



Soil Health, Agriculture and Climate in New England: Scientific Findings, Farming Practices and Policies

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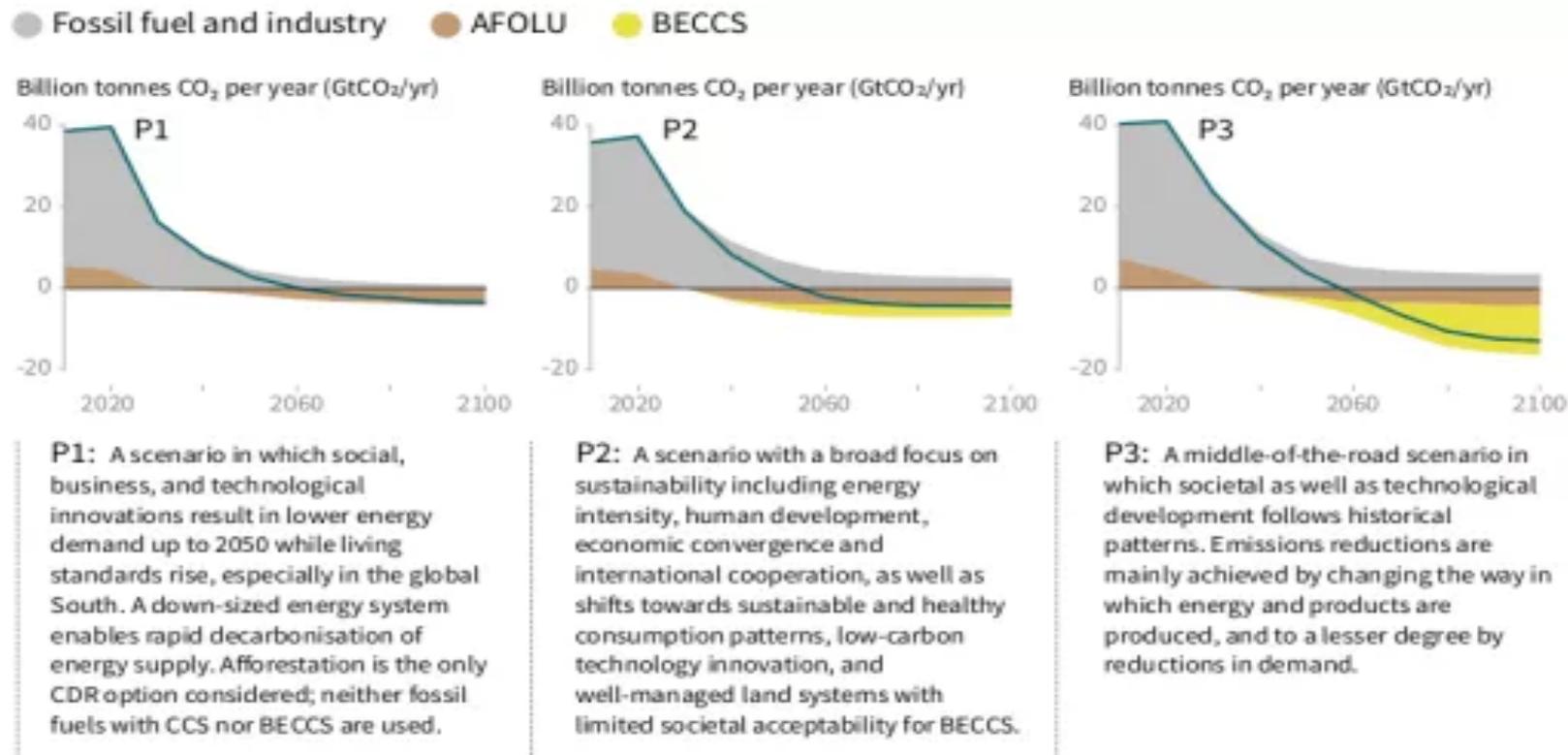
Past Intern with the FAO Global Soil Partnership

Researcher at the Tufts Global Development and Environment Institute (GDAE)

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The world needs “Negative Net Emissions” by 2040

- IPCC’s Fifth Assessment Report pathways for keeping global warming to 1.5°C prescribe carbon dioxide removal – sucking CO₂ out of the atmosphere; with “negative emissions technologies”
- Methods of carbon removal: four model pathways, all of which rely on Agriculture, Forestry and Other Land Use to remove carbon dioxide from the atmosphere

