FOOD FARMS AND FORESTS

CLIMATE SOLUTIONS IN THE EDGE SPACE

AMERICAN GENOCIDE AS "FIRST ORDER CONTRIBUTOR" OF LITTLE ICE AGE

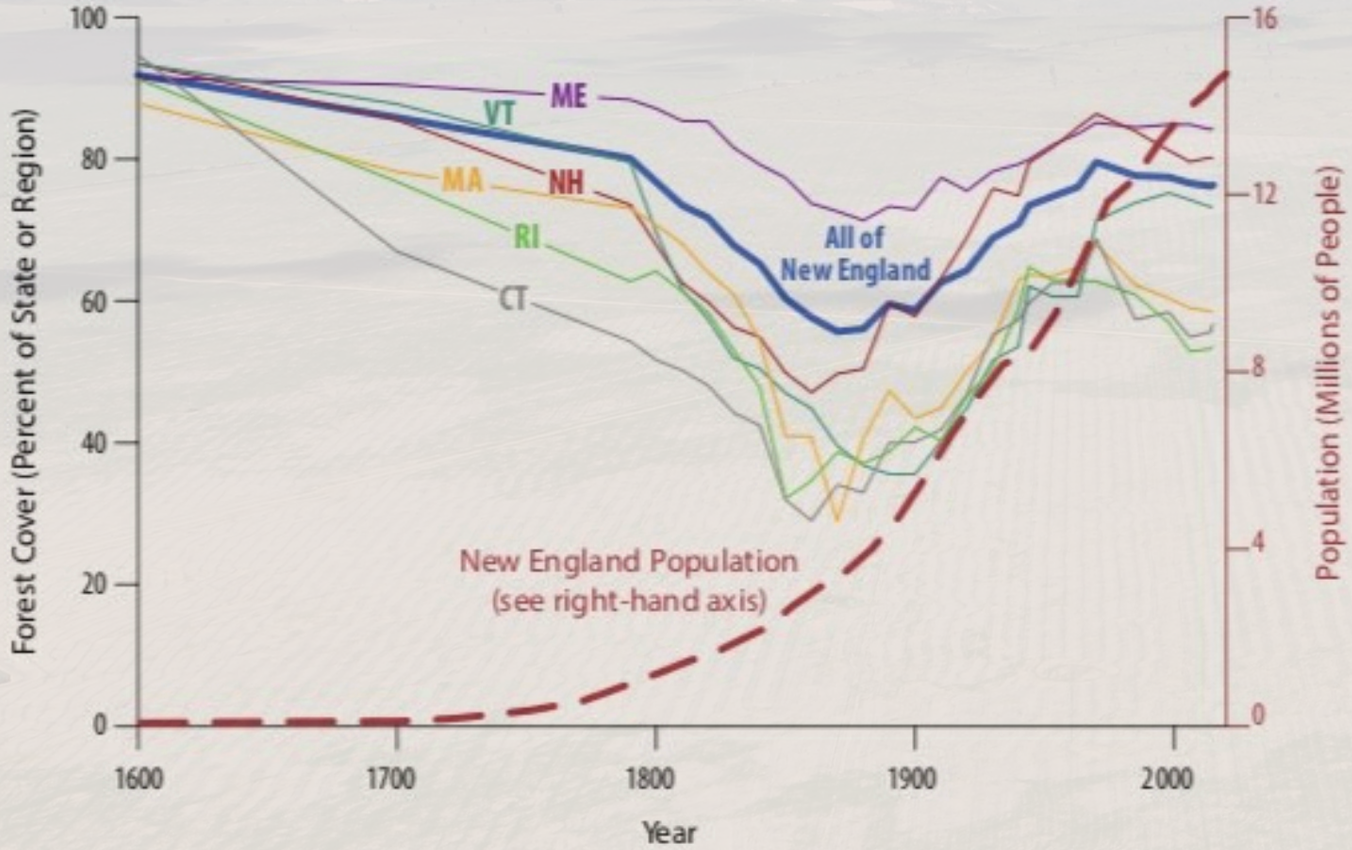
- Research from University College London, Stanford University & other academic institutions
- **<u>1500s: The Great Dying</u>**
  - 55 million people died in the Americas following contact with Europeans: epidemic, warfare, and mass genocide
  - 55.8 Mha (area size of California) of land cleared & cultivated by tindigenous Americans was subsequently abandoned & rewilded
  - **Estimated 7.5 Gt carbon drawn down from atmo. CO2**
  - Carbon drawdown interacted with increased volcanic activity and decreased solar activity to contribute to a global cooling period
- **<u>Early 1600s:</u>**
  - Detectible (7-10ppm) CO2 concentration decline based on ice core analysis
  - Little Ice Age peaks in Europe

Nevle, Richard & Bird, D.. (2005). Effects of Syn-Pandemic Reforestation on Atmospheric Carbon Dioxide From 1500 to 1700 A.D. AGU Fall Meeting Abstracts.

