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Agriculture is a major contributor to human induced nitrous oxide (N_2O) emissions, a greenhouse gas with about 300 times the global warming potential of carbon dioxide. (EPA, 2021)

Plants, including crops, take up nitrogen from the soil through their roots. Nitrogen is an essential nutrient for all plants and is the most needed for plant growth, so farmers typically apply additional nitrogen to increase productivity. Most agronomic crop yields, including important species like corn and cotton, benefit from this added nitrogen. Nitrous oxide emissions are generally driven by rain events, when the soils become saturated, through the natural process of denitrification. After fertilization it is normal to see some nitrous oxide emissions, however the magnitude of these losses can be significantly reduced when nitrogen is applied at rates aligned with crop nitrogen requirements. Wise agronomic use of nitrogen reduces nitrous oxide emissions. (Kim et al 2013, Shcherbak et al. 2014)

Agricultural soils produce **75% of N_2O emissions** in the US. (EPA, 2019)

N_2O molecules persist for an average of **114 years in the atmosphere** before they are converted to another, less harmful form of nitrogen. (EPA, 2021)

Fertilizer and manure applications on cropland, pastures, and haylands are the **main causes of agricultural N_2O emissions.** (EPA, 2021)

Nitrogen in runoff can also cause **excess growth of algae** in coastal waters, known as eutrophication, and negatively impact water quality. (Turner et al, 2007) (Aldridge et al, 2016)

N_2O Management Strategies

Using the 4Rs: Managing nitrogen fertilization by using the 4Rs (Right rate, Right timing, Right source, and Right placement) can minimize excess nitrogen and avoid environmental losses to waterways or the atmosphere, although not completely. (Gatiboni and Osmond, 2019; Line and Osmond, 2017)

Enhanced Efficiency Nitrogen Fertilizers: Using enhanced efficiency nitrogen fertilizers has the potential to reduce N_2O emissions but does not affect yields significantly. (Cavigelli and Parkin, 2012)

Other Management Practices: Reducing the frequency of high-nitrogen demanding crops in a crop rotation, incorporating nonlegume cover crops into crop rotations may take up residual nitrogen, and using legumes may fix more atmospheric nitrogen. (Cavigelli and Parkin, 2012)

Farming for the Future

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NCLFC Member Related Work:

- **NC Farm Bureau** collaborates with other agriculture and sustainability programs to provide Food and Agriculture Climate Alliance policy recommendations focused on reduction of greenhouse gas emissions.
- **The NC Department of Agriculture and Consumer Services** offers Agronomic Services to help farmers fine-tune their practices and minimize environmental degradation through practices like soil testing to optimize fertilizer applications.
- **NC Cooperative Extension** communicates research and resources to best support farmers and their needs, including nitrogen and fertilizer management practices.
- **The Crop and Soil Sciences Department at NC State** has a Nutrient Management Program which is made up of several initiatives to optimize nutrient agricultural productivity while protecting the environment.
- **Carolina Farm Stewardship Association** offers the Organic Commodities and Livestock Conference and Sustainable Agriculture Conference, which cover a range of topics from regenerative agriculture and soil health to precision cover cropping. They offer organic certification and conservation activity plan consultation.

CEFS Related Work:

- **The Greenhouse Gas Emission Monitoring Project at the Farming Systems Research Unit** is developing a continuous monitoring protocol for nitrous oxide and carbon dioxide emissions in agricultural fields under tillage and crop rotation treatments.

Other Related Work:

- **NC Department of Environmental Quality** offers information and guidance on nutrient practices and crediting to support the implementation of North Carolina's nutrient management strategy rules.

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