Agriculture and Greenhouse Gas Emissions

In the United States, agriculture accounts for approximately 10.5% of the total greenhouse gas emissions, with the primary emissions from agriculture being carbon dioxide, methane, and nitrous oxide as shown in Figure 1 (courtesy of USDA Economic Research Service). These emissions come mainly from livestock such as cows – including manure and enteric fermentation, from agricultural soils, and from rice production. Figure 2 provides details on the share of greenhouse gases associated with specific agricultural practices; Figure 3 highlights those at the farm scale.

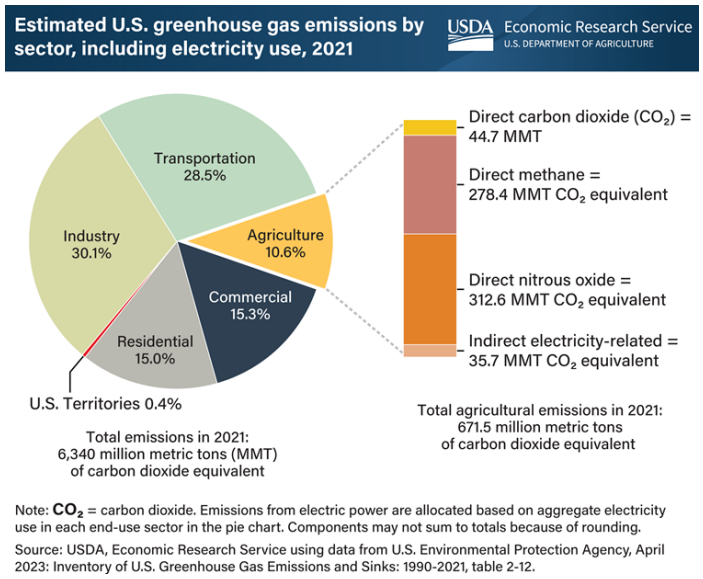

Figure 1: US Greenhouse Gas Emissions by Sector

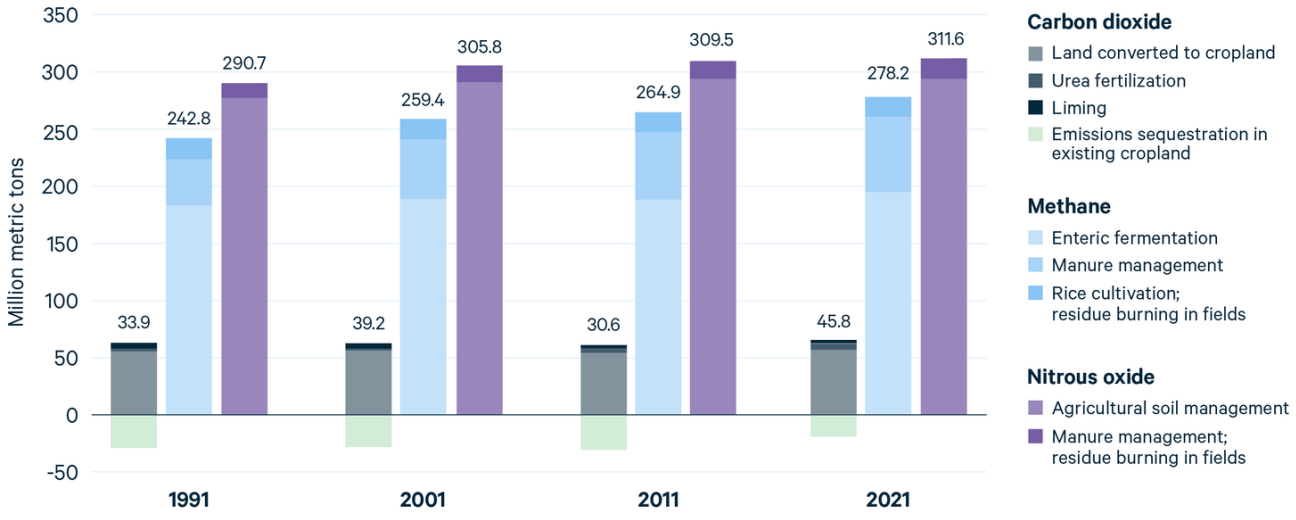

Figure 2: Greenhouse gases and agriculture categorized by use: courtesy of Resources for the Future based on EPA Greenhouse Gas Inventory Data Explorer; https://www.rff.org/publications/explainers/agricultural-greenhouse-gas-emissions-101