Dull, Robert & Nevle, Woods, et al (2010) The Columbian Encounter and the Little Ice Age: Abrupt Land Use Change, Fire, and Greenhouse Forcing. Annals of the Association of American Geographers. Vol. 100, No. 4, Climate Change (October 2010), pp. 755-771

Koch, Alexander & Brierley, Maslin et al. Earth system impacts of the European arrival and Great Dying in the Americas after 1492. Quaternary Science Reviews. Vol 207 (March 2019) pp 13-36

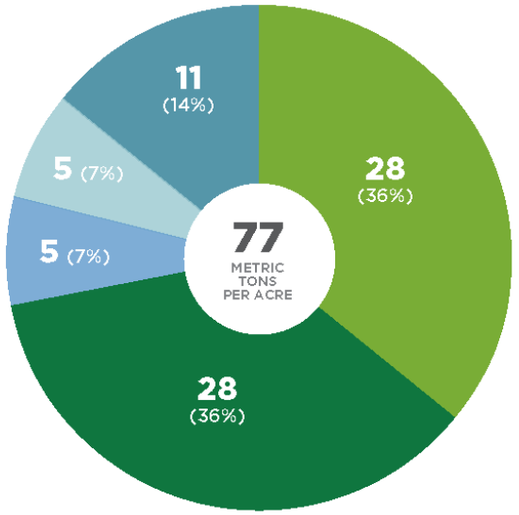
New England Forest Cover and Human Population



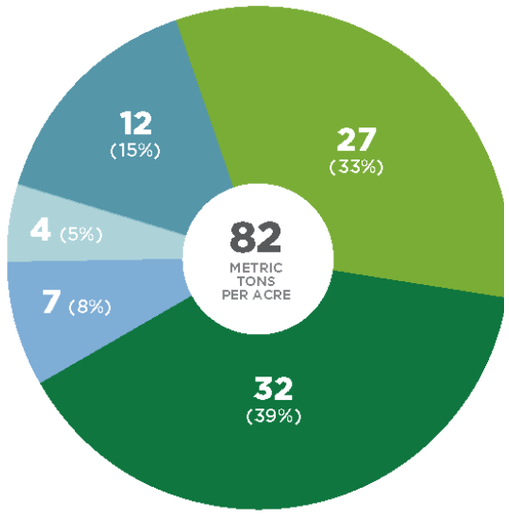
- Regional land-use patterns add up and interact with other global climate dynamics
- Consider impacts of regional land-use patterns in a global context