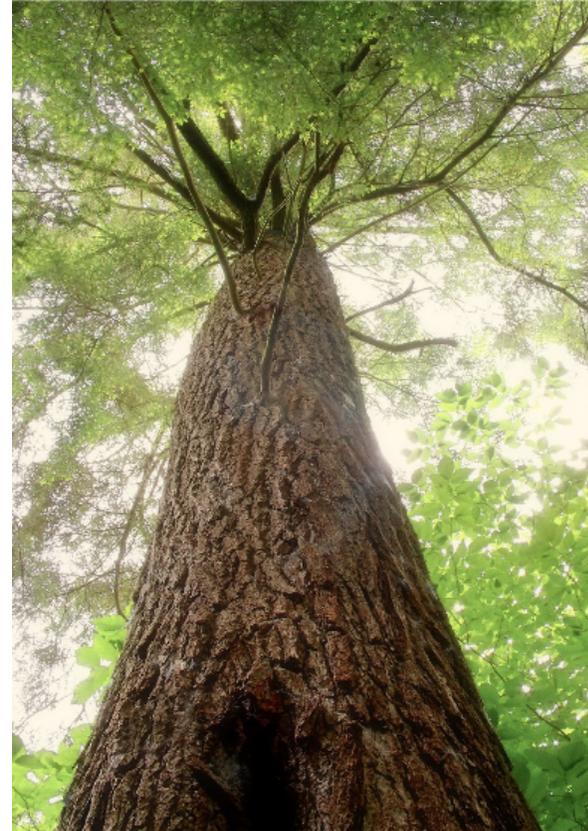
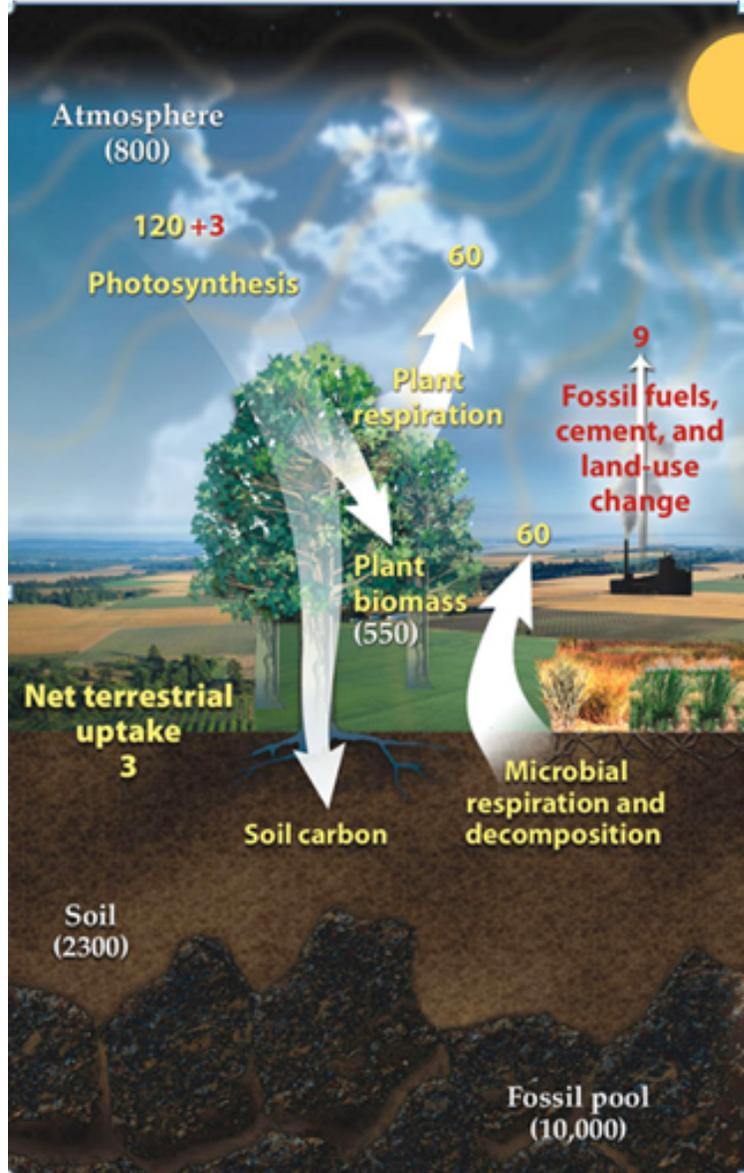


Nature-made carbon capture technology: Soil “biomass processing function” converts CO2 into organic carbon into plants...

The Atmosphere: 860 Gigatons (Carbon budget left = 160Gt!)

Plant biomass: 550 Gt

Soils: 2300 Gigatons



Plants that then sequester more CO2, and store it in Soil



& turn that carbon into food & forest products



Soil carbon sequestration “discovery” gains soil global government attention

These Candidates See Farming as a Climate Solution. Here’s What They’re Proposing.

