Agriculture and Climate Change

- Sources
- Sinks
- Control of GHGs from agriculture
- Co-benefits for water quality
- Production of biofuels
- USDA programs for implementation
U.S. Sources of GHGs

- Transportation: 28%
- Industrial: 20%
- Residential & Commercial: 11%
- Agriculture: 7%
- Electricity: 34%
Agricultural GHG Emissions

- Other direct sources (CH₄ & N₂O) 2%
- Manure management (CH₄ & N₂O) 12%
- Energy use (CO₂) 14%
- Enteric fermentation (CH₄) 29%
- Soil management (N₂O) 43%

Agricultural Emissions in million metric tons (MMT) of CO₂e
Agriculture Sources of GHGs

- Soil Management
  - fertilizer applications - N2O
  - livestock manure applications - N2O
  - cropping practices – CO2
  - drainage/irrigation – N2O

- Land use changes
  - conversion from native vegetation or pasture to cropland – CO2

- Livestock
  - enteric fermentation (digestion) – CH4
  - animal waste storage – CH4
Agriculture Sources of GHGs

• Rice cultivation and field burning of agricultural residues -- 2% of non-energy related direct GHG emissions from agriculture.

• Energy use
  • 3rd largest source, 14% of total agricultural emissions
  • Direct use for farm activities
    • electricity used to power irrigation pumps
    • fuels for field equipment--tractors, combines, etc.
  • Indirect use
    • emissions associated with the production of commercial fertilizers and other energy-intensive farm inputs.
Agriculture Sources of Water Quality Impairments

- **Soil Management**
  - fertilizer applications
  - livestock manure applications
  - cropping practices
  - drainage/irrigation

- **Land use/hydrology changes**
  - conversion from native vegetation or pasture to cropland
  - channelizing streams

- **Livestock**
  - animal production areas

- **Pathogens, animal hormones and pharmaceuticals, pesticides**
Agriculture Carbon Sink: SOIL

- Carbon can remain in soils for thousands of years, effectively storing or sequestering CO2 from the atmosphere.

- Relative to native ecosystem levels, most agricultural soils are depleted in carbon, having lost 30-50% of their original carbon levels.

- Carbon in cropland soils can be regained with improved management.
Reducing Agriculture Sources of GHGs

Soil Management

- Fertilizer and Manure Applications
  - Nutrient Management
    - method of application
    - rate of application
    - timing of application
    - form of fertilizer
  - Cover Crops
  - Water Management
    - controlled drainage
    - constructed wetlands

- Cropping Practices
  - Tillage
    - continuous no-till
  - Crop Rotations
    - additional crops beyond corn and soybeans
Reducing Agriculture Sources of Livestock GHG Emissions

- Land Use changes
  - Keep land in native vegetation/pasture
  - Cropland retirement
  - Wetland restoration

- Livestock
  - Enteric fermentation
    - Feed management, especially beef and dairy cattle
  - Animal waste storage
    - Dry/Solid manure handling
      - Stacks, dry lots
      - Anaerobic digesters
Reducing Agriculture Sources of Water Pollution

- Fertilizer and Manure Applications
  - Nutrient Management
  - Cover Crops
- Cropping Practices
  - Tillage
  - Crop Rotations
  - Drainage
    - controlled drainage
    - constructed wetlands
- Land Use changes
  - Keep land in native vegetation/pasture
  - Restore wetlands
- Livestock
  - Feed management to control nutrients
  - Animal waste storage
Increasing Carbon Sequestration – Agriculture Soils

- If farmers widely adopt the practices to store carbon, and undertake cost-effective reductions in nitrous oxide and methane, U.S. GHG emissions could be reduced by 5 to 14%.

- Preventing erosion and loss of carbon
  - No-till

- Residue management
  - leave more plant material in the fields for conversion to soil organic matter

- Improved cropping rotations
  - increase the amount of plant material that becomes soil organic matter.

- Winter cover crops
  - add additional residues to the soil and help decrease soil erosion and nitrogen losses

- Land Retirement
  - Conservation Reserve Program (CRP)
  - Conservation buffers (e.g. filter strips, grassed waterways)
Water Quality Benefits of Increasing Soil Carbon

- Increasing the organic matter content of soils
  - improves soil quality
  - Improves soil fertility
  - increases water retention
  - reduces erosion

- Cover Crops
  - Take up excess nitrogen in soils after harvest
Biofuels

• Energy Independence and Security Act (EISA) goals
  • Energy security
  • Lower GHG emissions

• Vast majority of biofuels produced from corn

• Corn production
  • High inputs, especially nitrogen fertilizer
  • Increased soil drainage
  • Increased irrigation

• Cellulosic -- Corn stover
  • Tradeoffs
    • stover adds carbon and nutrients to the soil
    • holds water and soil when no crop growing (most of the year)
USDA Conservation Programs

- Voluntary
- Financial and technical assistance
- Approximately $5 billion a year
- Working lands or land retirement
USDA Conservation Programs
Working Lands

- Environmental Quality Incentives Program (EQIP)
  - Cost-share up to 75% for conservation practices
  - 1-10 year contracts
  - Structural and management practices
  - $1 billion annually

- Conservation Stewardship Program (CSP)
  - New program in 2008 Farm Bill
  - $1 billion

- Cross-Compliance
  - Conservation Compliance on Highly Erodible Land
  - Swampbuster/Sodbuster
USDA Land Retirement Programs

**Wetlands Reserve Program (WRP) NRCS**
- permanent or 30 year easements
- ~150,000 acres/year
- Raised cap to 3.041 million acres (from 2.275 m acres)

**Conservation Reserve Program (CRP)**
- 10 to 15 year contracts
- 32 million acre cap
- General sign-up = bids based on national environmental index
- Continuous sign-ups for “highly desirable environmental practices”: filter strips, grassed waterways, riparian buffers, public wellhead areas

**Conservation Reserve Enhancement Program (CREP)**
- State and federal partnership