Soil Organic | Live Aboveground | Live Belowground | Deadwood | Litter

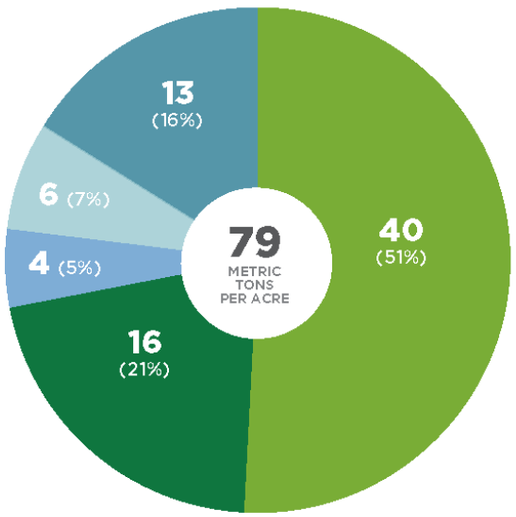
NORTHERN HARDWOOD



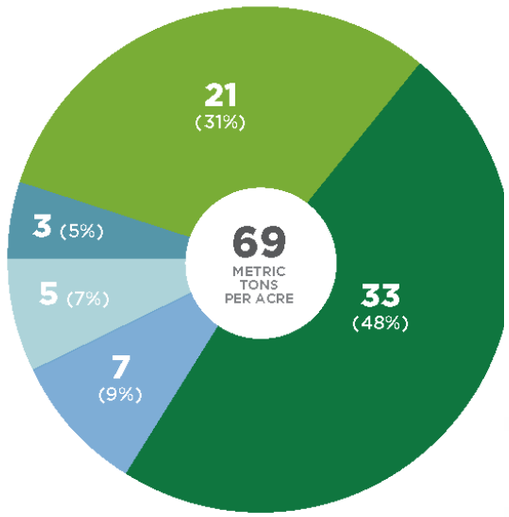
OAK-PINE



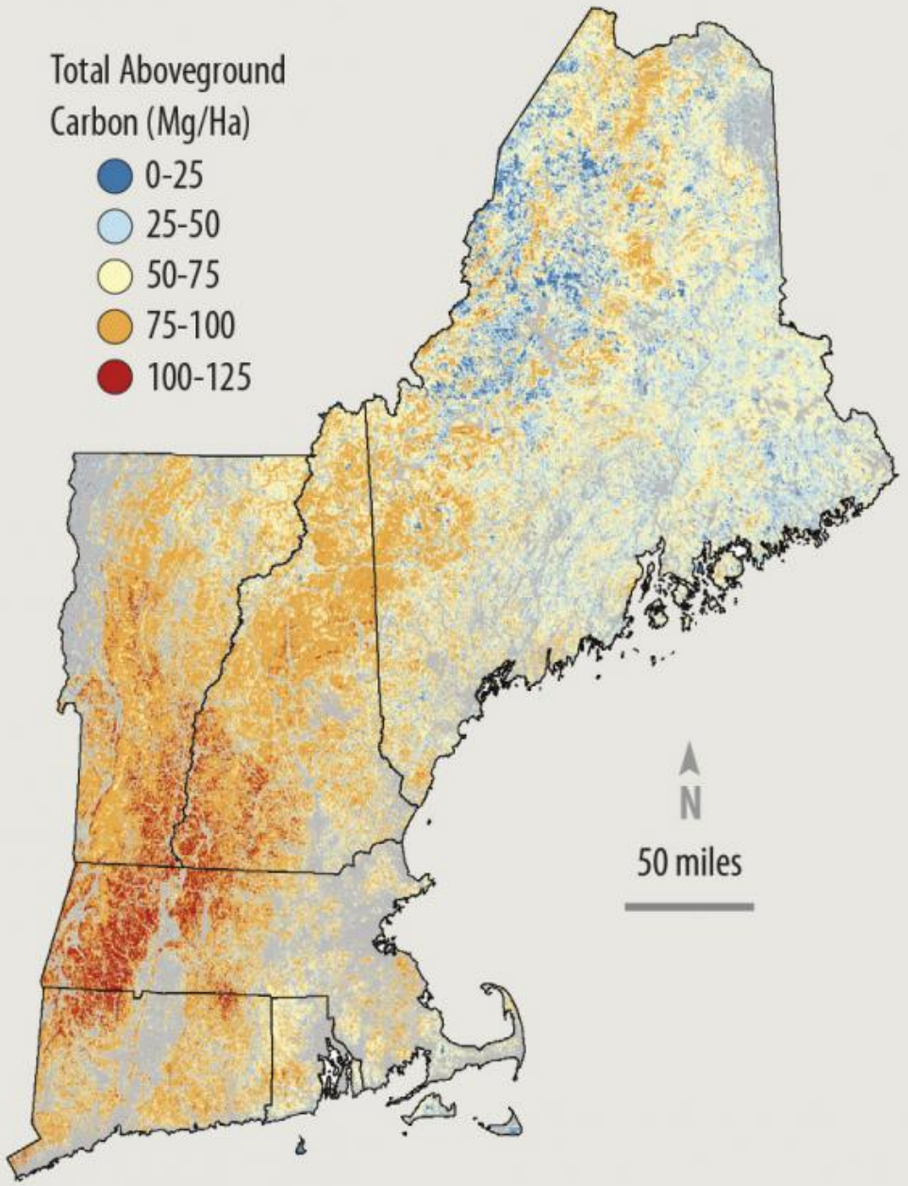
SPRUCE-FIR



OAK-HICKORY



Forests Store Carbon

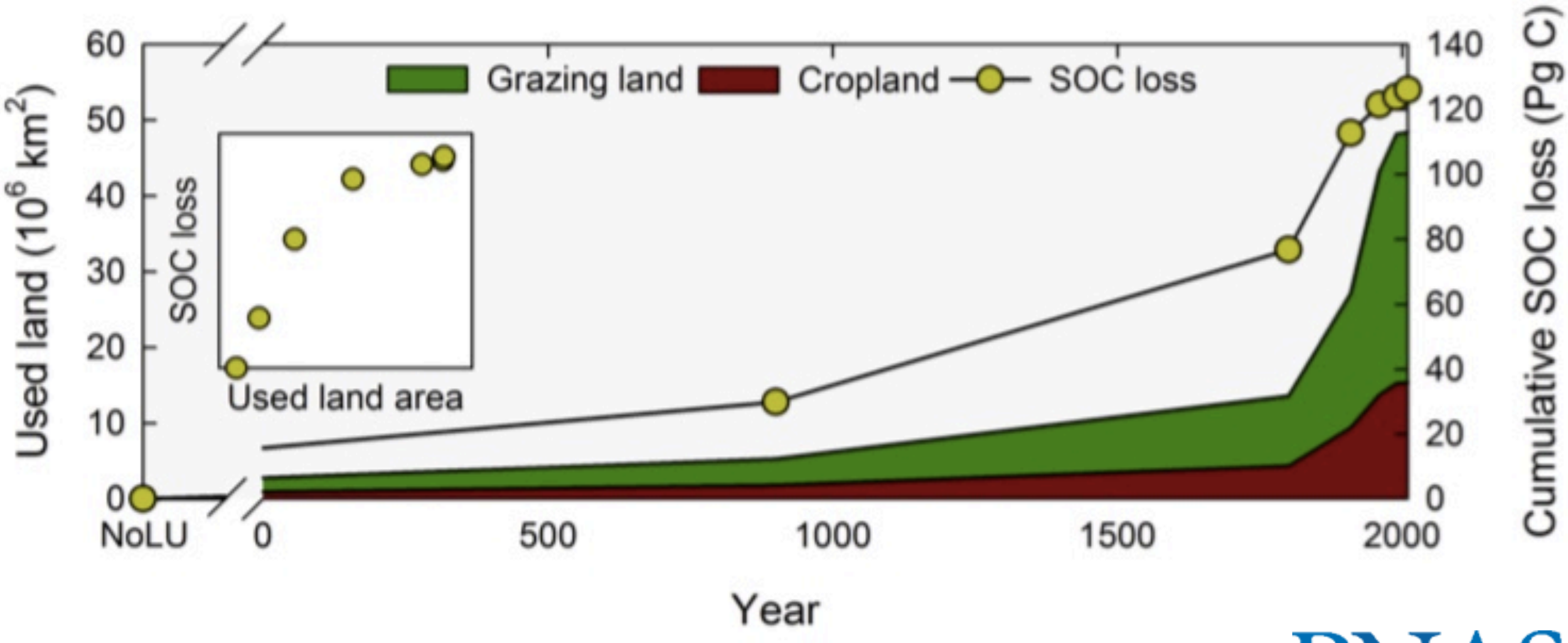


New England's forests provide a vast store-house of carbon that helps mitigate global climate change. Variation in the amounts of carbon, wood, and the size of trees across the region is largely due to the history of timber harvesting. Data are not represented for gray areas that are predominantly agricultural or densely populated.

SOIL CARBON LOSS & LAND USE CHANGE

- Estimates of SOC loss from cultivated lands vary widely & depend on soil depth evaluated and research methodology (133 - 456 Gt)
- Overall the trend has been towards deforestation; conversation of forested land to grazing and crop land is accompanied by a loss of SOC.

Historic reconstruction of loss in SOC relative to 10,000 BC (assumed NoLU).



Sanderman, Jonathan, Hengl, Fiske, Soil carbon debt of 12,000 years of human land use
PNAS 2017;114:36:9575-9580, https://www.pnas.org/content/114/36/9575

PNAS


Walgreens

Toensmeier, E. The Carbon Farming Solution, Chelsea Green
"The oceanic sink for for anthropogenic CO2 from 1994 to 2007":
https://science.sciencemag.org/content/363/6432/1193

SOIL CARBON LOSS

- 2.5 trillion tons of C held in the top meter of soils worldwide (+560 billion in surface biomass) - 6x current amount of C in the atmosphere (Toensmeier)

