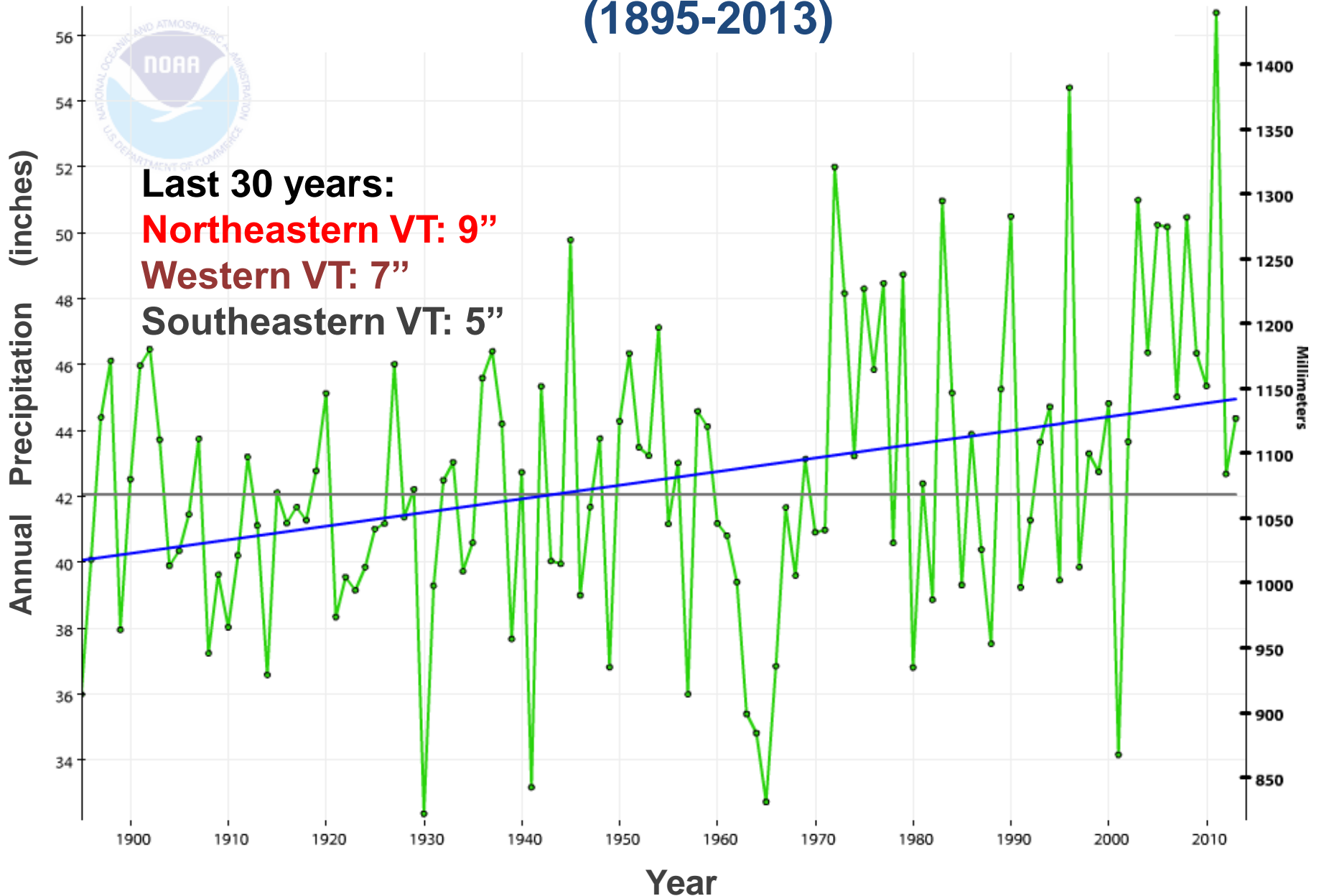


Understanding the Role that Farms and Farmers Play in the Water and Climate Conversation in Vermont



