SOIL HEALTH & CLIMATE CHANGE
ADAPTATION & MITIGATION

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Cornell University

New York Soil Health Summit
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Albany NY

Find our education, outreach, and peer-reviewed materials here:
http://blogs.cornell.edu/woodbury
Soils and Climate Change

• This talk is focusing on how Farms, Landowners, and citizens can promote resiliency through the soil:

• FOR EXAMPLE: Double Cropping
  • Slow the rate of change (through carbon sequestration)
  • Increase resiliency (reduce erosion)
  • Reduce impact (better able to absorb extreme precipitation)
  • Increase productivity (double crop, e.g. winter wheat/soybean)

• Resulting in local and global sustainability
  • Increasing knowledge
  • Minimizing impacts for future generations
NYS Greenhouse Gas (GHG) Emission Reduction Goals

- Governor Cuomo
- Executive Order No. 166, June 1, 2017
  - 40x30: 40% reduction of 1990 level GHG by 2030
  - 80x50: 80% reduction of 1990 level GHG by 2050 (from ALL sectors)
    - Programs include NY Sun-solar, Green Bank, methane reduction plan, Clean Energy Standard, Clean Energy Fund, Environmental Protection Fund, NYSERDA, RGGI, Transportation and Climate Initiative (TCI), Ocean Action Plan, Climate Risk and Resiliency, Climate Smart, Climate Resilient Farming
GHG by Type – Most is from CO$_2$
Common Farm & Forest Greenhouse Gases (GHG)

- **Carbon Dioxide (CO₂)**
  - e.g. combustion of fossil fuels, released from soils, burned forests

- **Methane (CH₄)**
  - e.g. cow rumen, manure

- **Nitrous Oxide (N₂O)**
  - e.g. nitrogen fertilizer
Global Warming Potential (GWP)

• Different GHGs can have different effects on the Earth's warming.
  • their ability to absorb energy (their "radiative efficiency"),
  • how long they stay in the atmosphere (their "lifetime").

• The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases.
Global Warming Potential (GWP)

- CO$_2$, by definition, has a GWP of 1

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Global Warming Potential (GWP)

- CO$_2$, by definition, has a GWP of 1

- Methane (CH$_4$) and Nitrous Oxide (N$_2$O) are Important Land-based GHG

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How Do We Avoid Emitting GHG?
Some Examples involving CO₂ and N₂O

• Avoid producing carbon-based GHG
  • Reduce tractor passes -> reduce fossil fuel use
  • Reduce tillage
  • Reduce synthetic N purchase (fuel intensive process)

• Avoid the GHG impact from nitrogen processes
  • Reduce synthetic N use to reduce field N₂O (GWP = 298)
  • Manage manure-N to reduce field N₂O
How Do We Mitigate (Reduce) GHG?

Some Examples involving CO$_2$

- Sequester the CO$_2$ in soil, products, root systems, wood
  - Promote vegetative cover: perennials, cover crops
  - Improve pasture and grazing
  - Add biochar to soils
  - Increase yields by double cropping
  - Plant rows of trees, buffer strips, reforest marginal lands
  - Manage woodlots (increase C in trees and soil)
Carbon Sequestration - permanence

- For carbon sequestration to have a meaningful impact on the atmosphere it is necessary to ensure that the carbon remains sequestered and is not released back into the atmosphere.

- For example, years of carbon built up and stored in soils can be released back into the atmosphere from just one instance of tillage.

- Some strategies are permanent, others are not (but may have other benefits).
Conserve/Improve vegetative cover

- Protect agricultural and forest lands from development

- Move toward soil sequestration mechanisms including perennials, double crops, cover crops, reduce tillage, biochar, improved pasture and grazing

- WHY?
  - These practices sequester carbon, improve productivity, reduce erosion, improve water quality and improve soil health
Improve Nutrient management

- Reduce synthetic nitrogen consumption (energy intensive process) on Agricultural lands, yard/landscaping

- Manage manure and synthetic Nitrogen use to reduce $N_2O$ field emission and it’s high GWP (298x $CO_{2e}$)

- WHY?
  - These practices remove emissions from fertilizer manufacturing, improve profitability, improve water quality, improve air quality, and improve soil health
Improve Forest Management

• More than 60% of our state soil is forested!
• 30% of Ag. land is wooded

• Manage woodlots, privately owned forests, plant riparian buffer strips, reforest marginal lands

• WHY?
• These practices sequester carbon in tree trunks, soil, and profitable long-lived wood products, reduce erosion, improve water quality, air quality, and soil
Improved Soil Health Reduces GHG emissions

- Farms can increase soil carbon,
  - which improves soil health,
  - crop productivity,
  - water infiltration and retention,
  - and can also sequester carbon in soil and products.

- Mechanisms include
  - tillage practices,
  - soil amendments, manure, biochar
  - annual versus perennial crop options for maximizing soil carbon storage
  - cover crops/double crops
  - Plant forests on marginal lands, add buffer strips, manage woodland
## PRELIMINARY Benefits

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<tr>
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<th>Permanent GHG mitigation</th>
<th>Verifiable GHG mitigation</th>
<th>Build Climate Resiliency</th>
<th>Improve Productivity</th>
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<tbody>
<tr>
<td>Avoid Land Conversion (Defense)</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
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<tr>
<td>Forest Management</td>
<td>x</td>
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<td>x</td>
<td>Retirement income</td>
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<td>N-management</td>
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<td>Cost-effective</td>
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<tr>
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<td>Nutrient store</td>
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<td>Additional income</td>
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<td>Soil Amendment</td>
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<td></td>
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<td>Reduced inputs</td>
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Current or Recent Opportunities
Climate Smart Community Grants, July 27! ($10k - $100k from $8.8 million pool)

- [https://www.dec.ny.gov/docs/administration_pdf/cscrfa(1).pdf](https://www.dec.ny.gov/docs/administration_pdf/cscrfa(1).pdf)
- For municipalities

- Such projects include, but are not limited to, reduction of future flood risks

- Implementation of municipal food waste/composting programs
Trees for Tributaries (DEC), due September 2018

Trees for Tribs Grant Program (Round 1) Eligible Watersheds

Legend:
- Great Lakes Priority Watershed
- Mohawk Priority Watershed
- Statewide Priority Watershed
- Ineligible Watersheds
Climate Resilient Farming, due Feb 2018
Maybe again in 2019? (NYSDAM)

- $2 million available, covers 75% of costs
- [https://www.nys-soilandwater.org/programs/crf.html](https://www.nys-soilandwater.org/programs/crf.html)

- Agricultural waste storage cover and flare systems
- Riparian Buffer System
- Stream Corridor
- Erosion Control
- Prescribed Rotational Grazing
- Soil Conservation System
Horizon: Climate Action Reserve (CAR) – N-management credits

- CAR is currently revising protocols for N-management accounting for possible sale.

Future Needs: Assessment

• Better quantify financial and environmental benefits/costs

• Improve assessment of overall environmental performance among and between practices and end-goals (water/air/soil/productivity)
Future Needs: Promote Practices

- Promote best management practices that include GHG mitigation, Climate change adaptation, and long-term resiliency

- Educate current and future farmers

- Educate current and future policy makers
Future Needs: Create Policies

• Provide science-based information to policy makers as they negotiate a multitude of societal needs.
  • Farm productivity
  • Farm profitability
  • Water quality
  • Air quality
  • Soil health
  • Societal resiliency
Please share suggestions of Needs
Thank you

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- http://blogs.cornell.edu/woodbury

- Support from NYS Department of Agriculture and Markets