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

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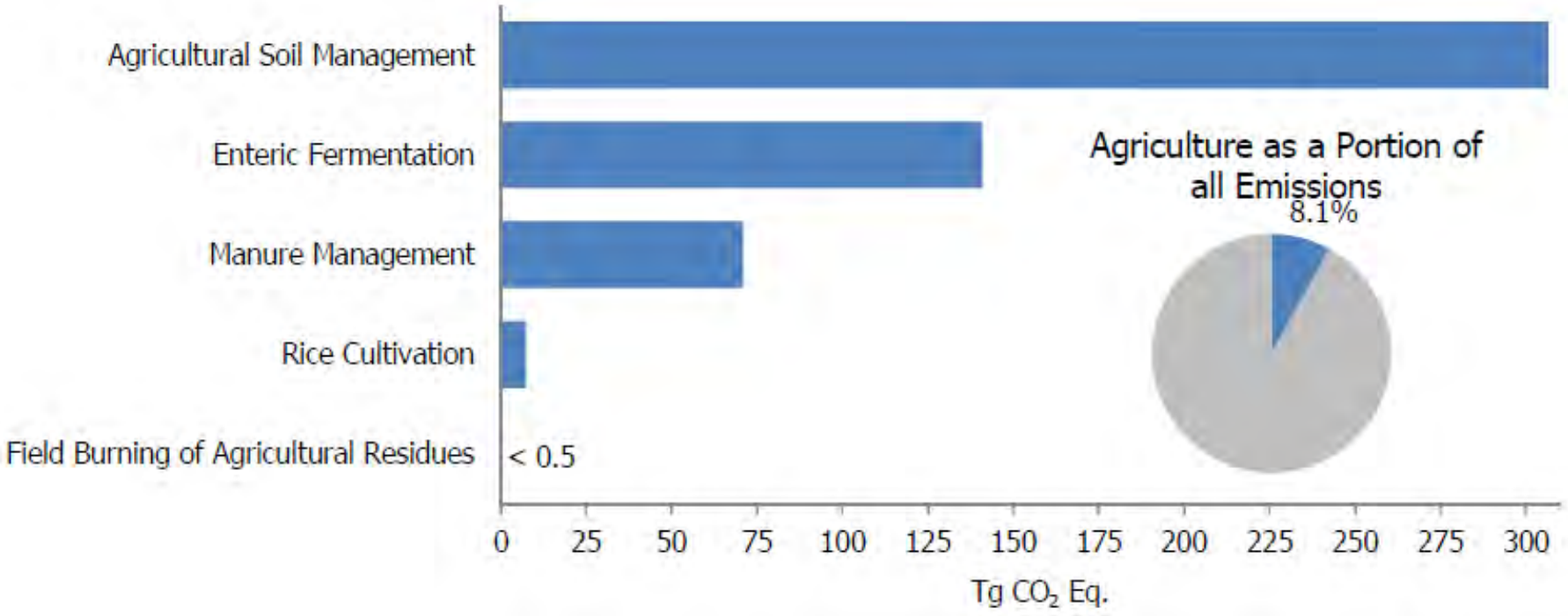