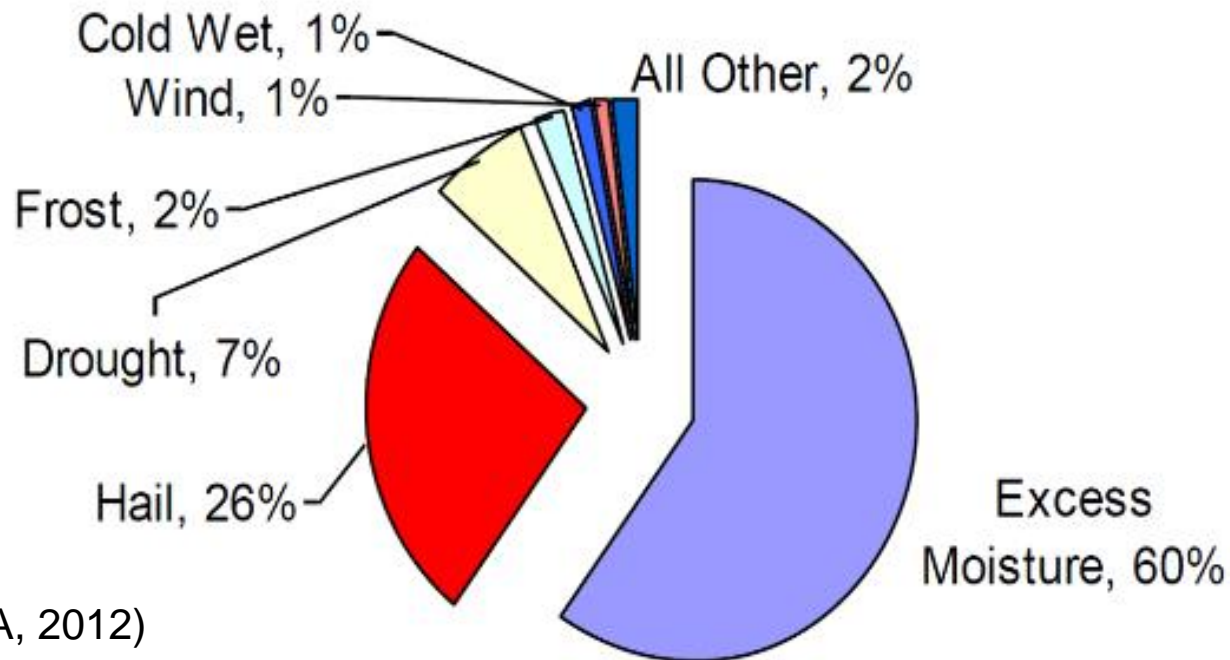
THE UNIVERSITY OF VERMONT
EXTENSION

Northeast Annual Precip.: +4.15"/century (1895-2013)



