GHG 101: 3 gases

**October 2021**

Jenifer Wightman &
Peter Woodbury

Greenhouse Gas Mitigation on Working Lands

# 3 Key Gases from US Agriculture

*Focus on:*
*Carbon dioxide ($CO_2$)*
*Methane ($CH_4$)*
*Nitrous oxide ($N_2O$)*

Reducing greenhouse gas (GHG) emissions can help lessen the impacts of climate change. To reduce our greenhouse gas emissions on farms, we need to know what they are, where they come from, and how much we are emitting. This fact sheet pulls data from the 2021 National USEPA inventory to answer these 3 questions:

1) What are the key greenhouse gases emitted by agriculture?
   Methane ($CH_4$), Nitrous oxide ($N_2O$), and Carbon dioxide ($CO_2$)
2) How much is U.S. agriculture emitting (what percent of total U.S. emissions)?
   629 million metric tons of $CO_2e$ (10% of the total United States emissions)
3) What are primary sources of emissions from the Agricultural Sector?
   - Soil nitrogen lost to the air as nitrous oxide ($N_2O$) accounts for 58% of total U.S. agricultural emissions.
   - Livestock enteric & manure emissions of methane ($CH_4$) accounts for 41% of total U.S. agricultural emissions.
   - Farm energy use emissions are counted by the Energy Sector.

For meaningful GHG accounting, farms must be evaluated for all three GHGs ($CO_2$, $CH_4$ and $N_2O$), together. The release of these gases is an unintended byproduct of farming. All these GHGs increase the trapping of heat in the atmosphere and change the climate.

## U.S. Agricultural GHG Emissions by Source

In 2019, total U.S. GHG emissions were 6,558 Million Metric Tons (MMT) of $CO_2$ equivalents ($CO_2e$ or $CO_2Eq.$). About 37% of national $CH_4$ and 75% of national $N_2O$ emissions come from agriculture. Altogether, agriculture accounted for about 10% of U.S. GHGs (Figure 1, inset pie chart, USEPA 2021).

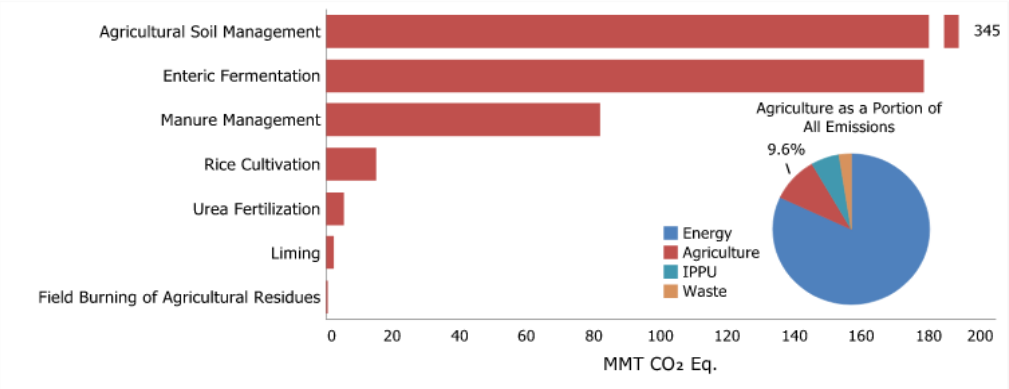


***Figure 1: U.S. Agricultural Greenhouse Gas Emissions by Source.*** *from USEPA 2021, Figure 5-2 <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>*

***Carbon dioxide equivalent ($CO_2e$)*** *is the common unit used for comparison of greenhouse gases.*

*Please see our fact sheet on the different* ***global warming potentials (GWP)*** *of methane and nitrous oxide to understand why even small changes in these gases is so important in climate change.*

## U.S. Agricultural GHG Emissions by Gas

Carbon dioxide is the main driver of climate change for most sectors of society (transportation, building heat, electricity), accounting for over 80% of total national GHG emissions. However, summarizing the data in Figure 1, most agricultural emissions come from $CH_4$ (livestock enteric and manure management) and $N_2O$ (agricultural soil management and manure management), see Figure 2.

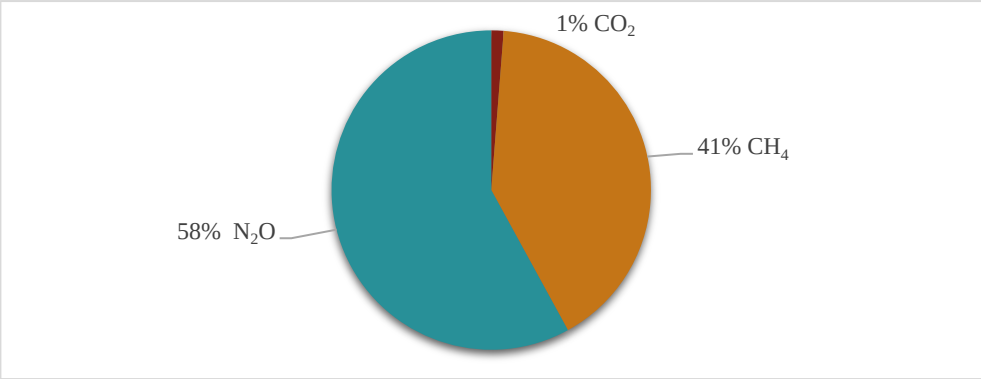


**Figure 2: U.S. Agricultural Greenhouse Gas Emissions by Type of Gas.**
Values are from the U.S. Annual Greenhouse Gas Inventory for 2019 (USEPA 2021).

In 2019, 41% of agricultural emissions came from methane ($CH_4$, primarily from livestock) and 58% came from nitrous oxide ($N_2O$, from nitrogen use in agricultural soil management). In 1990, US agriculture contributed 555 million metric tons of $CO_2e$. In 2019, US agriculture contributed 629 million metric tons of $CO_2e$, representing a 13% increase. In summary, agriculture needs to consider all three GHG together ($CO_2$, $CH_4$, $N_2O$) when calculating the net GHG mitigation benefit from any change in practice.

## Key Mitigation Opportunities - focus on $CH_4$ & $N_2O$!

Key GHG emission reduction opportunities for agriculture are:

1) Fertilize crops at the right time with the right amount of nitrogen.
2) Adjust animal feed practices to reduce enteric methane.
3) Manage manure to reduce emissions of $CH_4$ and $N_2O$.
4) Consider renewable energy/energy efficiency to help the energy sector!

## To Learn More please visit: http://blogs.cornell.edu/workinglands

### GHG & Working Lands

This work is supported by the USDA NIFA - Smith Lever Project 2019-20-110.
Thanks also to editors: David Hollinger, Erin Lane, Curtis Dell, Lynn Knight.

Cornell CALS
College of Agriculture and Life Sciences

Working Lands & GHG: https://blogs.cornell.edu/workinglands