Democratic front-runner Joe Biden has one of the more ambitious rural climate-related goals, but could his plan actually achieve net-zero emissions

BY GEORGINA GUSTIN Follow @georgina_gustin

JUL 19, 2019



Global figures

- Agricultural soils: 1.4 GtC/year
- Forests soils and agroforestry soils: 1.3 GtC/year
- Grassland soils: 0.3 GtC/year
- Salt affected and desertified soils: 0.5-1.4 GtC/yr

Total estimate: 3.7 Gt C sequestration/year

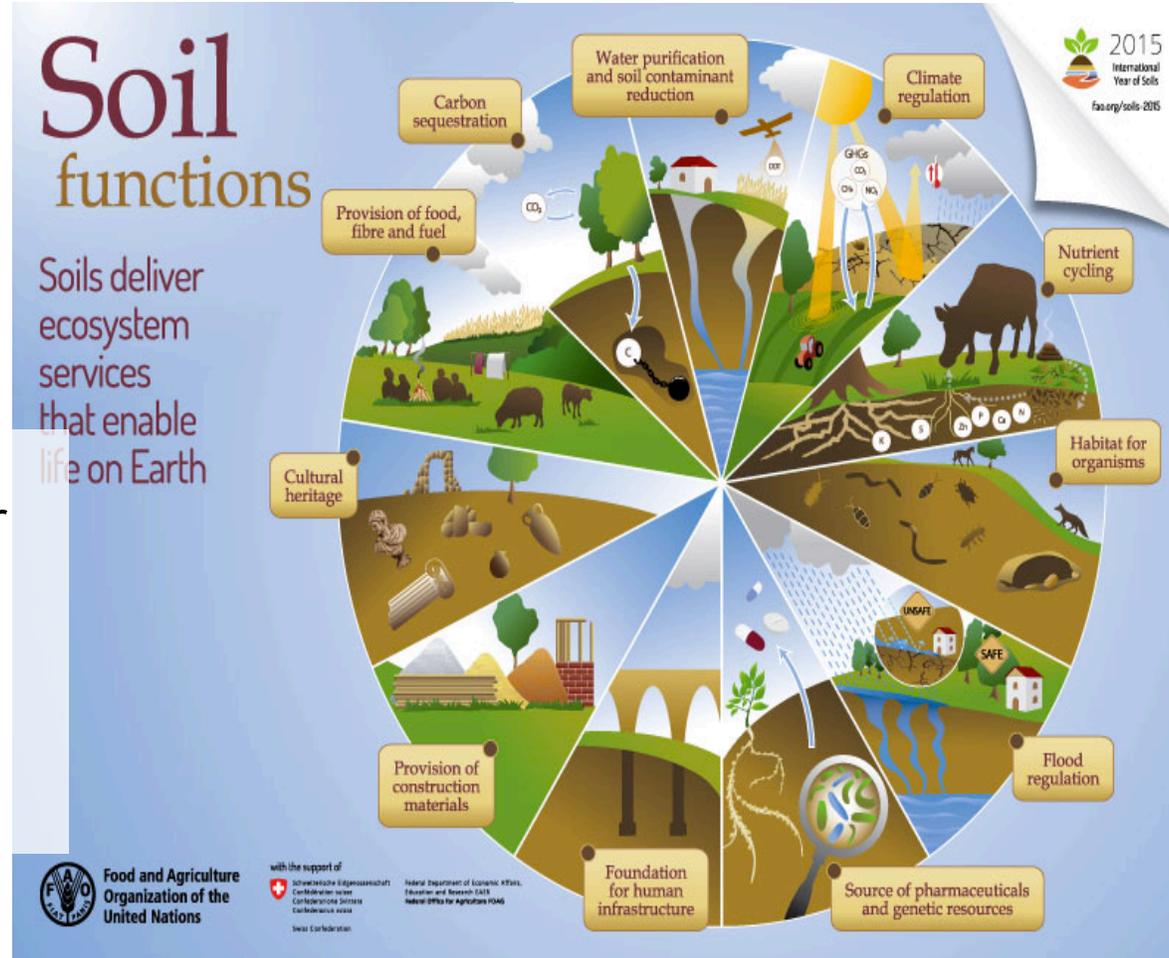
Sources: Rattan Lal, Ohio State University, Suzanne Lutfalla and Jean-François Soussana, INRA, Paris, The ‘4 per 1000’ Initiative and its international research

Sunday Review

The New York Times

Soil Power! The Dirty Way to a Green Planet

By JACQUES LESLIE DEC. 2, 2017



The eco-keystone:

- Co-benefits of **Healthy Soil**: Provides habitat for plants and animals.
- Stable soil structure stabilizes landscapes, prevents erosion, protects infrastructure.
- Soil sponge provides water filtration and groundwater storage,
- Determinant factor of crop yields

Realizing an agricultural-ecosystem investment synergy in the Northeast U.S.:

Soil ∞ Environmental ∞ Human Health

What incentives exist to improve soil health?