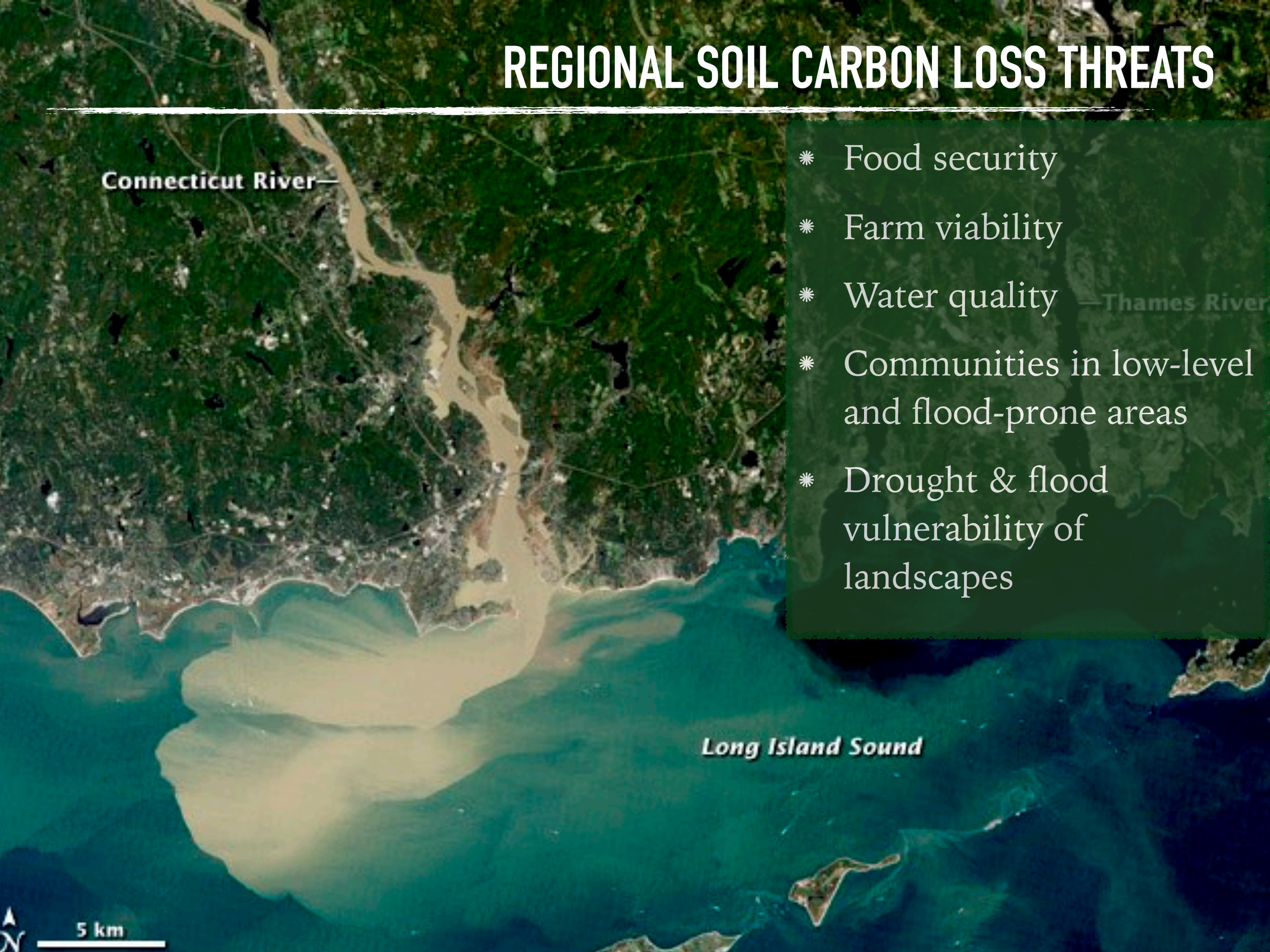
- Soil loses 30-50% of its organic carbon after being cultivated for 50 years in temperate climates— **loss accelerates with degradation.** (Toensmeier)

- Poor farming techniques account for an estimated 1.1 Gt (billion tons) per year in soil carbon loss (approx 0.52 ppm C / year) (Toensmeier)

- **Oceans absorb about 1/3 of annual anthropogenic carbon emissions** (1994- 2007, 31%) driving acidification (Science)

REGIONAL SOIL CARBON LOSS THREATS

- Food security
- Farm viability
- Water quality
- Communities in low-level and flood-prone areas
- Drought & flood vulnerability of landscapes

