New York State Climate Action Council

Agriculture and Forestry Advisory Panel

October 1, 2020

Meeting 2

NEW YORK STATE OF OPPORTUNITY. | Climate Action Council

Agenda

- Welcome
- Roll Call
- Carbon Farm Study Presentation – Dr. Peter Woodbury
- Agriculture and Forestry Draft Work Plan
- Meeting Schedule: next meeting

Carbon Farm Study-
Dr. Peter Woodbury

NY AGRICULTURE & CLIMATE CHANGE: KEY OPPORTUNITIES FOR MITIGATION, RESILIENCE, AND ADAPTATION

Jenifer Wightman and Peter Woodbury

Cornell University

Presentation to

NYS Climate Action Council Agriculture and Forestry Panel

1 October, 2020

OUTLINE OF TALK

- C-Farming report
- What is Carbon Farming?
- What we evaluated
- Importance of counting all 3 greenhouse gases (GHG)
- SMART decision matrix
- Our Ranked Top 5 Opportunities for Ag GHG Mitigation
- Importance of permanence
- Issues of verifiability
- Things to work towards
- Current project
- Your Questions

NY AGRICULTURE & CLIMATE CHANGE: KEY OPPORTUNITIES FOR MITIGATION, RESILIENCE, AND ADAPTATION

JENIFER WIGHTMAN & PETER WOODBURY

- AKA "Carbon Farming Report", submitted May 2020, available online.
- Supported by the State of New York
- Administered by the NYS Department of Agriculture and Markets (NYS AGM)
  - Thanks to Brian, Steinmuller Greg Albrecht, and Jennifer Clifford
- Following
  - the NYSAGM mandate (2008 NYS Bill S8143/A10685)
  - NYS fiscal year 2017-2018 budget (S2004-D)
  - And the Carbon Farming Act (A3281)
- 2018-2020

WHAT IS CARBON FARMING?

- In the Carbon Farming Act (A3281),
  - Carbon Farming was defined as:
  - "the implementation of a land management strategy for the purposes of reducing, sequestering, and mitigating greenhouse gas emissions on land used in support of a farm operation and quantifying those greenhouse gas benefits"

WHAT WE EVALUATED

- Sources of emissions and mitigation from different farm activities
  - 3 greenhouse gases
  - 5 general mitigation strategies
- Preliminary mitigation potential for 13 different practices
- Qualifying the Mitigation
  - Co-benefits
  - Scale of opportunity (big or small)
  - Cost to Implement (cost savings or expensive)
  - Realistic? (easy or hard to implement)
  - Timeline (how permanent is the mitigation)

GREENHOUSE GASES (GHG) EVALUATED

We evaluated three key greenhouse gases associated with working lands:

- Carbon dioxide, CO_2
- Methane, CH_4
- Nitrous oxide, N_2O

Carbon Farming is something of a misnomer.

GHG mitigation on farms involves both N and C.

GLOBAL WARMING POTENTIAL (GWP)

Greenhouse Gas	Potency (relative to CO2) 20 year-time (IPCC AR5)	Potency (relative to CO2) 100 year-time (IPCC AR4)
Carbon Dioxide (CO2)	1	1
Methane (CH4)	84	25
Nitrous Oxide (N2O)	264	298
	NYS 2019 CLCPA* uses these 20-year values	Carbon Farming report used these 100-year values

CLCPA= Climate Leadership and Community Protection Act, signed 2019. https://climate.ny.gov/

80% OF NY AGRICULTURAL GHG COME FROM CH4 AND N2O EMISSIONS

Methane and nitrous oxide are common gases in agriculture.

Because they are so much more potent GHG, very small amounts of methane and nitrous oxide are very large players in farm GHG accounting.

“Carbon Farming” is a misnomer, must account for nitrogen also.

5 CATEGORIES OF FARM GHG MITIGATION

Sequester Carbon

Trees,
Soils,
Long-lived wood products

Destroy Methane

Capture methane from manure storage and flare it

Increase Efficiency

Energy use on farm,
Milk production efficiency,
Crop production efficiency,
Nitrogen-use efficiency

Displace Fossil Fuels

Produce renewable energy

Conserve

Energy,
Natural Resources,
Leave forest as forest

TYPES OF PRACTICES

Dairy	• Feed management (CH_4, N_2O) • Manure storage (CH_4, N_2O) • Milk product efficiency (CH_4, N_2O)
Crops	• Nitrogen management (N_2O, CO_2) • Soil Carbon (N_2O, CO_2)
Woodlands	• Improve forest management (CO_2) • Agroforestry (alley crop, silvopasture)
Idle Lands	• Afforestation (CO_2) • Solar/Wind energy (CO_2) • Biomass for feed or fuel (CO_2)
Conserve	• Reduce Energy or Resource Use • Conserve Land (Forest stays forest)