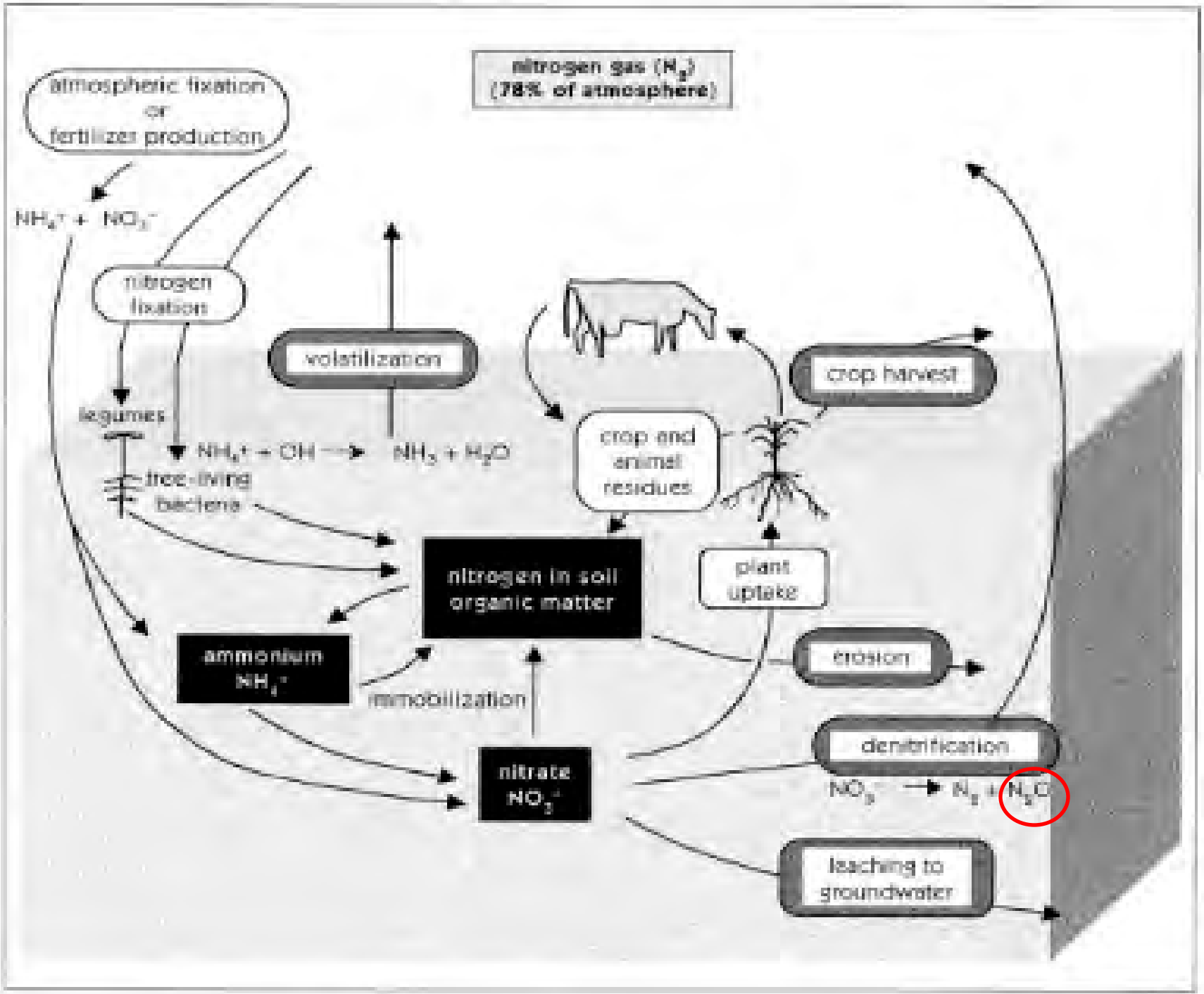
2012 US Agriculture Greenhouse Gas Emission Sources (USEPA 2014)




