Using Ecosystem Models to Inventory and Mitigate Environmental Impacts of Agriculture

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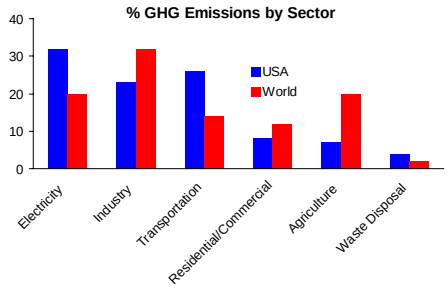
OBJECTIVES

- Estimate greenhouse gas (GHG) emissions for agricultural sector for US GHG inventory
- Summarize the methodology used to conduct current inventories
- Identify areas with large mitigation potential
- Asses impacts of mitigation strategies on yields, GHG fluxes, and NO_3 leaching

Agriculture as a GHG Source



Although agriculture is responsible for a relatively small portion of total US GHG emissions it is more important at the global scale.

METHODOLOGY

Major Crops and Grazed Lands

Field Data
Soil Type
H_2O
Temperature
N_2O
NO_3
Etc.

Simulation Models
Plant Growth/Senescence
Organic Matter Decomposition
Nitrification/Denitrification
Soil H_2O/NO_3 Flow
Etc.

Model Inputs
Vegetation Type
Climate
Land Management
Soil Type
Etc.

Model Outputs
Crop Yields
CO_2, N_2O, CH_4 Fluxes
NO_3 Leaching
Etc.

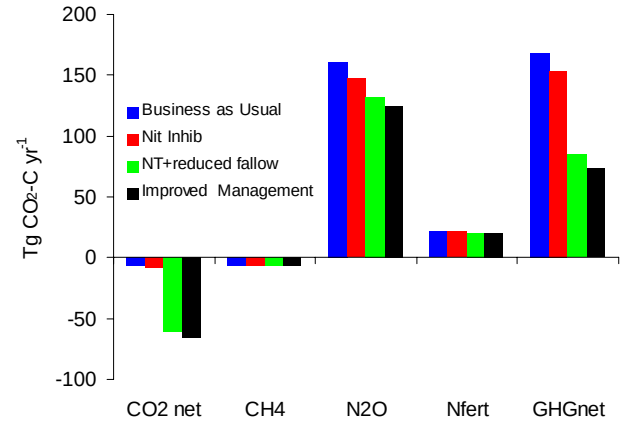
Other Crops

Activity Data
N fertilizer
Livestock Numbers
Crop yields
Land Areas
Etc.

IPCC Methodology
CO_2 = Factor * Area
N_2O = 1.25% N inputs
NO_3 = 30% N Fertilizer
Etc.

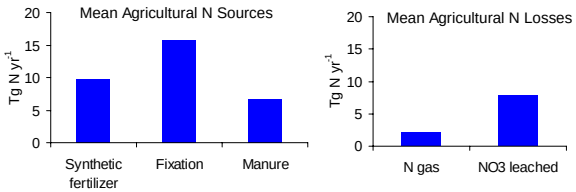
A hybrid approach that combines the DAYCENT/CENTURY simulation models and IPCC methodology is used to estimate GHG emissions and NO_3 leaching. DAYCENT/CENTURY simulate C and N flows for corn, soy bean, wheat, hay, cotton, sorghum, and grazed land. IPCC methodology estimates GHG fluxes and leaching for other grains (oats barley, etc.), high value crops (vegetables, sugar cane, tobacco, etc.), and histosols. DAYCENT/CENTURY model outputs are added to IPCC estimates to calculate total C and N fluxes.

GHG MITIGATION OPTIONS



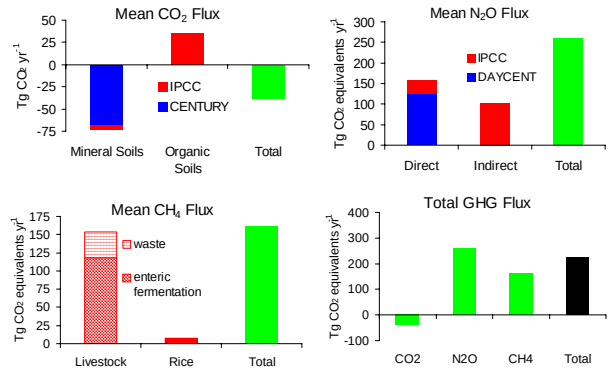
DAYCENT simulated impacts of different mitigation strategies on net GHG emissions. Improved management = nitrification inhibitors + no till + reduced summer fallow, where feasible.

Agricultural N Sources and Losses



Mean (1990-2004) nitrogen sources include fertilizer applied to cropped and grazed lands, N fixed by crops (soy bean, alfalfa, edible legumes) and grazing land legumes, manure N applied or deposited on to cropped and grazing land soils.

Agricultural GHG Fluxes



CO_2 and N_2O are for 1990-2004 (EPA, 2006), CH_4 is for 1990-2001 (USDA, 2004). Positive represents GHG emissions to the atmosphere, negative uptake by soils.

POINTS TO REMEMBER

- Agriculture males a small contribution to total US GHG emissions, but its mitigation potential is large
- Simulation models can be combined with IPCC emission factor methodologies to improve GHG inventories
- Conversion to no till and reduced cropping of histosols have large potential to reduce net CO_2 fluxes for agricultural soils
- Nitrification inhibitors significantly reduce N_2O emissions and NO_3 leaching while maintaining crop yields

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