MULTIPLE EVALUATION CRITERIA:

INTRODUCING THE **SMART MATRIX**

- **S**ervices – co-benefits
- **M**easurable quantity at the NYS level
- Cost to **A**chieve implementation
- **R**ealistic to implement?
- **T**imeframe of implementation

SMART MATRIX

- **Services**
- **M**easurable
- **A**chievable
- **R**ealistic
- **T**imeFrame

Services : co-benefits or "ecosystem services" provided by a practice

- Soil health
- Community relations
- Adaptation to climate change
- Profitability
- Air quality
- Water quality
- Biodiversity
- Energy

SMART MATRIX

- **S**ervices
- **Measurable**
- **A**chievable
- **R**ealistic
- **T**imeFrame

Measurable:

- Estimated statewide GHG mitigation potential for a practice
- Degree to which it is *Verifiable*.

SMART MATRIX

- **S**ervices
- **M**easurable
- **A**chievable
- **R**ealistic
- **T**imeFrame

Achievable: Estimated direct cost

- (0-$100/ Mg CO_2e, where Mg is megagram or metric ton).

- Note: Costs are for implementation only, not including cost to educate, measure, verify, or account in formal registries.

SMART MATRIX

- **S**ervices
- **M**easurable
- **A**chievable
- **Realistic**
- **T**imeFrame

Realistic: amount of engagement required, such as:

- acres of applicable lands,
- number of stakeholders to be engaged,
- availability of technical tools.

- Can we do it now?
- Do we need more research/education/tools?

SMART MATRIX

- **S**ervices
- **M**easurable
- **A**chievable
- **R**ealistic
- **T**imeFrame

Time Frame: lifespan of infrastructure, time limits of mitigation strategy, and short-and-long term effectiveness.

- (indirectly a measure of ***Permanence***)

13 PRACTICES EVALUATED

1. Afforestation of Idle Lands
2. Manure Storage Cover & Flare
3. Reduced Food Waste
4. Renewable Energy
5. Woodland Management
6. Cover Crops & Double Crops
7. Feed Management
8. Alley Cropping (10% of Ag land)
9. Replace Annuals with Perennials
10. Crop Nutrient Management (N-fertilizer reduction)
11. Riparian Buffers
12. Biochar
13. Reduced Tillage/No Tillage

OUR TOP 5

BASED ON SMART CRITERIA

Manure Cover and Flare

Nitrogen-Use Efficiency

Feed Efficiency

Improved Management of Woodlands

Planting Trees on Idle Lands

TOP 5 MITIGATION PRACTICES

Cost 0-$50 per MT CO2e mitigated

Represent real and permanent mitigation

Most can be directly verified

Have a suite of co-benefits

Many increase production/efficiency of NYS Agriculture.

OPPORTUNITIES AND BARRIERS
MANURE COVER & FLARE

OPPORTUNITY

- Large mitigation opportunity for NYS
- ~1.3 MMT CO2e/yr
- Low cost per MT CO2e
- Small stakeholder group of 500 farms
- Several co-benefits: community relations, hauling costs, and water quality benefits
- Existing programming through CRF
- Many have already implemented (farmer:farmer)

BARRIER

- Upfront cost to Farmer
- May require engineering to retrofit
- Milk pricing/farm ability to participate in cost-share
- Technical Assistance
- New policy to require new manure storages to be designed to easily accept cover/flare systems

OPPORTUNITIES AND BARRIERS
FEED EFFICIENCY

OPPORTUNITY

- ~0.7 MMT CO2e/yr mitigation opportunity
- Cost saving per MT CO2e
- All livestock, particularly ruminants
- Many farms are doing it (farmer: farmer)

BARRIER

- Upfront cost to farmer
- Technical Assistance
  - Feed management planning and implementation
  - Improved diet
  - Feed and forage management
- Implementation
- Sustaining implementation

OPPORTUNITIES AND BARRIERS
NITROGEN-USE EFFICIENCY

OPPORTUNITY

- ~0.2 MMT CO2e/yr mitigation opportunity
- Cost saving or low cost per MT CO2e
- Implement 4-R Guidelines
  - right source, time, rate, & place
- All farms that use nitrogen
- Many farms are doing it (farmer: farmer)
- Co-benefits:
  - Improved water quality
  - Reduced upstream manufacturing emissions