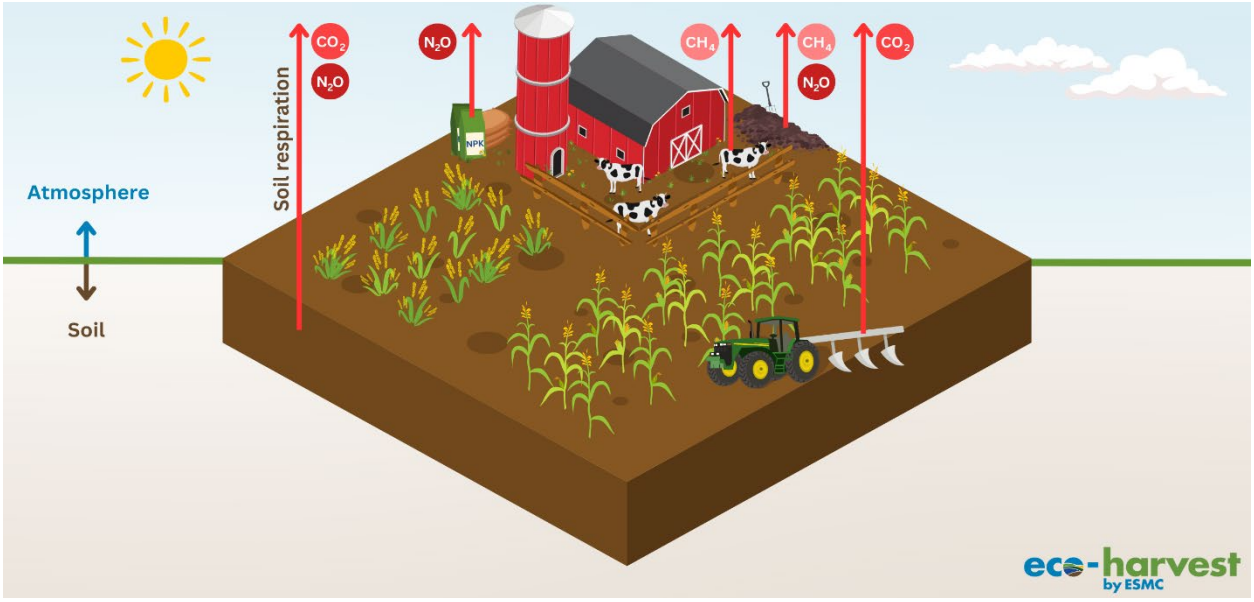

Figure 3: Greenhouse gas emissions at the farm scale

Agriculture as a Solution

Although agriculture is a source of greenhouse gas emissions, agriculture can also be a climate change solution through reduced and avoided emissions as well as carbon sequestration. Practices that fall under the umbrellas of "climate-smart agriculture", "regenerative agriculture", and "conservation agriculture" can reduce not only reduce greenhouse gases from agriculture but also help make agriculture more resilient to the impacts of climate change.

Practice changes that can reduce greenhouse gases from agricultural operations and remove carbon from atmosphere through soil carbon sequestration include:

1. Tillage Reduction/No Till
2. Nutrient Management
3. Cover Cropping

Current agriculture carbon and ecosystem services market programs focus mainly on carbon dioxide and nitrous oxide emissions reductions and removals from the three practice changes highlighted above. In addition to greenhouse gas mitigation and reduction benefits, these practices can increase soil health as well as resiliency to the impacts of climate change such as drought, flooding, and pest pressures. These benefits can include:

- Improved soil water holding capacity – reduces soil erosion, makes soils more resistant to drought
- Improved plant health and productivity fertility – increased soil health and soil structure

- Enhanced nutrient uptake by crops and reduced nutrient losses in surface and ground water can reduce input costs and improve water quality
- Increased soil and farm resiliency to the impacts of extreme weather (floods, droughts, high wind events, high temps)

Tillage Reduction/No Till

Reduced tillage/no tillage can increase soil organic carbon. The act of tilling can create a large release of nitrous oxide and carbon dioxide. Reduced/no till keeps that carbon in the soil and avoids nitrous oxide emissions which would have been created by full tillage. According to the USDA, "No-till systems enrich the soil with organic matter, increase soil water-holding capacity, and protect crops during periods of drought and flooding. The crop residue left on the soil surface also prevents wind and water erosion, benefitting water and air quality" (https://www.climatehubs.usda.gov/hubs/international/topic/no-till-farming-climate-resilience).