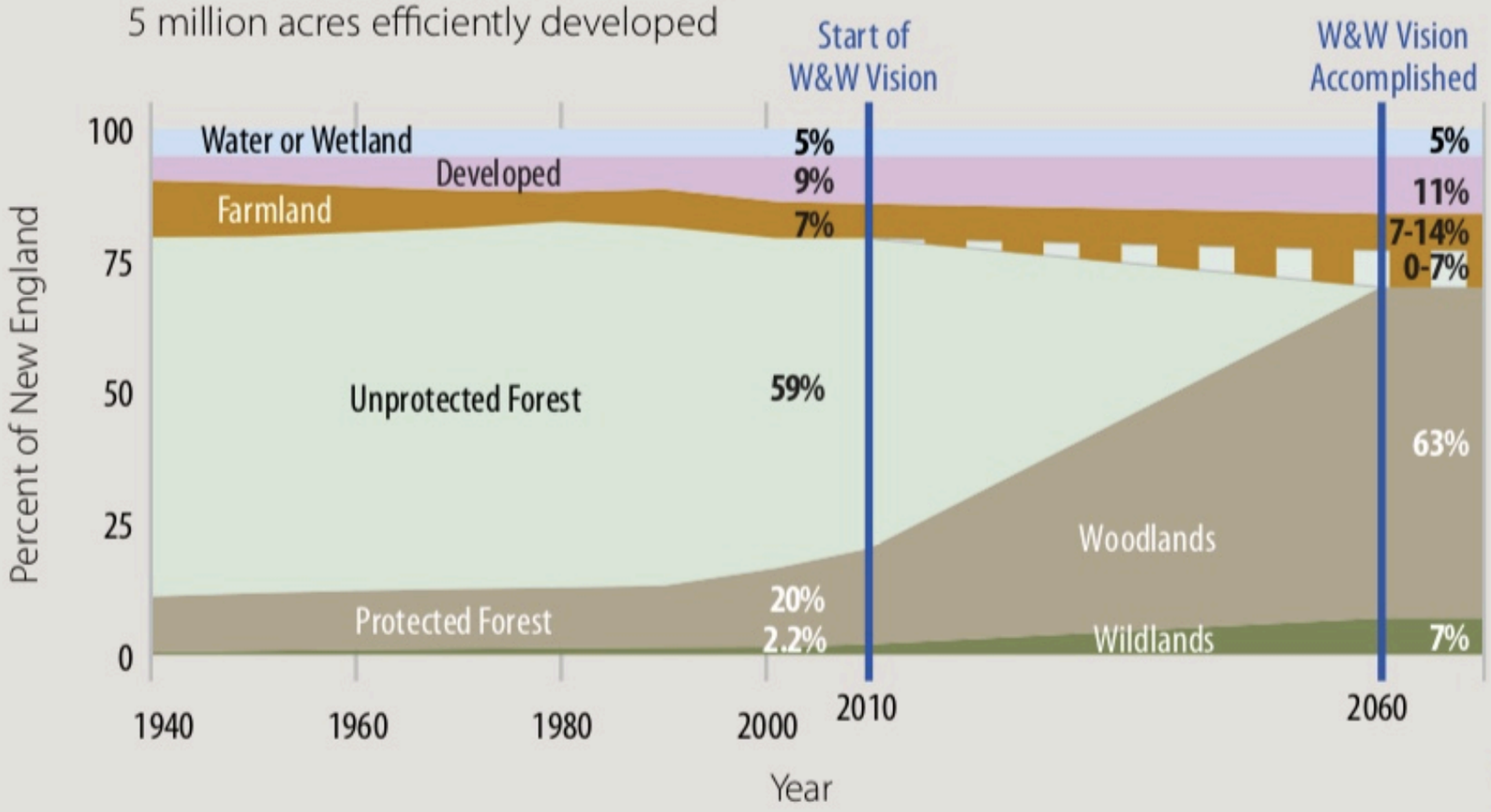


HOW DO WE PROTECT AND RESTORE SOIL CARBON?

- Land use practices that protect and enhance the diversity and abundance of life in the soil:
  - ➤ Minimize soil disturbance
  - ➤ Keep the soil covered year-round
  - ➤ Maximize time (days/year) that living roots spend on the soil
  - ➤ Maximize biodiversity (plants, animals, microbes)

Wildlands & Woodlands Vision for New England in 2060

30 million acres conserved forest
90% Woodlands / 10% Wildlands
3-6 million acres conserved farmland
5 million acres efficiently developed



