Carbon sequestration is critically important to maintain tilth, enrich soils, and reduce carbon dioxide in the earth’s atmosphere and is becoming a hot topic in sustainable agriculture.

1. What Is Carbon Sequestration?
Carbon sequestration is defined as a tool of storing carbon into the plants and the soil from the atmosphere. Agriculture can be a sink by sequestering carbon because crops and trees use a lot of carbon dioxide in the process of photosynthesis and store carbon in the soil over time. Carbon dioxide (CO2) in the air is taken up by plants and incorporated into living plant matter. As the plants die or are harvested, some of the carbon-based leaves, stems, and roots decay in the soil and become a valuable organic carbon source such as humus.

2. Why Should Carbon Sequestration Be Increased?
Sequestering carbon in the soil provides for an opportunity to reduce the amount of CO2 in the atmosphere. For example, the absence of tillage slows down the oxidation of organic matter both on the soil and in the root zone, therefore slowing the release of CO2 back into the atmosphere. Also, no-tillage practices provide significant savings of fuel and hence lower CO2 emissions (about 20% less carbon emissions) compared with conventional practices, because of the need for fewer field passes and lower traction requirements.

3. What Can Agricultural Producers Do to Increase Carbon Sequestration?
Reducing atmospheric CO2 or increasing carbon sequestration can be achieved by: 1) increasing organic carbon production (trapping carbon within plants by photosynthesis); 2) decreasing organic carbon mineralization (managing crops and soil to reduce the conditions that break down plant residues); and, 3) reducing soil erosion, thereby keeping carbon trapped in the soil. One of the key concepts to increase carbon sequestration is to retain the soil organic matter as much as possible. Several agricultural practices increase carbon sequestration: no-till or reduced tillage, growing cover crops, applying manure or compost, effective pasture management, buffer strips, and crop rotation.

Soil organic matter consists of decomposed plant and animal matter. It helps bind soil mineral particles together into clumps, called soil aggregates. Higher levels of soil organic matter leads to more stable soil aggregates, better soil infil-
tration capability and aeration, better water holding capacity, more resistance to wind erosion, reduced potential for soil compaction, and overall better soil fertility. Organic matter also helps hold soil nutrients in place so that they are not lost by erosion, surface runoff, or leaching. If left undisturbed, soil organic matter eventually can be transformed into long-lasting humus. However, if the soil is tilled, soil organic matter will be oxidized and the carbon will be lost to the atmosphere as CO2. If the soil erodes, the organic matter will be removed in runoff water.

5. No-till as a Key Role in Carbon Sequestration

How can we sequester more soil carbon in crop production? One of the key roles in sequestering carbon in the soil will be tillage management. Several methods of tillage in crop farming are conventional till (moldboard plow), minimum till, ridge till, and no-till. Among these tillage practices, no-till has a greater potential to store more carbon in the soil than other tillage methods.

6. What Are the Advantages of No-till in Crop Production?

First, no-till keeps a lot of crop residues that provide a good amount of organic matter in the soil. Crop residues on the soil surface will reduce topsoil degradation and surface runoff including soil erosion. Second, no-till makes more stable soil aggregates that increase water and nutrient holding capacity resulting in potentially better crop production. In particular, no-till increases more micro-aggregate stability that contributes to the higher biological activity in the soil than conventional tillage. Third, no-till will increase significantly earthworm and biological populations (particularly fungi) that contribute to better soil physical properties.

Further, there will be an additional economic benefit combined with less disturbance of soil by reducing fossil fuel energy costs by not tilling.


Although some carbon from crops and soils can be sequestered over time, still other greenhouse gases such as methane (CH4) and nitrous oxide (N2O) have higher global warming potential than CO2 (i.e., 23 and 296 times more potent for methane and nitrous oxide, respectively, than CO2 over a 100-yr period). Practices promoting efficient nitrogen use to reduce the nitrous oxide emission are: 1) pre-sidedress nitrate tests for corn; 2) spring fertilizing as close as possible to active crop growth period; 3) split application of fertilizer for hay and pasture fields; 4) use of cover crops; 5) band nitrogen placement rather than broadcasting for corn; 6) use of nitrification and urease inhibitors; 7) storage of animal waste anaerobically in liquid form or in a lagoon; 8) avoid manure application to fallow fields in fall or winter; 9) maintain optimum stocking density on pasture; and 10) plant filter strips to reduce surface runoff, erosion, and nitrate nitrogen leaching.

Carbon sequestration and greenhouse gases emissions can’t be separated in dairy-forage systems. These two challenges should be considered as a full-cost accounting at the whole-farm or regional landscape scale. Carbon sequestration is a long-term win-win process in agriculture. If judicious soil management and adoption of appropriate farming/cropping systems are properly made, carbon sequestration can be an effective tool to increase agronomic productivity, profitability, and environmental quality.