The agricultural practices funded by USDA federal and state offices determine:

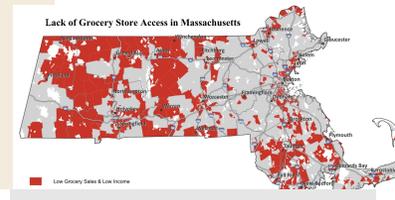
- Nutritional Health of citizens:
 - Average State estimated cost of diagnosed diabetes, in 2012: **\$4.9 billion**
 - **23.5 million Americans** living in food deserts
- Rates of soil erosion
 - Average state infrastructure repair costs: **\$238 million**
- Nutrient runoff from farms
 - Up to **\$70 million** to clean up algal blooms (Champlain, VT, Hudson River valley, NY)
 - Freshwater pollution costs us **\$4.3 billion** per year nationally



Figure 5. Low and Very Low Food Security

	2000-2002	2007-2009	2010-2012
Connecticut	8%	11%	13%
Maine	9%	15%	15%
Massachusetts	6%	10%	11%
New Hampshire	7%	9%	10%
Rhode Island	10%	14%	15%
Vermont	9%	14%	13%

Shown as Percentage of Population



40% of MA is a Food Desert

The Northeast goes organic: Regional Local & Organic Farming Movement = visibly healthier land, and variety of veggies

IN DEFENSE
OF FOOD
AN EATER'S MANIFESTO



Diversified land, healthy land



“Nature Abhors a Monoculture”



- Organic acreage in U.S. increases by 20% 2011-2018
- 5 million acres - 1% total U.S. Ag land
- ~70,000 Farms in the Northeast
- ~5,000 NOFA members
- Less than 5% Northeast farms are Organic

Polycultures of crops!



Access to fresh produce!



Science educator Leah Penniman, who recently won a Fulbright Distinguished Award in Teaching, at her family's farm in Rensselaer County.

Soil degrading



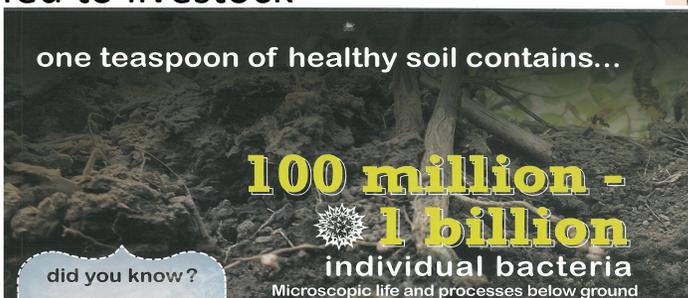
Soy goes to cattle
Percentage corn to biofuel

"When you farm a monoculture, you choose to fight nature"

- 1960s farm consolidation, green revolution: *seeds, fertilizers and pesticides* – Bayer & Monsanto **\$120mil on lobbying** since 2005

USDA has \$34.5 billion in funding for commodity assistance

- USDA Commodity Marketing Loan Program: sets prices for **corn, soy, wheat**. %59 U.S. agricultural land.
- **%50** of this grain is fed to livestock



Where's the money going? Modern Government farm investment

VS.

- Vermont's 134,000 organic acres account for **11%** of its total 1.25 million farm acres
- Maine and New York next largest shares of organic land: both **4%**
- MA and CT 2%
- Cow's Milk the Top organic product

PRACTICE	GHG Mitigation	Public Benefits
Managed grazing 	0.18 – 0.26 Mg CO2e / acre per year	<ul style="list-style-type: none"> • Soil health • Prevent overgrazing • Reduce N2O • Soil carbon seq.
Cropland to pasture 	0.22 – 0.37 Mg CO2e / acre per year	<ul style="list-style-type: none"> • Reduce erosion • Minimize water pollution • Prevent soil carbon loss

Soil building



Cedar Circle VT

Organic farming faces: transition costs (\$50/ton compost, \$332/acre management change) + \$750 cost of getting USDA Organic certified



VT Sunk costs into feeding cows corn, instead of grass

Soil carbon sequestration & storage: nature's ultimate Climate change reversal tool?

Technical potential for increasing soil carbon intake *if soil health is regenerated*

PRACTICE	GHG Reduction	Public Benefits	Private Benefits
Crop rotations 	0.22 – 0.26 Mg CO ₂ e / acre per year	<ul style="list-style-type: none"> • Reduce erosion • Improve water quality, soil moisture • Soil carbon seq. 	<ul style="list-style-type: none"> • Reduce fertilizer, pesticide, irrigation costs • Economic resilience
Cover Crops 	0.26 – 0.37 Mg CO ₂ e / acre per year	<ul style="list-style-type: none"> • Reduce erosion • Improve water quality • Pest suppression • Soil carbon seq. 	<ul style="list-style-type: none"> • Reduce fertilizer, pesticide costs • Reduce on-farm energy use • Improve yield
No-till 	0.31 – 0.35 Mg CO ₂ e / acre per year	<ul style="list-style-type: none"> • Reduce erosion • Improve water and air quality • Prevent soil carbon loss 	<ul style="list-style-type: none"> • Soil health • Reduce fertilizer, irrigation costs • Reduce on-farm energy use

