Livestock grazing and soil carbon sequestration

Considering the importance of rangeland in land use (accounting for about 40% of the total land surface area), herders and pastoralists could play a crucial role in soil carbon sequestration.

Global studies have found that grazing can have either a positive or negative impacts on rangeland vegetation and soils, depending on the climatic characteristics of rangeland ecosystems, grazing history and effectiveness of management (Milchunas and Lauenroth, 1989).

Common grazing management practices that could increase carbon sequestration include: (i) stocking rate management, (ii) rotational, planned or adaptive grazing, and (iii) enclosure of grassland from livestock grazing.

Stocking rate management.

Conventional rangeland science suggests that sustainable management of grassland can be achieved by grazing livestock at stocking rates that do not exceed the grassland carrying capacity.

Rotational, planned or adaptive grazing.

Many grasslands increase biomass production in response to frequent grazing, which, when managed appropriately, could increase the input of organic matter to grassland soils.However, there have been few studies of the effects of rotational grazing on soil carbon stocks. Two published reports indicate that rotational grazing would have limited impacts on soil carbon stocks, despite the benefits for livestock production and vegetation. Site specific planned and adaptive grazing is likely to be more effective in managing soil carbon.

Enclosure of grassland from livestock grazing.

The effects of closing off land from livestock grazing vary in relation to the type of land. The Conservation Reserve Program run by the United States Department of Agriculture and the

‘Return Grazed Land to Grass’ Program in the People’s Republic of China are large-scale interventions that support the closing off of degraded grasslands from livestock grazing for given periods of time.

Grazing intensity should be properly regulated to enhance carbon sequestration. It is important to note that methane emissions, grazing intensity and increase in woodland cover are all interrelated issues. Therefore GHG emissions should be considered in conjunction with carbon sequestration when analysing the impacts of livestock on GHG emissions and climate change. It has been suggested (FAO, 2009b) that a sustainable livestock distribution could be operated, including a rotational grazing system combined with a seasonal use of land. The proposal is based on the hypothesis that a reduced grazing intensity would result in increased soil carbon stocks.

However, Gifford (FAO, 2009a,b) demonstrates that the situation is more complex and the interaction among these elements is not entirely linear for the following four reasons:

- The woody component has high aboveground carbon stocks and high deep-soil carbon stocks.
- Wildfires contribute to the loss of carbon stocks.
- The reduction in grazing land for native herbivores can be partially offset by the expanding population of unmanaged herbivores (e.g. kangaroos in Australia).
- Floods and desert storms contribute to the shifting of vast quantities of topsoil characterized by high carbon stocks.

Given the complexity of the interaction between grazing and soil carbon sequestration and the associated environmental, social and economic issues, therefore, reducing grazing intensity does not necessarily imply an increase in soil carbon stocks.

When analysing the effect of grazing on rangeland carbon stocks, the following three factors should be taken into account:

- Overgrazing does not mean soil degradation; the two terms should not be confused or considered as synonyms
- Overgrazing can contribute both to an increase in ecosystem carbon stocks (e.g. from wood thickening) and to a decrease in soil carbon stocks (i.e. soil degradation).
- There is a weak basis for estimating carbon sequestration potential from grazing: few data exist on the impact of changed grazing intensity on soil carbon stocks.

Finally, Conant et al (2002) demonstrates that grazing management drives change in soil carbon stocks by influencing the balance between what goes into the soil (inputs) and what comes out of it (outputs): effective livestock management systems that adopt better feeding practices and use specific agents and dietary additives have a positive effect on food security (enhancing productivity and meat quality) and soil carbon stocks.

Source:

Adapted from Calvosa, C., Chuluunbaatar, D and Fara, K. (2009), Livestock and Climate Change. IFAD Livestock Thematic papers. IFAD, Rome.

Cited references:

Milchunas,D. and Lauenroth, W. 1989. Quantitative effects of grazing on vegetation and soils over a global range of environments. In Ecological Monographs 63, Vol. 4: 328-366

FAO, 2009a. Enabling agriculture to contribute to climate change mitigation. FAO, Rome.

FAO, 2009b. Grasslands carbon sequestration: management, policy and economics. FAO, Rome

Conant R.T. and Paustian K. 2002. Spatial variability of soil organic carbon in grasslands: implications for detecting change at different scales. In Environmental Pollution 116: pp. 127-135.

Other resources:

FAO- Grasslands, Rangelands and Forage Crops website

Challenges and Opportunities for Carbon Sequestration in Grassland Systems - A technical report on grassland management and climate change mitigation