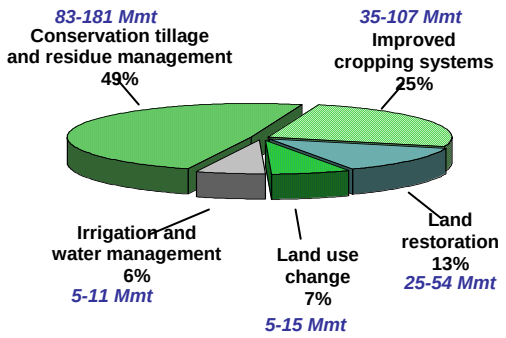
Background

Cropping systems play an important role in greenhouse gas status. Duxbury (1994) estimated that agriculture contributed 25% of the historical anthropogenic emission of CO_2 during the past two centuries. Soils store carbon for long periods of time as stable organic matter, which reaches an equilibrium level in natural systems determined by climate, soil texture, and vegetation. When native soils are disturbed by agricultural tillage, fallow, or residue burning, large amounts of CO_2 are released (Allmaras, et al., 2000). However, a significant portion of this carbon can be sequestered by soils managed with direct seeding and other techniques. Studies in the dryland region of eastern Washington have shown that continuous cropping with direct seeding (no-till) can sequester up to 1700 lbs per acre of carbon in a three-year period and over 4000 lbs per acre in a 25- year period (Bezdicek, et al., 2002).

While agriculture may only represent approximately 7% of US greenhouse gas emissions (EPA 2004), it has the potential, with new practices, to also act as a sink, tying up or sequestering CO_2 from the atmosphere in the form of soil carbon (Willson, et al., 2001; Lal, 1999). Estimates of the potential for agricultural conservation practices to enhance soil carbon storage range from 154-368 million metric tons carbon equivalent (MmtCE) (Fig. 1) – between 50% and 100% of the 345 MmtCE of reduction proposed for the US under the Kyoto Protocol (Lal, et al., 1998).

Fig. 1 – Potential for Agriculture to enhance soil carbon storage (Source: Lal, et al, 1998)



Current research efforts and opportunities

There have been twelve different research efforts related to direct seeding / no till technologies in the Pacific Northwest. These studies have demonstrated that in intermediate and high rainfall areas, direct seeding can have a positive economic impact on dryland grain production. Direct seeding also enhances the amount of carbon sequestered in the soil, improving soil structure and consequently nutrient and water holding capacity (PNW Direct-Seed Cropping System Coalition Steering Committee 2001).

Research at the Land Institute in Kansas has demonstrated the potential for agricultural systems to mimic natural prairie systems through "perennial polyculture", utilizing plants from four representative groups – "warm season perennial grasses (C4), cool season perennial grasses (C3), perennial legumes and perennial members of the sunflower family" (Jackson & Jackson 1999). Mimicking the prairie facilitates "emergent ecological properties" from the cropping system, such as improved soil and water quality, improved nutrient management and increased carbon sequestration. Direct-seed, perennial polyculture is being compared with direct-seed organic, direct-seed Palouse Prairie, and direct-seed 'conventional' dryland cropping systems for the Pacific Northwest by members of the Climate Friendly Farming™ Research Team at the Palouse Land Management and Water Consevation Research Unit in Pullman, WA.

Precision agriculture is an information-intensive approach to crop production that utilizes Geographical Information Systems (GIS), Global Positioning Systems (GPS), and other technologies to enable very site specific (square meters) applications of agricultural inputs (Roberts, et al., 1994). Precision agriculture enables the management of variations in fields and soils and the overall reduction of chemical inputs, irrigation water and ultimately environmental degradation. Precision agriculture is another tool that can be used to manage cropping systems for improved carbon sequestration capacity. Precision agriculture is being combined with direct-seed cropping systems at WSU's Cunningham Agronomy Farm in Pullman.

Another way that agriculture can contribute to a reduction of carbon dioxide in the atmosphere is through the

replacement of fossil fuel based energy, fuels and other products. Biomass from agricultural production has the potential to offset significant amounts of CO_2 emissions from fossil fuels by substituting biomass energy, fuels and products that "recycle" carbon already in the atmosphere. It has been estimated that there is sufficient biomass in Washington to supply 45% of current residential energy needs in the state (USDOE 2001).

Many of these research efforts and opportunities are now being coordinated and expanded to develop baseline data and a better understanding of the carbon sequestration potential of these systems and technologies in the Pacific Northwest by the Climate Friendly Farming™ Research and Demonstration Project.

Resources

The Washington State University Center for Sustaining Agriculture and Natural Resources' Climate Friendly Farming™ Research and Demonstration Project is a resource for research and educational outreach on agricultural carbon sequestration. The web page for the Climate Friendly Farming™ Research and Demonstration Project is http://cff.wsu.edu/.

Research on perennial polyculture, direct seeding, organic cropping systems, prairie cropping systems and greenhouse gas mitigation is underway at the USDA Agricultural Research Service Palouse Land Management and Water Conservation Research Unit in Pullman, Washington. http://pwa.ars.usda.gov/pullman/lmwc/.

The Washington State University Center for Precision Agriculture is researching the application of precision agriculture technologies in Pacific Northwest farming systems. http://www.precisionag.prosser.wsu.edu/.

A collaborative project between the Department of Ecology, INTEC, and Washington State University Department of Biological Systems Engineering produced a Bioenergy Inventory and Assessment for Eastern Washington. The report and interactive CD is available from Dr. Shulin Chen, Department of Biological Systems Engineering, Washington State University, 509-335-3642 or chens@wsu.edu.

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