BARRIER

- Cultural shift away from 'insurance N'
- Upfront cost to farmer
  - Soil testing/planning
  - Precision nutrient management may be more costly
- Technical assistance
- Implementation
- Sustaining implementation

OPPORTUNITIES AND BARRIERS
WOODLAND MANAGEMENT
1.4 MILLION ACRES

OPPORTUNITY

- 21% of ag land is wooded, 1.4 million acres!
- Farmers are great land managers
- Long-term profit potential
- Many forest owners are doing it – share knowledge between groups
- Several co-benefits,
  - diversify farm income
  - improve diversity and habitat
  - Improve water and air quality

BARRIER

- Forest harvest often done to address a financial need
- Upfront costs:
  - Forest management plan
  - Periodic maintenance
- Cultural separation between forest managers and farm managers
- Technical assistance

NOTE: Statewide GHG mitigation potential not yet estimated.

OPPORTUNITIES AND BARRIERS
ACTIVATE IDLE LANDS
1.7 MILLION ACRES

OPPORTUNITY – GROW TREES

- 4.9 MMT CO2e/yr mitigation potential!
  - Long lived wood products (C-sequestration)
  - Increased profitability of land area

OTHER COMPETING OPPORTUNITIES

- Solar
- Wind
- Bioenergy
- Grazing
- New Products?

BARRIER

- Existing deer, pests, and invasive shrubs
- Diverse ownership
- Parcels all over the state
- Varying soil quality, slope
- Landowner interests/goals
- High upfront costs
- Technical assistance

- Lots of possibility, Lots of unknowns!

FIVE STAR VERSUS ONE STAR RANKING: TWO EXAMPLE PRACTICES

GHG BMP	System Co-benefits	Measurable Mitigation	Cost to Achieve	Realistic to Implement	Time Frame of Mitigation benefit
Manure Cover + Flare	* Water, resiliency to extreme weather, reduced hauling costs, decreased odor for neighbor relations	* Large 1.3 MMT CO2e Easily verifiable with meter and flare	* <$10 MT CO2e	* Yes, Only engage 500 large farms, Technology is available and working	* Methane destruction is permanent
Biochar	* Water quality, soil health	Potentially large	TBD	Real potential but **more research needed**	Great potential but full life cycle must be evaluated

Table A. Preliminary Estimates of Greenhouse Gas Emissions from New York Agriculture. Units are million metric tons of carbon dioxide equivalents per year. Positive values are emissions, negative values are mitigation or sequestration.

	Recent Year Emission		Mitigation Potential		Possibly outside sector?
Category & Sub-Categories	Sub-Category		Sub-Category		
	---------- $MMt\ CO_2 e\ y^{-1}$ ----------				
Enteric Fermentation	12.46		-2.34		
Manure Management (storage)	6.68		-4.33		
Agriculture Soil Management	4.08		-1.68		
Reduce Food Waste	n/a		-3.60		Yes
Farm Energy Conservation	?		?		Yes
Wind & Solar Energy on Agricu	?		?		Yes
Avoided Grassland Conversion	n/a		0.00		
Forested Riparian Buffer	-0.06		?		
Alley Cropping	0.00		-0.67		
Bioenergy	?		?		Yes
Reforestation of Former Agricul	0.00		-4.90		
TOTAL	**23.16**		**-17.52**		
TOTAL, WITHIN SECTOR	**21.65**		**-13.92**		

Orange highlighted values are approximate estimates based on 20-year GWP for methane.

Source: McDonnell, T.C., T.J. Sullivan, P.B. Woodbury, J.L. Wightman, G.M. Domke, C.M. Beier, et al. 2020. Sources and Sinks of Major Greenhouse Gases Associated with New York State's Natural and Working Lands: Forests, Farms, and Wetlands. New York State Energy Research and Development Authority.

Table B. Preliminary Estimates of Greenhouse Gas Emissions from New York Agriculture. Breakdown of Agricultural Soil Management. Units are million metric tons of carbon dioxide equivalents per year. Positive values are emissions, negative values are mitigation or sequestration.

