6-1-2009

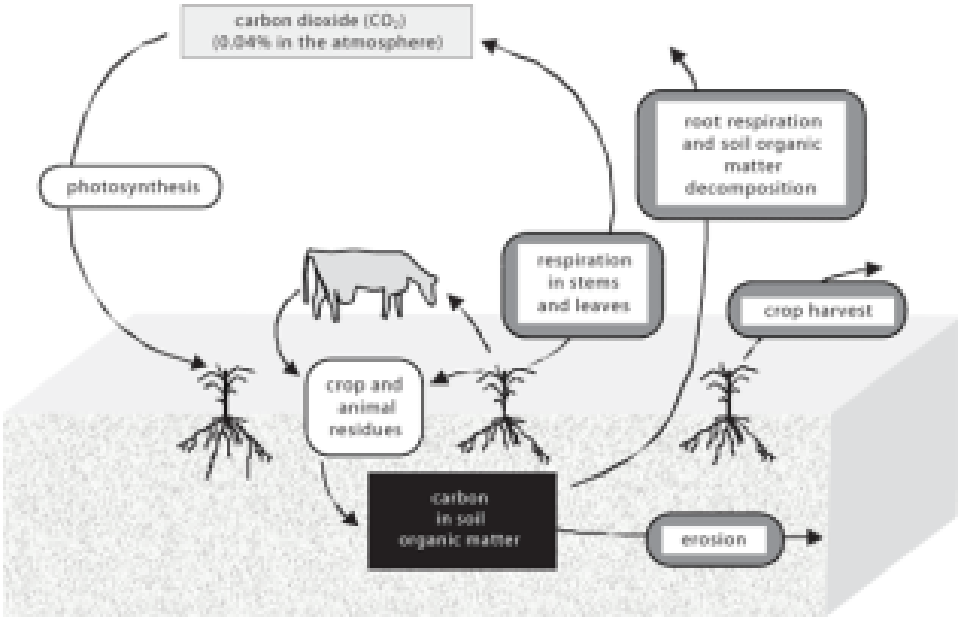
Grazing Lands and Soil Carbon Storage

John A. Guretzky
University of Nebraska-Lincoln, jguretzky2@unl.edu

Noble Foundation Ag News & Views. 27:6 (June 2009)

Grazing Lands and Soil Carbon Storage

By John Guretzky



On March 31, 2009, a draft discussion of the American Clean Energy and Security Act of 2009 was released to the public. The bill contains four sections addressing:

1. clean energy;
2. energy efficiency;
3. reducing global warming pollution; and
4. transitioning to a clean energy economy.

Section 3 contains a description of the proposed cap-and-trade program designed to reduce industrial emissions of greenhouse gases (GHG) including carbon dioxide (CO_2), methane (CH4), nitrous oxide (N_2O), hydro-fluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF6) and nitrogen trifluoride (NF3). Agricultural sources, although largely diffuse and not regulated directly by the bill, account for 8 percent of U.S. annual GHG emissions (U.S. EPA, 2008). The agricultural community can address climate change by reducing its emissions and adopting

management practices that enhance storage of carbon in soil. The objective of this article is to describe the effects of grazing land management on soil carbon storage.

The amount of carbon stored in soil is a net result of additions minus losses (see figure). The amount of soil carbon in grazing lands depends on properties such as climate, soil type, grazing land productivity and plant species composition. Atmospheric CO_2 is captured through photosynthesis, where it becomes the carbon that is in plants. Carbon enters the soil through production, growth and decay of plant roots and litter. Carbon in plant material consumed by grazing animals also enters the soil from animal excretions. Because living plants, animals and soil organisms respire, much of the carbon that initially was captured through photosynthesis and entered into the soil returns to the atmosphere as CO_2. If the net amount of carbon entering the soil exceeds that lost back to the atmosphere, soil carbon storage increases.

Long-term experiments have revealed that cattle can affect the amount of soil carbon stored in grazing lands. The consumption and trampling of plant material, and cycling of carbon and nutrients by cattle affect amounts of litter, roots and other plant material available to enter the soil carbon cycle. Overstocking reduces potential productivity of grazing lands and the quantity of carbon that enters the soil from roots and litter. A significant loss of soil carbon also can occur through erosion if pastures are overgrazed. The exposure of soil aggregates during erosion enables microbial decomposition and losses of carbon to the atmosphere.

Management that favors growth of productive, perennial grasses is important to soil carbon storage in grazing lands. Native grass systems tend to have positive net GHG balances because of their productivity and limited fertilization requirements. Fertilization promotes plant growth in grazing lands and, hence, would seem to enhance soil carbon storage. The industrial production of fertilizers, however, results in N_2O emissions. Fire is a component of range management that is generally regarded as having positive impacts on ecosystems by reducing invasion of woody species and enhancing plant diversity and quality of grasslands for livestock and wildlife habitat. Research shows that although fires consume and release to the atmosphere carbon stored in aboveground plant tissues, belowground soil carbon storage may be enhanced through increased plant growth and root productivity.

Regardless of whether the cap-and-trade policy results in additional revenue for landowners as pointed out in this issue of *Ag News and Views* by Dustin Oswald and Jon Biermacher in their article on the policy, implementation of management practices that enhance soil carbon storage will have positive impacts on the grazing lands you manage. Secondary benefits of soil carbon storage in grazing lands include enhanced plant productivity, increased availability of soil water and nutrients, and improved water and air quality.