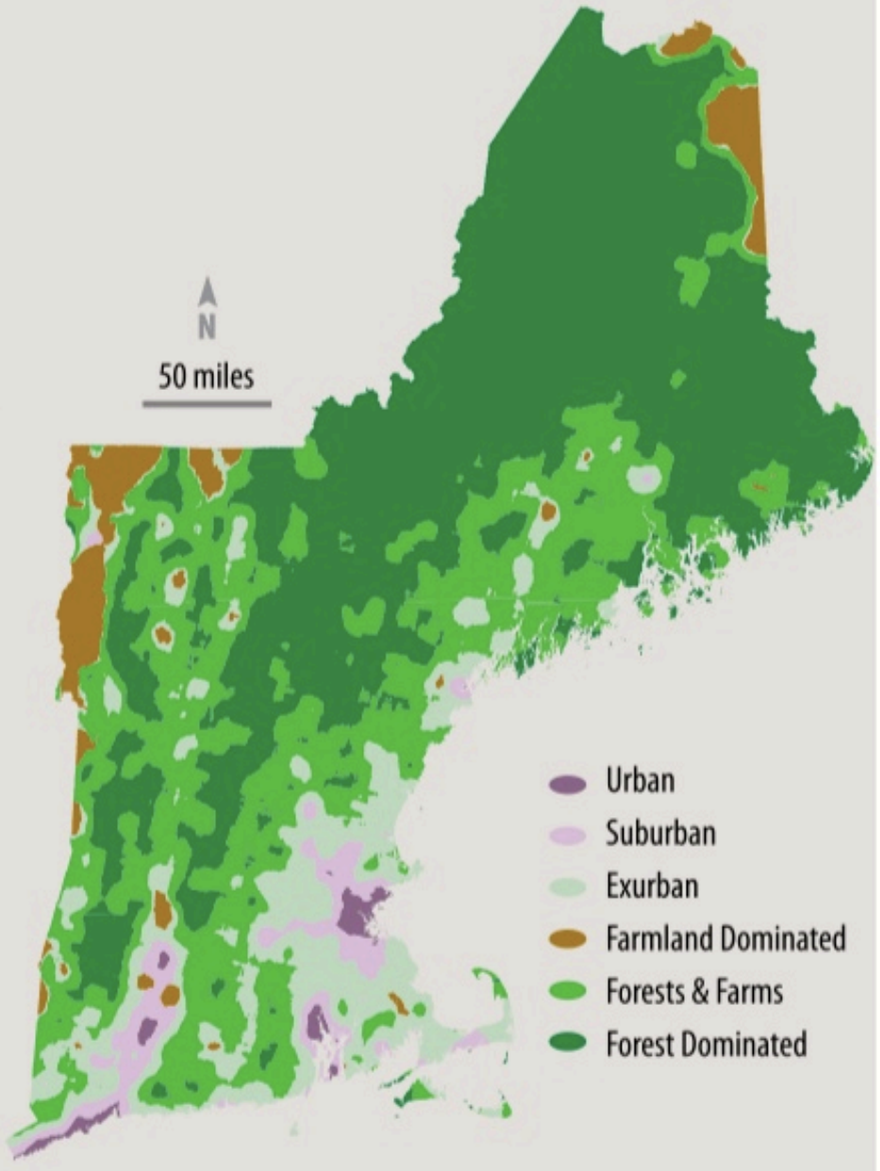
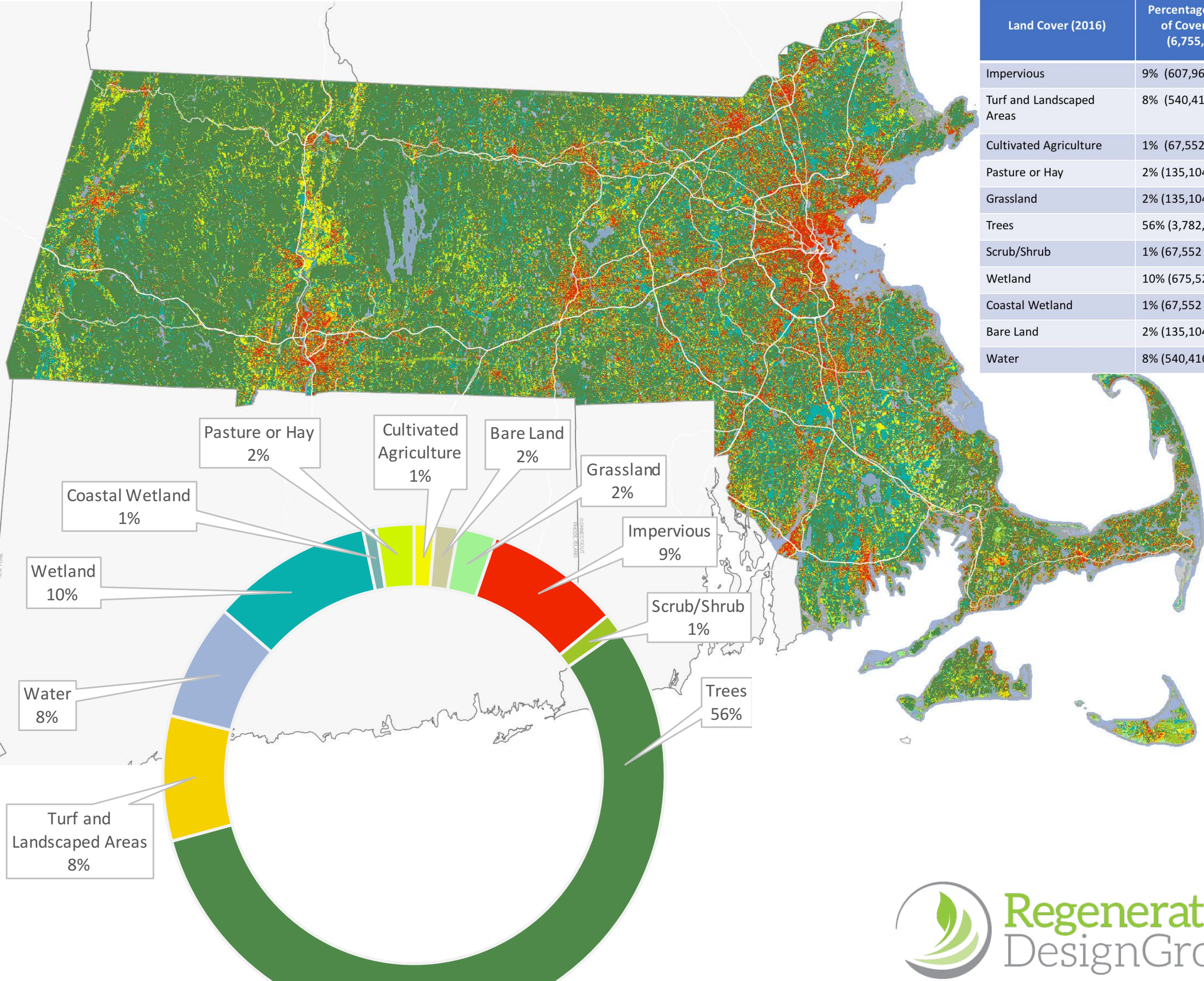


