Evaluating the Potential for Enhanced Nutrient Management Techniques to Reduce Nitrous Oxide Emissions and Generate Carbon Offsets

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2012 US Agriculture Greenhouse Gas Emission Sources (USEPA 2014)

- **Agricultural Soil Management**: Largest source of GHG emissions.
- **Enteric Fermentation**: Significant, but less than soil management.
- **Manure Management**: Moderate impact.
- **Rice Cultivation**: Smaller impact compared to other sources.
- **Field Burning of Agricultural Residues**: Very small impact, less than 0.5 Tg CO₂ Eq.

Agriculture as a portion of all emissions is 8.1%.
• Nitrous oxide is ~ 300 x more potent than CO2

• Mitigation benefits are not reversible

• Both the Verified Carbon Standard (VCS) and the American Carbon Registry (ACR) have approved protocols for carbon credits:
  - **VCS**: MSU/EPRI Reduced fertilizer application. Empirically derived EF (North Central Region) or 1% IPCC default
  - **ACR**: MSU/EPRI or DNDC model for fertilizer management
Objectives

• Develop and calibrate a Chesapeake region-specific version of DNDC model
• Work with farmers in PA and VA to promote adoption of enhanced nutrient management approaches
• Apply the DNDC model to estimate changes in N2O emissions reductions
• Apply the ACR methodology for fertilizer management
Enhanced Nutrient Management

• “Adaptive Nutrient Management” in South Central, PA – EDF and Team Ag
  – Soil testing, corn stalk nitrate test, and education to promote nutrient use efficiency and better nutrient management

• Variable Rate Technology/Greenseeker in VA Eastern Shore – VA Tech
DNDC Model Development

- Regional Calibration from long-term dataset from USDA-ARS Beltsville Lab
- User friendly web tool to facilitate data entry
Participation

- PA: 6 producers and roughly 3000 acres corn/wheat/soybean rotation under adaptive nutrient management
- VA: 8 producers implementing GreenSeeker on roughly 18,000 acres corn/wheat/soybean over 3 years.
  - On average, GreenSeeker reduced corn N application by 11lbs/acre and wheat by 2.4 lbs/acre
N leaching by farm field, 2013
Conventional N application vs. Greenseeker

Legend:
- Blue: Greenseeker
- Red: Conventional
Challenges

• DNDC Model is data intensive
  – Fertilizer form, rate, and date of application
  – Planting and harvest dates
  – Residue management/tillage
  – Yield
  – Irrigation amounts, dates
Challenges

- ACR Methodology requires 5 years of historic information for baseline
- For a variety of reasons (time, trust, availability) data are hard to extract from farmers
- Difficulty in discerning “change in practice” from farmers implementing ANM
Opportunities

• GreenSeeker is demonstrated to, on average, reduce N application with no effect on yield

• High farmer interest in GreenSeeker where it has been piloted, hence, opportunity to scale up

• Possible to create interface that would allow automatic download of GreenSeeker outputs to help simplify data collection
Next Steps

• Develop “synthetic baseline” for PA ANM farmers to estimate potential benefits from change in practice

• Fill datagaps from GreenSeeker farmers and run DNDC scenarios to discern change from baseline
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