nitrogen gas (N_2)
(78% of atmosphere)
atmospheric fixation
or
fertilizer production
$NH_4^+ + NO_3^-$
nitrogen fixation
volatilization
crop harvest
legumes
$NH_4^+ + OH^- \rightarrow NH_3 + H_2O$
free-living bacteria
crop and animal residues
plant uptake
nitrogen in soil organic matter
ammonium NH_4^+
erosion
immobilization
denitrification
nitrate NO_3^-
$NO_3^- \rightarrow N_2 + N_2O$
leaching to groundwater

- Nitrous oxide is ~ 300 x more potent than CO_2

- 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

Carbon credits

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

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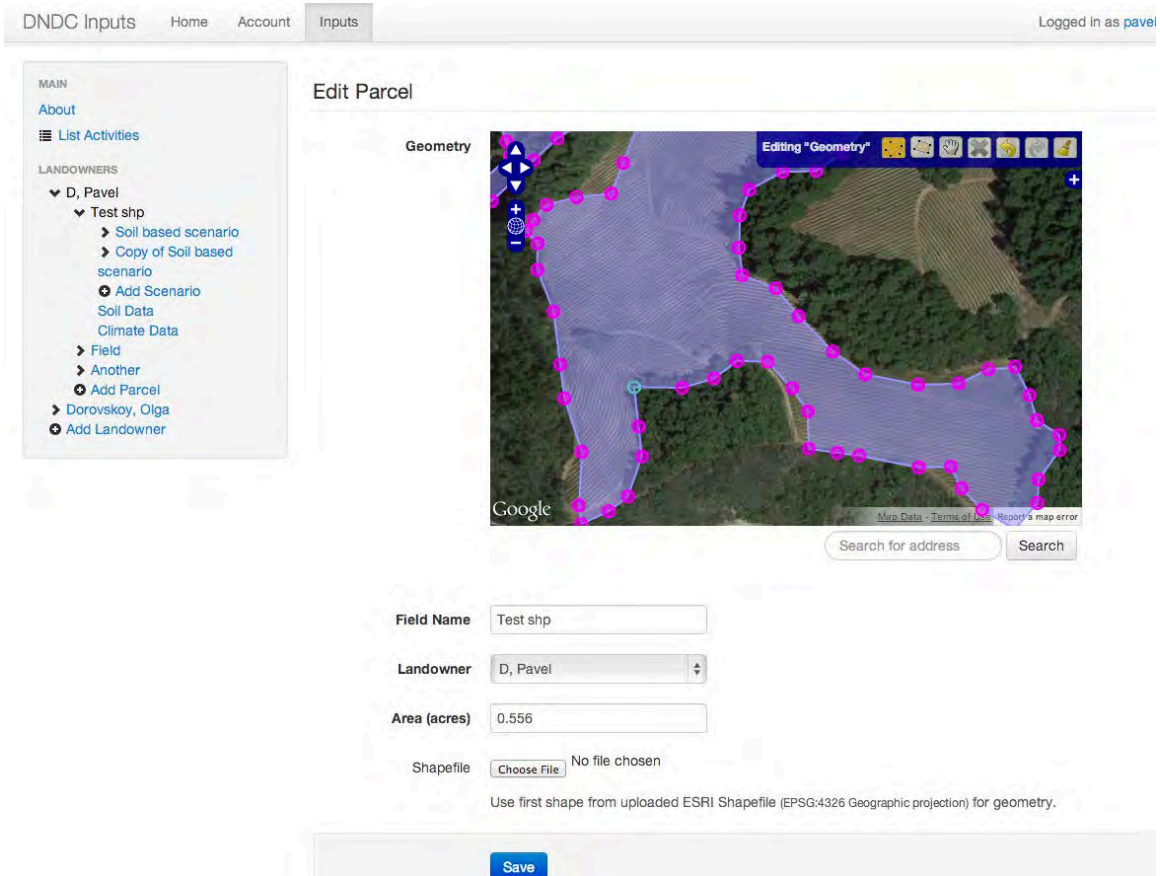
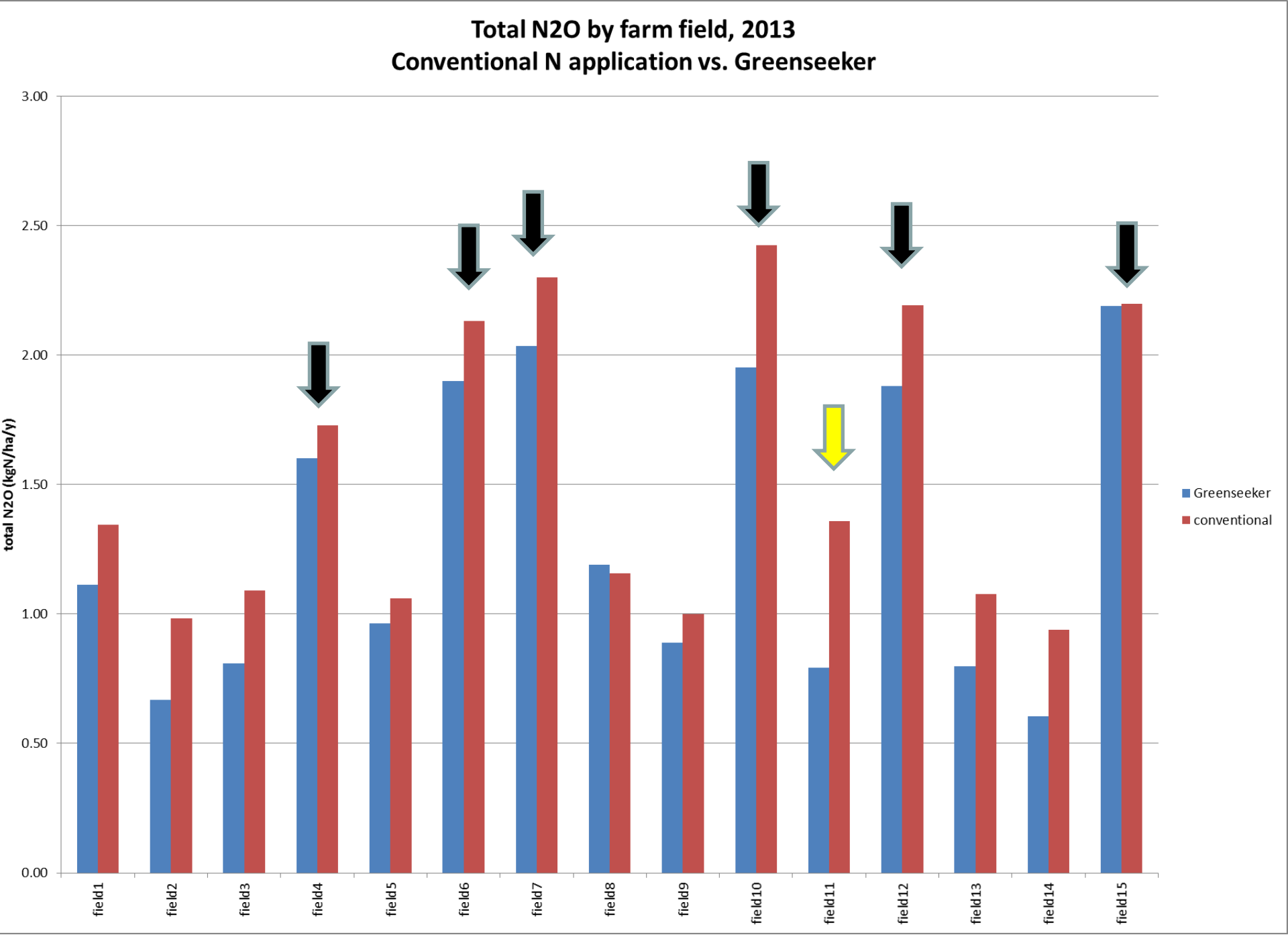
DNDC Model Development

