



## Fact Sheet 4 in the Series: Tough Questions about Beef Sustainability

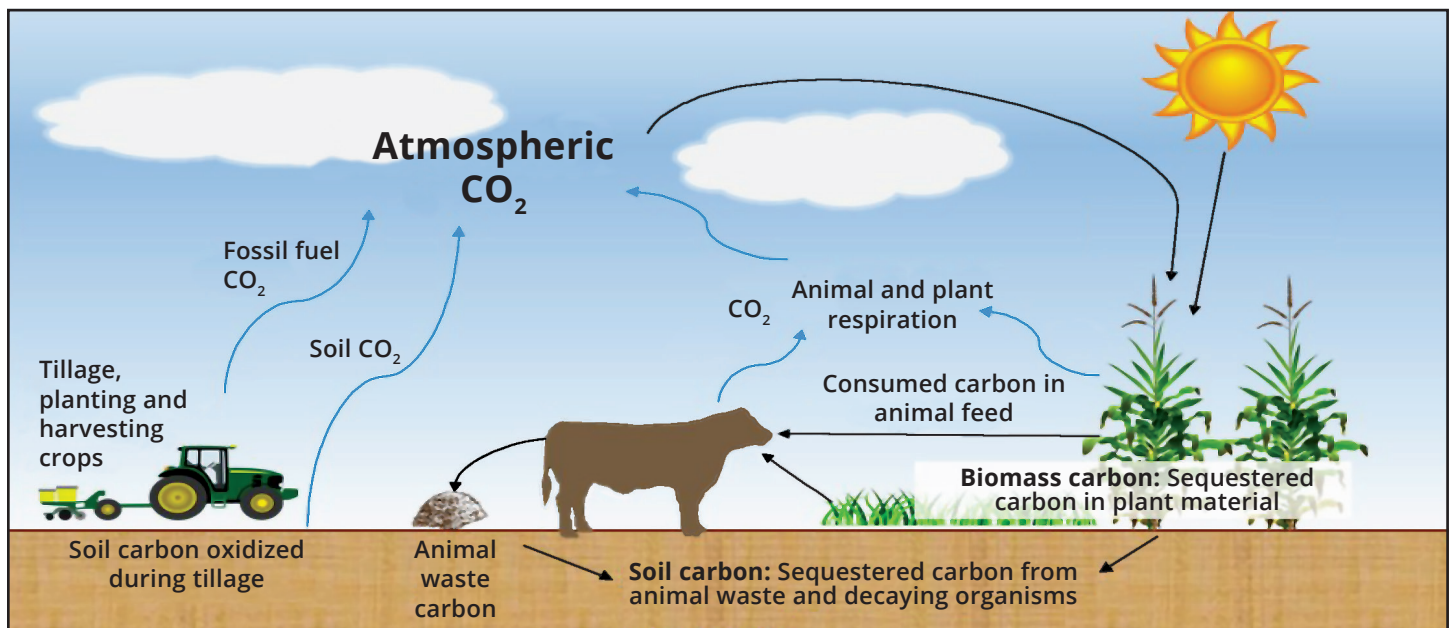
# How does carbon sequestration affect the sustainability of beef?

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Carbon is one of the most common elements on earth and is essential for life. Carbon sequestration refers to the long-term capture and storage of carbon from the atmosphere (typically carbon dioxide, CO<sub>2</sub>). Enhancing biological carbon sequestration in soil and plants is a promising method of reducing greenhouse gas (GHG) emissions and combating climate change. Anthropogenic or human activities such as burning fossil fuels and land use changes (e.g., deforestation, and the tillage of native grasslands for crop production) have led to an increase in atmospheric concentrations of carbon dioxide (a GHG) since the beginning of the industrial revolution. Carbon dioxide atmospheric concentrations have risen from their pre-industrial level of 280 parts per million (ppm) to over 400 ppm today.<sup>1</sup> The increase in concentrations of

carbon dioxide and other GHGs in the atmosphere has contributed to global climate change and variability.