Category & Sub-Categories	Recent Year Emission		Mitigation Potential		Possibly outside sector?
	Category	Sub-Category	Category	Sub-Category	
	---------- $MMt\ CO_2e\ y^{-1}$ ----------				
Agriculture Soil Management	**4.08**		**-1.68**		
Manure management (field)		0.01		0.00	
Field emissions from liming		0.28		0.00	
Crop N_2O emissions (direct & indirect)		2.20		-0.20	
Cover crops		?		-0.85	
Reduced tillage		0.00		?	
Drained wetlands		0.07		?	
Replace annual with perennial crops		n/a		-0.62	
Equipment (fuel)		0.26		0.00	Yes
Equipment (embodied)		0.09		0.00	Yes
Production of herbicide, P, K, seed		0.18		0.00	Yes
Production of lime		0.79		0.00	Yes
Production of synthetic N		0.19		?	Yes
TOTAL	**4.08**		**-1.68**		
TOTAL, WITHIN SECTOR ONLY	**2.57**		**-1.68**		

This table is sub-categories of soil management

A NOTE ON GHG ACCOUNTING -- BOUNDARIES

- If we reduce nitrogen fertilizer use in NY State while maintaining crop yields.
- There will be a reduction in GHG emissions from fertilizer manufacturing.
- Will this be counted under the CLCPA?

A NOTE ON GHG ACCOUNTING -- PERMANENCE

Climate change is a long term problem, so we need long term solutions.

Covering and flaring methane from manure storage is permanent.

Sequestering carbon in soil with reduced tillage is not permanent, it can be released later.

A NOTE ON VERIFICATION AND NET GHG ACCOUNTING

A leguminous cover crop can add soil carbon, but can also increase N2O emission.

Carbon sequestered the soil can be measured and verified (but is expensive).

N2O emission from a field can only be estimated, not measured (much too expensive)

N2O is ~300x more potent than CO2,

How to evaluate net GHG Mitigation?

TWO KEY ATTRIBUTES

PERMANENT

- Climate change is long-term
- So we need long-term mitigation

VERIFIABLE

- Must account for all 3 GHG's as NET mitigation
- Some practices are more easily or cost effectively monitored, or measured
- Some practices are very difficult to verify

A QUALIFICATION ON COST

Our estimate only includes Implementing a Practice on farm

Education	• Cost to create education materials, new research, and distribution
Policies	• Cost to develop, implement and administer new policies
Implementing a Practice on farm	• **Cost just to implement a project on a farm or in a field**
Measuring, Ensuring, Reporting	• Measuring evidence of mitigation, ensuring permanence, and associated reporting
Verifying/Registering	• Cost of hiring a 3rd party verifier and cost of the registries that account for all activities

WHAT DO WE PAY FOR?

GHG mitigation only?

GHG and other benefits like clean water and healthy soils?

Or do we set GHG caps and use the markets to accommodate for the increased costs to mitigate?

FINANCIAL WAYS TO MITIGATE FARM GHG

Market Driven

Voluntary actions

Double cropping to increase product sales on farm

Public Financial Support

Federal/State/Local Govt's provide expertise, grants, tax incentives, and/or peer-support systems

Compliance Driven

Cap and Trade programs like RGGI –

For example, the electric sector regulation paying for reforestation 'offset' projects for carbon mitigation.

SOME EXISTING PROGRAMS

- Climate Resilient Farming (CRF)
  - Cover/flare
  - Soils
  - Water quality
- Trees for Tributaries
- SWCD & Cooperative Extension outreach
- Ag & Markets Tier II
- NYS Environmental Protection Fund (EPF) "Open Space Program"
- Conservation Easements
- Potentially -- Regional Greenhouse Gas Initiative (RGGI) offsets

CLIMATE RESILIENT FARMING, NY AGRICULTURE & MARKETS

SINCE 2015

PROJECT FUNDING

- 4 rounds
- $8 million for projects on 121 farms

MITIGATION

- -231,000 MT CO2e/yr

SCALE UP

- Basic infrastructure is in place!

MOVING FORWARD: CONSIDERATIONS

1. Evaluate all GHGs together
2. Prioritize Permanent & Verifiable practices
3. Consider co-benefits & other State objectives
4. Compare alternatives for current and former agricultural land
   - Bioenergy
   - Solar
   - Wind
   - Afforestation
   - Increased agricultural production

MOVING FORWARD: RECOMMENDATIONS

1. Integrate GHG into current soil & water initiatives
2. Improve forest management in farm planning

    21% of farmland is wooded
3. Prioritize permanent GHG mitigation activities
4. Celebrate/Share current farm mitigation activities
5. Advocate expansion of Climate Resilient Farming
6. Continue/expand great work in existing programs!

A NEW RESEARCH PROJECT

In April 2020 we began a three-year project with DEC to:

1. Create a new NYS agricultural GHG Inventory,
2. Quantify GHG Mitigation Potential, and
3. Develop three Future Mitigation Scenarios.

We will have preliminary results to share during coming months.

THANK YOU!

NYS Department of Agriculture and Markets

Funding and collaboration for this project

Previous funding & collaboration to create GHG Tier II and Information Sheets.