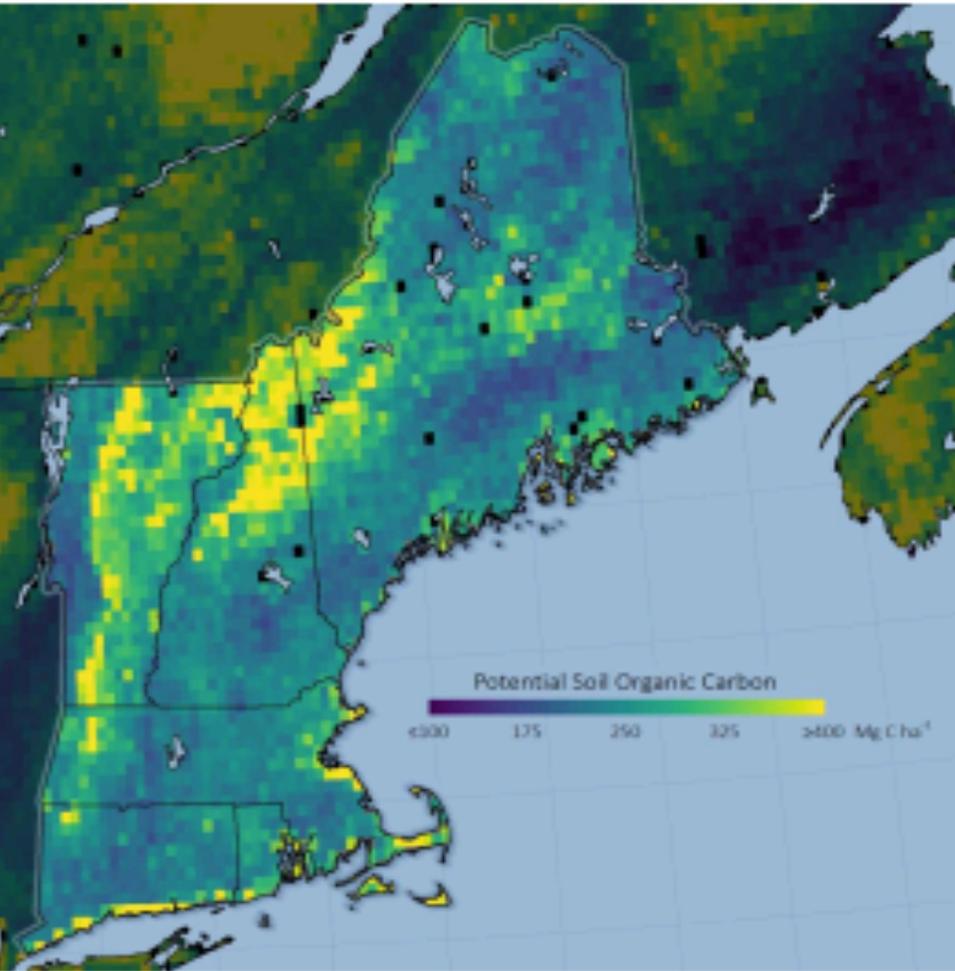
Northeast Regional

Soil carbon storage potential per acre, with manure compost applied

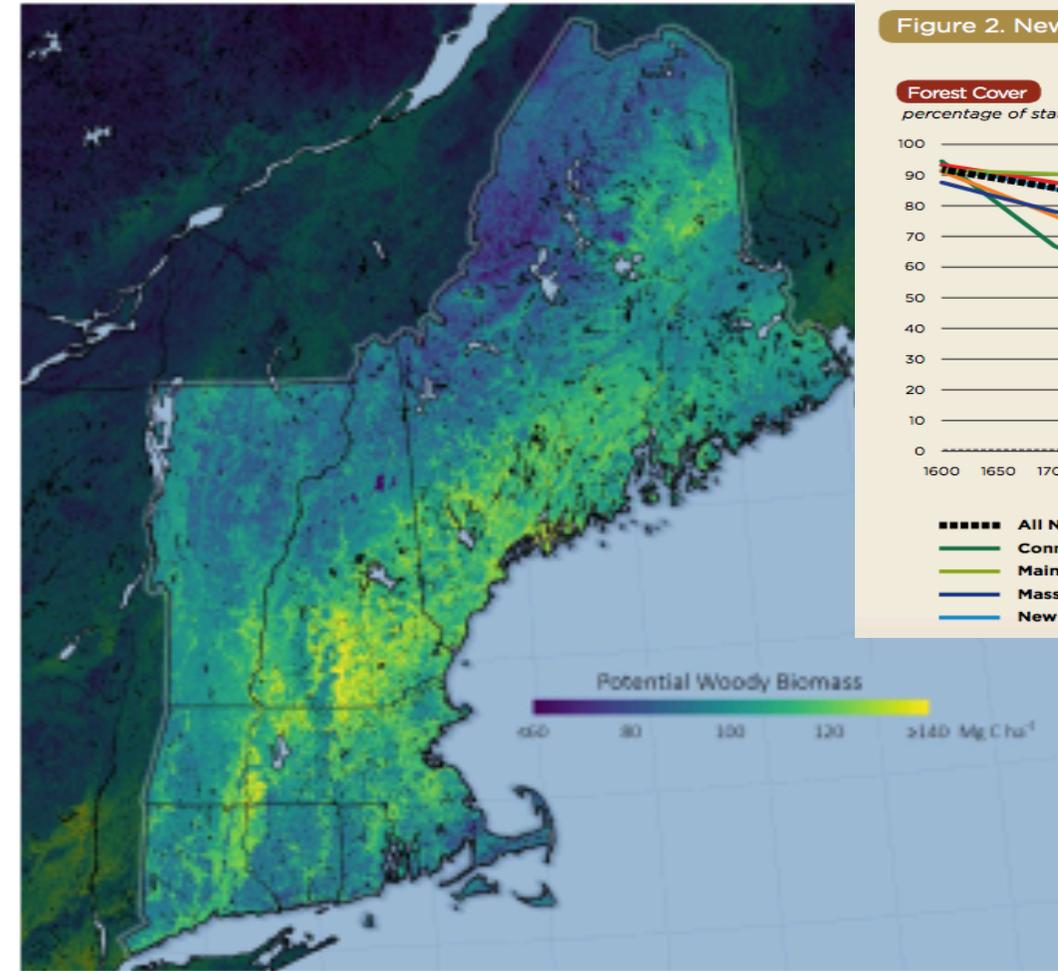
- Regenerative Grazing Avg. **0.6tC/acre per year** (Avg. MacMillen, 2015, Savory Institute)
- Organic row-cropping **0.151tC/acre per year** (Avg. NOFA MA, Lal, 2014)
- Legume/woody crop cover cropping of mined soil **2.8tC/acre per year** (Avg. IFOAM, Lal)