The carbon cycle (Figure 1), like any other naturally-occurring process, involves a cyclical recycling, storage, and use of a resource in different states. Carbon reservoirs, where carbon is stored, include oceans, soil, and vegetation. Plants take in sunlight and carbon dioxide to synthesize carbon-containing sugars and other carbohydrates during photosynthesis. Plants, animals (including humans), and soil microbes consume molecules containing carbon for energy and release some of the carbon back into the atmosphere in the form of carbon dioxide during the process of aerobic respiration. Organic carbon from animal waste and decaying plants is stored



**Figure 1.** Carbon cycle demonstrating both additions to and removal of atmospheric carbon dioxide (CO<sub>2</sub>)  
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in the soil. Whenever soil is disturbed and exposed to the air, it releases stored carbon back into the atmosphere. Carbon is also released into the atmosphere from anthropogenic activities, such as burning fossil fuels (which are themselves reservoirs of carbon).

Many different agricultural production practices exist that can capitalize on carbon sequestration in both soil and biomass to reduce environmental impact. The goal of these methods is to modify current production practices in a way that enables the use of the natural carbon cycle to replenish carbon stores while reducing the amount of carbon in the atmosphere.<sup>1</sup> Restorative agricultural production practices have the potential to decrease atmospheric carbon and reverse some of the effects of climate change.<sup>1,2</sup> One example of a restorative practice is “no-till” crop production, where farmers do not turn over or till the soil (commonly done to reduce weed growth) in preparation for planting the next round of crops.<sup>3</sup> Some “no-till” cropping systems also incorporate cover crops, which involves planting a secondary crop that will not be harvested (such as turnips), but can be utilized for grazing beef cattle, controlling weed growth, reducing erosion, and enhancing soil organic matter.<sup>2</sup>

Beef cattle production can play an important role in furthering carbon sequestration by producing a nutritious food product for humans by utilizing grasslands that can store a large amount of carbon. Globally, if soil organic carbon in agricultural lands and grasslands could be increased 10% over the course of the 21<sup>st</sup> century, carbon dioxide concentrations in the atmosphere could be reduced by 110 ppm.<sup>1</sup> Grazing cattle and other ruminants

on pasture and grasslands can preserve untilled land and reduce soil erosion (another environmental benefit) while producing human food and other products (e.g., leather).<sup>2</sup>

In the United States, pasture and grasslands represent 27% of the land area,<sup>4</sup> thus preventing the conversion of this land to tilled cropland and residential uses could prevent further increases in GHG concentrations. Additionally, establishing permanent pastures for grazing beef cattle on degraded croplands (lands that are currently tilled, but are of poor quality) can sequester carbon at rates comparable to forests.<sup>2</sup> Most beef cattle in the United States spend the majority of their lives on pastures and grasslands. For beef cattle finished in a feedlot, approximately 65-85% of their life will be spent grazing, and, for grass-finished beef cattle and beef cows, up to 100% of their life may be spent grazing. As a consequence, regardless of the beef production system, enhancing carbon sequestration through well-managed beef cattle grazing systems and improved feed production practices (e.g., no-till systems, using cover crops) can reduce the carbon footprint of beef and contribute to the reversal of global climate change.

**Bottom Line: Carbon sequestration is the long-term storage of carbon from the atmosphere in soil and plants. There are many different techniques to achieve carbon sequestration, including reducing tillage of soil and establishing permanent grasslands. Beef cattle play an important role in increasing carbon sequestration through the production of human food from untilled pastures and grasslands, and the integration of cattle grazing into “no-till” cropping systems.**

### Literature Cited

<sup>1</sup>Lal, R. 2011. Sequestering carbon in soils of agro-ecosystems. Food Policy. 36(Suppl. 1):S33-S39.

<sup>2</sup>Council for Agricultural Science and Technology (CAST). 2011. Carbon sequestration and greenhouse gas fluxes in agriculture: challenges and opportunities. Task Force Report No.142.

<sup>3</sup>Aziz, I., T. Mahmood, and K.R. Islam. 2013. Effect of long-term no-till and conventional tillage practices on soil quality. Soil Till. Res. 131: 28-35.

<sup>4</sup>Nickerson, C., R. Ebel, A. Borchers, and F. Carriazo. 2011. Major uses of land in the United States, 2007. Economic Information Bulletin Number 69. USDA/ERS, Washington, DC

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