Figure 1. *In a* Wildlands and Woodlands *future, New England will remain a diverse landscape with local conditions, community priorities, and landowner choices determining the relative amounts of forest, farms, and developed lands in each location.*

- Wildlands & Woodlands Vision: increase protected forest significantly (mainly from 'unprotected' forest), while also:
- Increasing farmland to meet local food supply demands
- Allowing for increased developed land

Land Cover (2016)	Percentage and Acreage of Coverage for MA (6,755,200 acres)
Impervious	9% (607,968 acres)
Turf and Landscaped Areas	8% (540,416 acres)
Cultivated Agriculture	1% (67,552 acres)
Pasture or Hay	2% (135,104 acres)
Grassland	2% (135,104 acres)
Trees	56% (3,782,912 acres)
Scrub/Shrub	1% (67,552 acres)
Wetland	10% (675,520 acres)
Coastal Wetland	1% (67,552 acres)
Bare Land	2% (135,104 acres)
Water	8% (540,416 acres)



Regenerative DesignGroup

THREE CROSS-LAND USE CATEGORY SOLUTIONS

- More micro-farms / market gardens in urban and suburban areas
- Integrate trees into open pasture land (silvopasture)
- Improve diversion of solid carbon waste streams from developed lands to support soil regeneration in parkland and farmland

Left: ReVision Urban Farm, Dorchester

AGROFORESTRY & AFFORESTATION OF FARMLAND

According to the MA Resilient Lands Initiative: Forestry Report, "Out of the over 3 million acres of forest land in Massachusetts, about 63% are privately owned… and 19% operate a farm within 1 mile."

➤12% of total forested land in MA owned by farmers

➤ Silvopasture is one example of an agroforestry practice that actually afforests open land, though sparsely

➤ Maple sugaring is the primary agroforestry enterprise in MA— but other agroforestry enterprises should be researched, developed and incentivized through processing facilities, marketing efforts and breeding programs

- ➤ Local chestnut industry
- ➤ Coppiced Christmas tree enterprise
- ➤ Pawpaw and other native tree fruits
- ➤**Northeast**/Mid-atlantic **agroforestry** (NEMA **Agroforestry**)

Foster, Zoe & O'Connor, MA Resilient Lands Initiative: Forestry Report MAY 2019, EEA Division of Conservation Services

Silvopasture: Valley farmers embrace an ancient form of regenerative farming to combat climate change

Lisa DePiano, a lecturer in the Sustainable Food and Farming Program at the University of Massachusetts, reseats a netting support around a young chestnut tree in the silvopasture demo lot of the UMass Agricultural Learning Center in Amherst on Wednesday, May 15, 2019. STAFF PHOTO / KEVIN GUTTING

USE CARBON WASTE STREAMS TO HEAL DEGRADED SOILS

- Marin Carbon Project findings:
- One-time application of composed manure to degraded rangelands resulted in **three years of progressive soil carbon gains**
  - Average: 1 ton C gained per hectare, while control sites lost C
  - The presence of a woody component in rangelands significantly increased soil C pools

Caro Roszell

Education Director
Soil Carbon Program Manager

NOFA/Mass
Owner/Operator
New Wendell Farm

caro@nofamass.org
c: 508-360-0874

www.nofamass.org

NOFA MASS
Northeast Organic Farming Association