→ Over **6.3 million acres** agricultural land in New England and New York. Million ton potential

Potential carbon stocks of New England

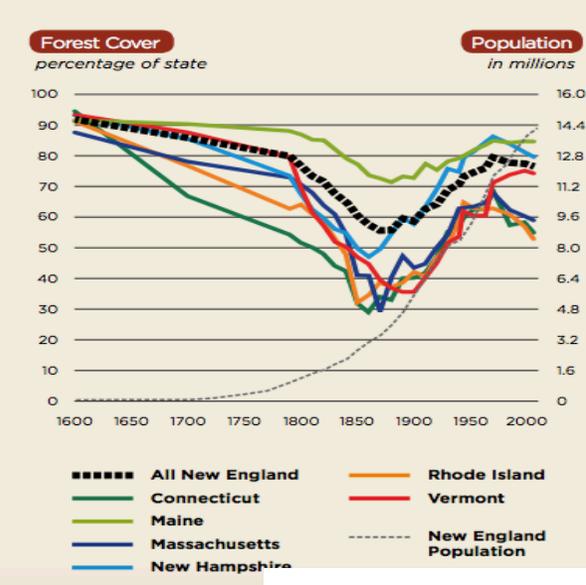


Soil = 4300 million tons C



Woody biomass = 1600 million tons C

Figure 2. New England Forest Cover



Northeast forest cover has stabilized

Funding & rewarding healthy soil practices on farms in Northeast States

PRACTICE	GHG Mitigation
 Managed grazing	0.18 – 0.26 Mg CO2e / acre per year
 Cropland to pasture	0.22 – 0.37 Mg CO2e / acre per year
 Dry manure storage	N/A (see "Organic soil amendments")

Dairy acreage (with potential for pasture grazing):

- 900,000 acres VT
- 700,000 ME
- 67,000 NH
- 78,000 NY
- 8200 CT



Potential if **all** N/E dairy cows and livestock are *moved onto pasture* (about 1,753,200 acres used for dairy operations and dairy feed): about **715,051 tons/year**

Thousands of Acres*		NEW ENGLAND PASTURE	NEW ENGLAND CROPLAND	NON-NEW ENGLAND PASTURE	NON-NEW ENGLAND CROPLAND	TOTAL FARMLAND NEEDED
1	Vegetables		100		120	220
2	Fruit		80		250	330
3	Grain, beans, and oil		70		1,480	1,550
4	Livestock					
	Pasture & harvested forage	450	950			1,400
	Dairy†				1,220	1,220
	Beef, sheep, goats†			3,180	4,140	7,320
	Horses†				40	40
	Swine				960	960
	Layers				320	320
	Broilers				950	950
	Turkeys				230	230
	<i>Subtotal</i>	<i>450</i>	<i>950</i>	<i>3,180</i>	<i>7,860</i>	<i>12,440</i>
5	Other foods					
	Nuts				70	70
	Sugar				410	410
	Coffee, tea, chocolate				570	570
	Wine				80	80
	<i>Subtotal</i>				<i>1,130</i>	<i>1,130</i>
6	Other agricultural products & cropland		210			210
TOTALS		450	1,410	3,180	10,840	15,880

98% VT cropland dedicated to crops for animal feed (corn, forages) in 2007

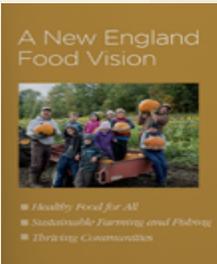
Food Solutions New England, UNH

NUMBER OF ANIMALS IN NEW ENGLAND

Dairy cows	200,000
Beef animals	200,000
Lambs	30,000
Pigs	44,000
Laying hens	6,800,000
Broilers	500,000
Turkeys	100,000