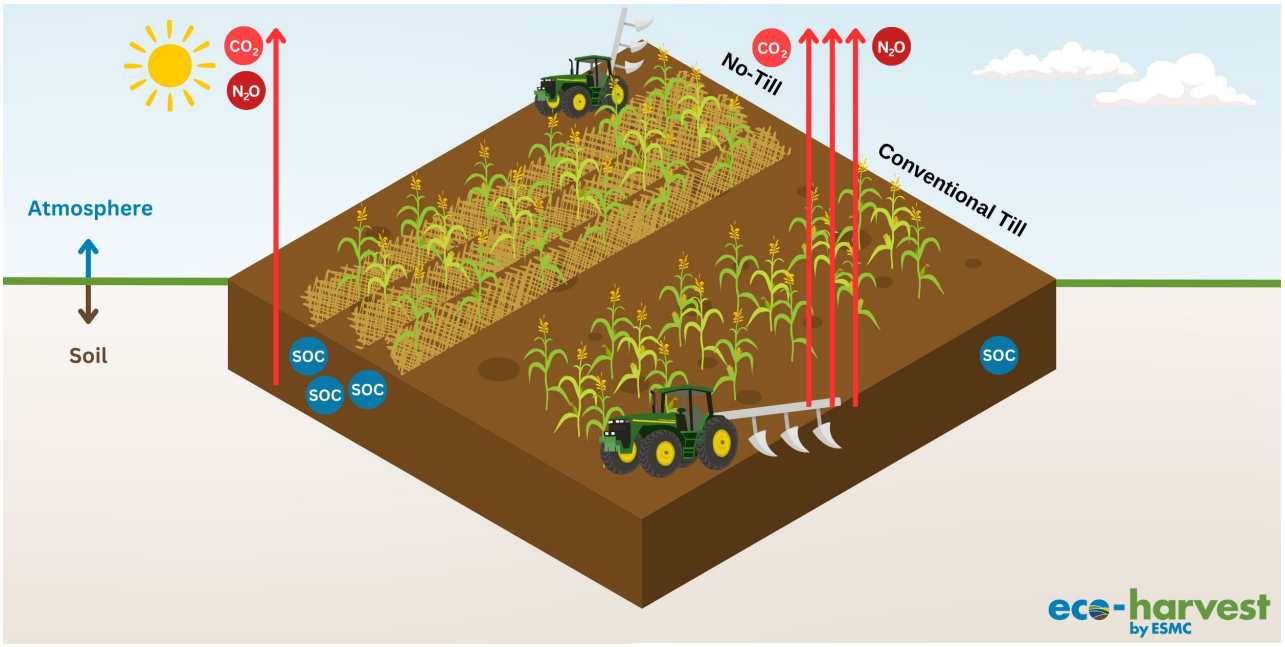

Figure 4: Emissions changes based on Reduced Till/No Till

Nutrient Management

Nutrient management – applying fertilizers at the right source, right rate, right place, and right time – increases nutrient use efficiency. With fertilizers the cause of a large amount of nitrous oxide emissions, careful and concise nutrient management not only reduces emissions but also reduces the amount of fertilizer farmers pay for. According to the USDA, producers could save an average of nearly $30 per acre on fertilizer costs with a Nutrient Management Plan (https://www.nrcs.usda.gov/getting-assistance/other-topics/nutrient-management).