NYS Department of Environmental Conservation for current work

NYS Energy Research and Development Authority for previous work

Further Information & publications

Blogs.cornell.edu/woodbury

KEY REFERENCES

- **New York Agriculture and Climate Change: Key Opportunities for Mitigation, Resilience, and Adaptation.** (NYS Carbon Farming Report). Jenifer Wightman and Peter Woodbury. May 2020. https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/2/7553/files/2020/07/CarbonFarming_NYSAGM_FINAL_May2020.pdf

- **Sources and sinks of major greenhouse gases associated with New York State's natural and working lands: Forests, farms, and wetlands.** McDonnell TC, Sullivan TJ, Woodbury PB, Wightman JL, Domke GM, Beier CM, Trettin C. 2020. NYSERDA. 20-06. 116 p. February 2020. https://www.nyserda.ny.gov/About/Publications/Research-and-Development-Technical-Reports/Environmental-Research-and-Development-Technical-Reports


QUESTIONS?

Draft Workplan

Draft Work Plan

- Section 1 – Identification of Panel Members
- Section 2 – Roles and Responsibilities of Chair, Panel members and agency staff
- **Section 3 – Goals for the Agriculture and Forestry Sector**
- **Section 4 – Scope of Work**
- Section 5 – Plans for Public Participation
- Section 6 - Timeline

Section 3 – Goals for the Sector

Section 3 – Goals for the Agriculture and Forestry Sector

1. Carbon Sequestration Goals:

2030: Return to 1990 levels of forest carbon sequestration, or approximately 30mmt of net CO_2e sequestered on forested lands on an annual basis, or an increase of approximately 5mmt over current conditions, as also considered in Pathways.

2050: Enhance carbon sequestration across all land use types to achieve the net zero goal, or approximately 60mmt of CO_2e sequestered. This includes forests, urban trees, harvested wood products, agricultural lands, and freshwater and coastal wetlands.

Section 3 – Goals for the Sector

Section 3 – Goals for the Agriculture and Forestry Sector

2. Agriculture GHG Emission Reduction Goals (in CO2e using a 20-year GWP)

2030: Reduce emissions from livestock and cropland soil management 15 percent from current levels, or approximately 3.5mmt CO2e.

2050: Reduce emissions from livestock and cropland soil management 30 percent from current levels, or approximately 7mmt CO2e and equivalent to 1990 levels and in line with projections that informed Pathways.

Section 3 – Goals for the Sector

Section 3 – Goals for the Agriculture and Forestry Sector

3. Cross-sectoral GHG Emission Reduction Goals

Reduce energy (electricity and fuel combustion) emissions associated with agricultural and forestry operations in line with the goals of the CLCPA, including the benefits of increased tree canopy in our urban areas and the resulting reduction in the heat island effect.

Section 3 – Goals for the Sector

Section 3 – Goals for the Agriculture and Forestry Sector

4. Other Goals

Avoid the leakage of GHG emissions into other jurisdictions and ensure resiliency of the food and forest products systems by maintaining and enhancing the agriculture and forestry industries in New York.

Ensure resiliency and resource conservation by maintaining the ecosystem services provided by the 'natural and working lands' (farms, forests, wetlands, and other land uses), including the benefits of enhanced right of way (ROW) maintenance of the state in light of changing climatic conditions.

Section 4 – Scope of Work

Section 4 – Scope of Work

This Panel will consider the following general topics in order to propose recommendations related to the Goals described above:

Land Use Conversions (avoiding conversions to more carbon intensive land uses and promoting conversions to less carbon intensive land uses)

- Farmland protection
- Riparian buffers and agricultural woodlands
- Private and public forest lands
- Urban and community forests

Forestry and Forest Management

- Climate adaptive forest management
- Forest regeneration (including climate-adaptive silviculture)
- Harvested Wood Products and maintaining viable forest products markets

Section 4 – Scope of Work

Section 4 – Scope of Work

Livestock Management

- Enteric fermentation (animal feeding)
- Manure management (manure storage)

Agricultural Soil Management

- Nitrogen fertilizer/manure use
- Soil carbon management (including regenerative agriculture)

Section 4 – Scope of Work

Section 4 – Scope of Work

Cross-cutting Issues

- Costs and innovative financing
- New York's Bioeconomy

Cross-sector Issues (to be discussed in conjunction with other Panels)

- Energy emissions (electricity and fuel use in this sector)
- Energy production (electricity and fuel use in this sector)
- Renewable energy siting
- Food waste and waste-based fuel production
- Net emissions and bioenergy accounting
- Land use (Local Government and Land Use)
- Adaptation and resilience

Meeting Schedule: Next Meeting