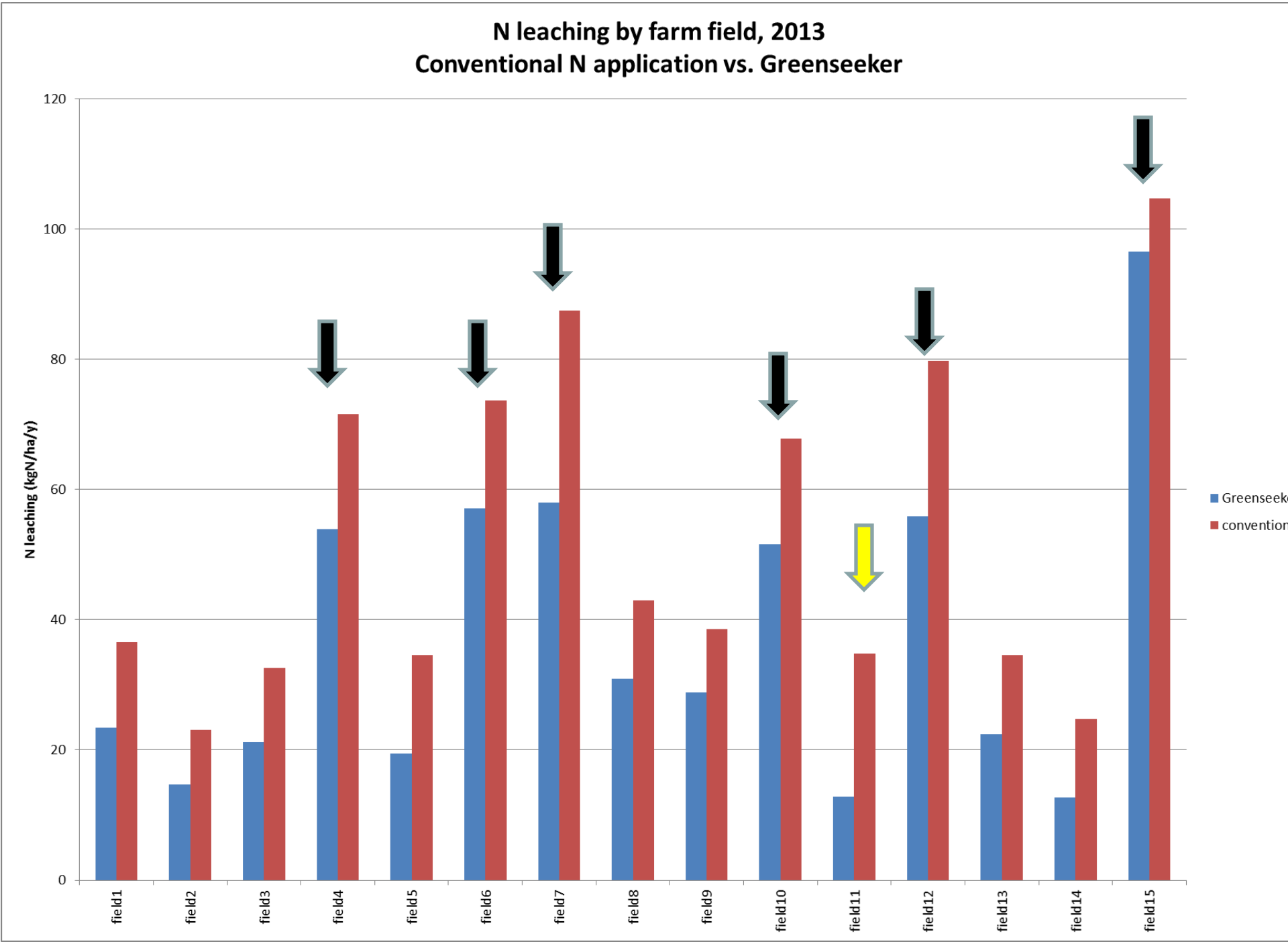
- Regional Calibration from long-term dataset from USDA-ARS Beltsville Lab
- User friendly web tool to facilitate data entry



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


Total N2O by farm field, 2013
Conventional N application vs. Greenseeker
total N2O (kgN/ha/y)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
field1
field2
field3
field4
field5
field6
field7
field8
field9
field10
field11
field12
field13
field14
field15
Greenseeker
conventional


N leaching by farm field, 2013
Conventional N application vs. Greenseeker
N leaching (kgN/ha/y)
120
100
80
60
40
20
0
field1
field2
field3
field4
field5
field6
field7
field8
field9
field10
field11
field12
field13
field14
field15
Greenseek
convention

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

Acknowledgements

- USDA Natural Resources Conservation Service Conservation Innovation Grant Program
- Washington Gas Energy Services and Sterling Planet