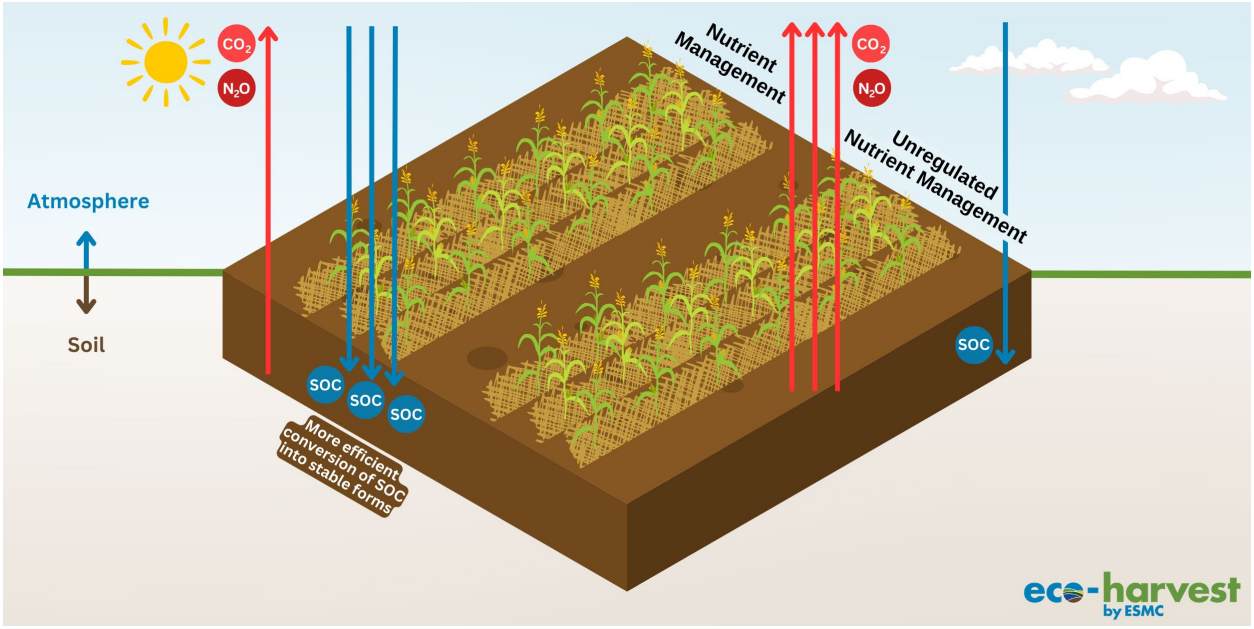

Figure 5: Emissions changes based on Nutrient Management

Cover Crops

Cover crops can increase soil organic carbon, increasing the removal of carbon in agricultural systems. According to the USDA, cover crops, "can bring greater crop production stability and profitability to a farm. Cover crops increase soil organic matter and improve soil fertility by capturing excess nutrients after a crop is harvested. They also raise soil moisture holding capacity, help prevent soil erosion, limit nutrient runoff, reduce soil compaction, and can even help suppress some pests" (https://www.climatehubs.usda.gov/hubs/northeast/topic/cover-cropping-improve-climate-resilience).

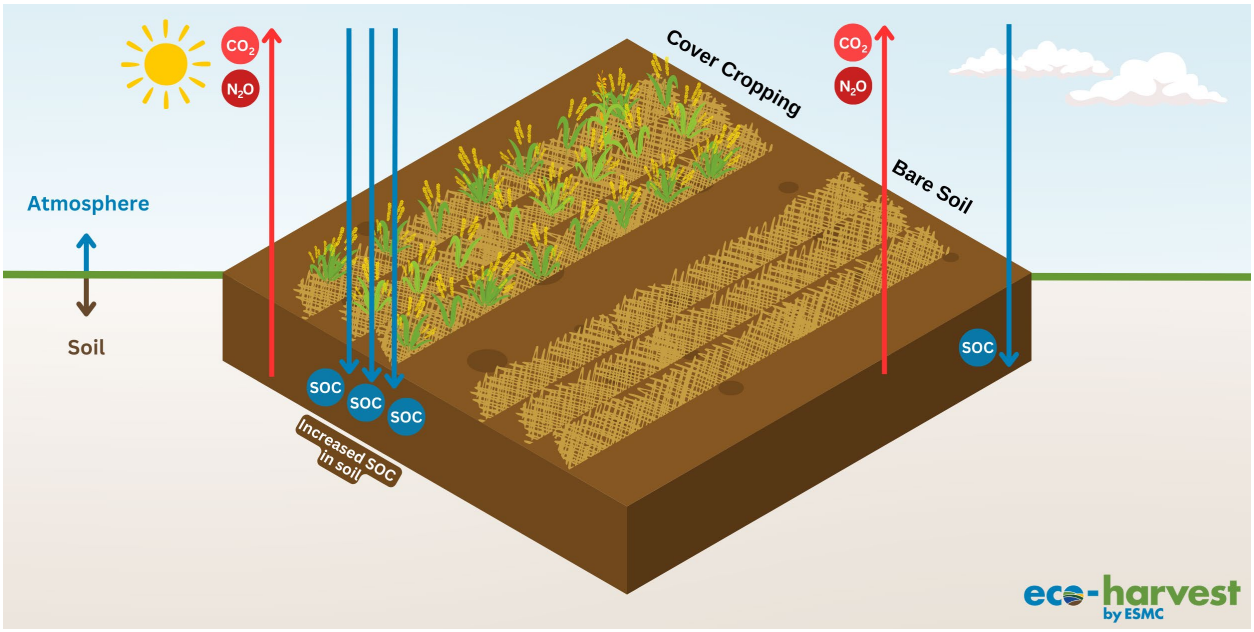

Figure 6: Emissions changes based on Cover Crops