*rounded to the nearest 10,000 acres (totals may not sum correctly) †additional feed

Source: Food Solutions New England,



Existing Farm Evaluation Systems

“Old guard” Soil tests:

- Cornell Soil Health Tests
- USDA COMET “Carbon Management Evaluation Tool”

Developing “Radicals,” biodiversity-focused tests:

- VT Organic Certification
- NOFA NY Organic Certification
- Savory Institute [Ecological Outcome Verification \(EOV\)](#)
- [Real Organic Project “Add on” to USDA label](#)
- [Rodale Organic Certification](#)
- LandStream, VT
- Wolfe’s Neck [OpenTEAM](#)
- Vandana Shiva’s [“Health per Acre” measurement](#)



EOV MEASURES THE HEALTH OF THE LAND AS A LIVING SYSTEM

DOWNLOAD PDF



Soil Health

Healthy soils absorb more carbon, retain more water, and are richer in fertility



Biodiversity

Plants are more varied and resilient, domestic animals and wildlife are more plentiful



Ecosystem Function

Water, minerals, nutrients and energy are cycled through a continual process of birth, growth, death and decay and back to birth again

Covered:

- Soil texture
- Water capacity
- Organic Matter
- Soil respiration
- Active Carbon
- Nutrient Analysis
- Salinity
- Root Health Bio-Assay
- *Biodiversity & Ecosystem Function (Savory EOVS)*

Needed:

- **Ecosystem health & services model**
 - Soil Microbiome profiling
 - Carbon flux analysis by soil type
- **Nutrient production & human health impact?**

A Next step: Convince Northeast states to *Reform* Agricultural Spending, with a soil health focus!

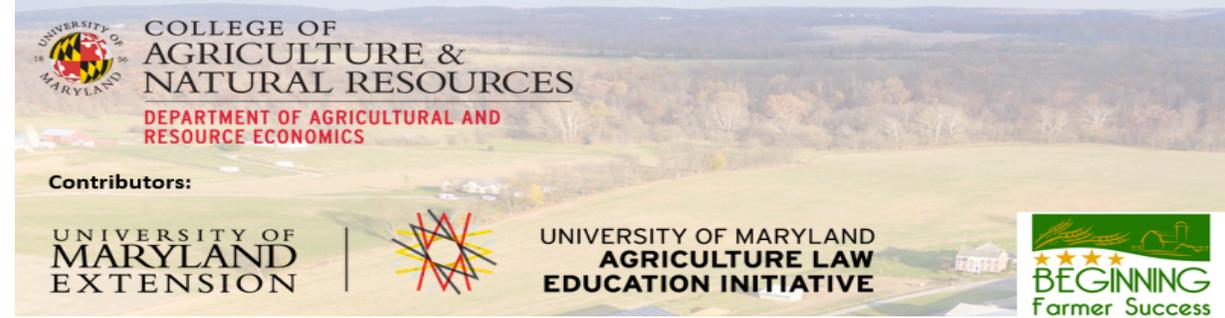
- Soil health Research & evaluation systems
 - Jon Sanderman, Woods Hole. Analysis of Soil Carbon storage potential of the Northeast
 - Christine Jones, PhD
 - Didi Pershouse and Walter Jehne “Soil Sponge” work
- Farm-tested Agricultural practices to recommend
 - Maine Farmland Trust (branch of AFT) launches statewide “Maine Healthy Soil Assessment” during development of state Climate Change plan
 - USDA NRCS EQIP funded practices that have been successful on-farm
- Government program administrators
 - USDA: \$34.5 billion nationally
 - NRCS “Soil programs” \$208 million nationally
 - SARE N/E - \$44mil
 - State Ag departments N/E - \$269 mil
 - University Extension Services - \$200mil nationally from the Farm Bill



BUILDING HEALTHY COMMUNITIES
2016 Fuller Field School
July 7-8, Emporia, KS

DIDI PERSHOUSE
SOIL HEALTH AND PUBLIC HEALTH
PART 1





Case Studies: The California Healthy Soils Initiative - Maryland Healthy Soil Program treat water & climate illness (soil degradation & erosion) rather than symptoms

CA:

- A collaboration led by the California Department of Food and Agriculture, to promote the development of healthy soils.
- > main incentive: scarce water resources
- Budget of \$7.5million in 2017 allocated from the **state climate fund**
- Marin Carbon project pioneers funded composting system
- 22 healthy soils programs demonstration projects have been selected and funded for 2018 - **COMET Carbon Farming Planner** in use

MD:

- Healthy Soil Program defines and supports healthy soils by directing the Agricultural Department to support practices through incentives, R&D, possible funding
- Maryland **Agricultural Water Quality CostShare Program** provides 34million for Chesapeake bay watershed cover cropping
- & met RGGI carbon storage goal through cover cropping efforts

In the Northeast, VT, MA, ME & NY Pioneer Policy projects:

Vermont: Bill S.160
Payment for Ecosystem
Services Working Group

- Soil conservation working group centered around PES launched by Sec. of Ag and Markets
- UVM Gund, Dept. of Ag, farmers, specialists
- VT Environmental Stewardship Program (VESP) pilot in progress, to support ag producers in achieving ENV goals (water quality motivated)

Maine: Healthy
Soil Assessment

- The **ME Climate Table** works with the Governor's team on state climate action plan:
- Recruits **ME Farmland Trust** for a soil health contribution; they're conducting an assessment of soil building practices used throughout the state, to create an ME definition & support for Healthy Soil practices

New York's
Climate Resilient
Farming Grant
program:

- Launched by Governor Cuomo, integrates soil health and water quality investment
- *County Soil and Water Conservation Districts apply for grants*
- Support Groups: EarthJustice, NOFA NY, Hudson Carbon

Massachusetts:
Act to promote
healthy soils

- S.438/H. 873 would create Healthy Soils Program within Commission for Conservation of Soil & Water
- Would create a fund for providing incentives - loans, grants, tech assistance
- Support groups: NOFA MA, Food Policy Council, Soil4Climate

Collective need - Fund stream for farm transition costs to healthy soil practices & market expansion to help local products compete with industrial ag products

Same goal, different grants: A fragmented Northeast Support Network for Healthy Soils

Northeast Farmer Organizations

- About 5,000 NOFA members
- VT Grass Farmers Association
- VT Real Organic Project (ROP) - 50 certified farms
- Farm Bureau presence
- Farmers Union presence
- Farmworker Justice
- National Young Farmers Coalition presence
- Agrarian Trust



Advocacy Groups

- USDA Presence
- UNH FSNE's role in profiling NE
- Rodale org. certification
- Savory Institute Hubs - ME & NH
- New England American Farmland Trust
 - The ME healthy soil assessment from MFT
- VT Organic
- New York soil health road map
- EarthJustice
- Hudson Carbon
- Regen Network
- Green America
- Soil Carbon Coalition
- Nature Conservancy
- Organic Consumer Association



FARMWORKER JUSTICE



INDIGO AG ANNOUNCES THE TERRATON INITIATIVE THAT PAYS FARMERS FOR CARBON SEQUESTRATION

PAYMENTS FOR PARTICIPATING FARMERS WILL VARY DEPENDING ON FACTORS LIKE SOIL TYPE AND CLIMATE, BUT THEY MAY TRANSLATE INTO AN ESTIMATED \$30 TO \$60 PER ACRE.

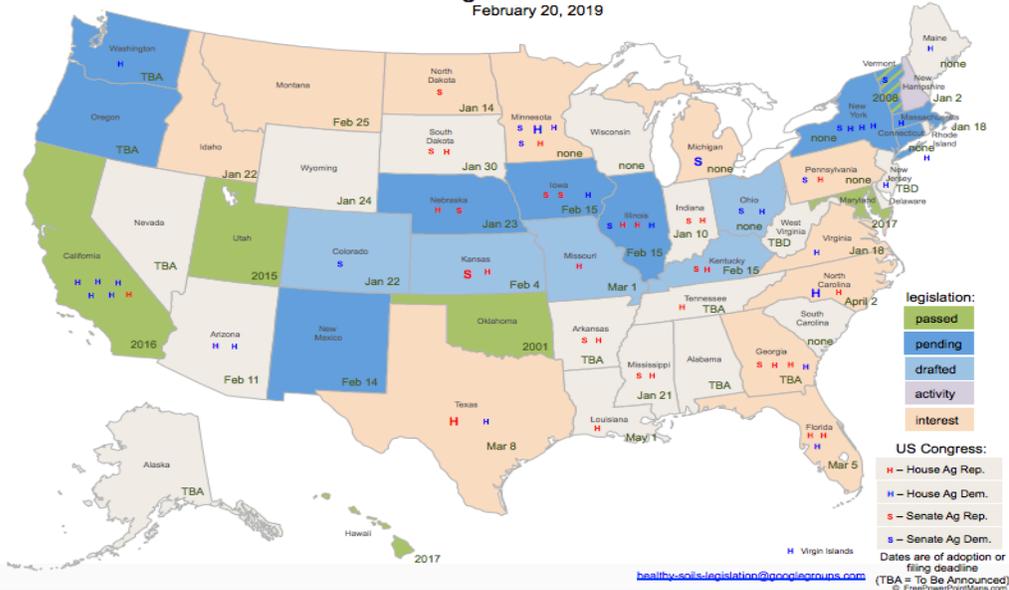
Bonus: Gov Programs & Corporate Partners (?!?)

- Breakthrough Strategies and Solutions
- Northeast RGGI
- General Mills
- Indigo Ag Terraton Initiative



Next step- Coordinate Northeast actors & evaluation systems around soil health co-benefits, to pass and implement effective farm policy, at a critical moment for humanity's food system

Healthy Soils
legislative status
February 20, 2019



The New York Times

Climate Change Threatens the World's Food Supply, United Nations Warns



UN August, 2019 Report: “soil is being lost between 10 and 100 times faster than it is forming”