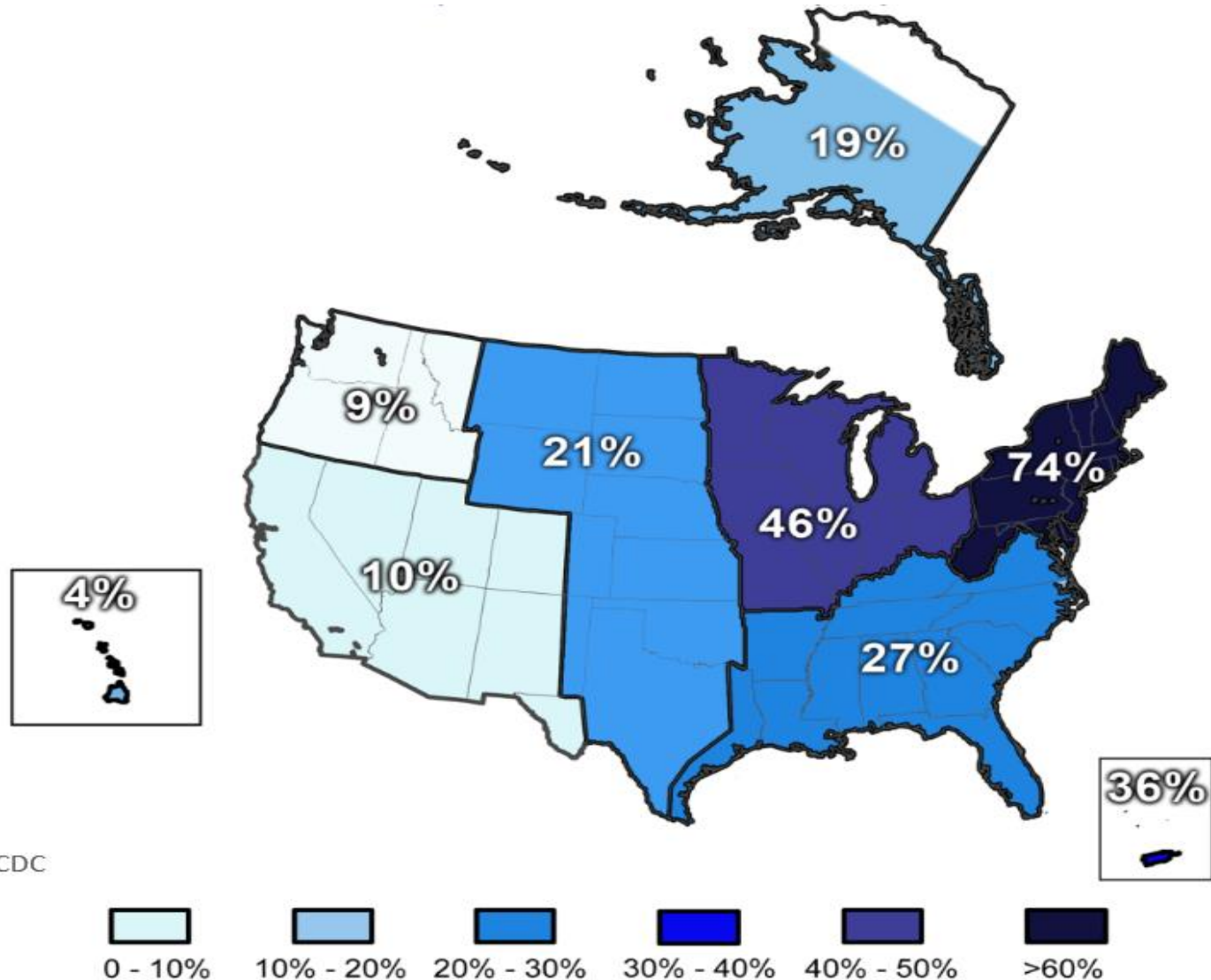
Why Vermont Crops Fail (2001-10)

Since 1988, Crop Ins. provided
\$213 Bil. of Protection and Paid \$15 Million
in Loss Payments to VT Farmers



(USDA RMA, 2012)

Trend in 1-day Very Heavy Precipitation (1958-2010)



**'In general, erosion increases at a rate
1.7 times annual rainfall increases'**

(Nearing et al., 2004)



Flooding and Downstream Impacts



Sediment input to the Hudson River due to Lee and Irene was 5 times the long-term annual average (Ralston et al., 2013)

Connecticut River

Thames River

Long Island Sound



2018 Field Crop BMP Conservation Practices

Jeff Carter
Middlebury, VT



THE UNIVERSITY OF VERMONT
EXTENSION



Field Practice BMPs

**Improve Soil Health
&
Reduce Nutrient
Losses**

**Reduced Tillage
No-Till Planting**



Field Practice BMPs

**Improve Soil Health
&
Reduce Nutrient
Losses**

**Reduced Tillage
No-Till Planting
Cover Crops**



Field Practice BMPs

**Improve Soil Health
&
Reduce Nutrient
Losses**

**Reduced Tillage
No-Till Planting
Cover Crops
Manure Injection**



South Lake A **2018 Field Practices Survey**

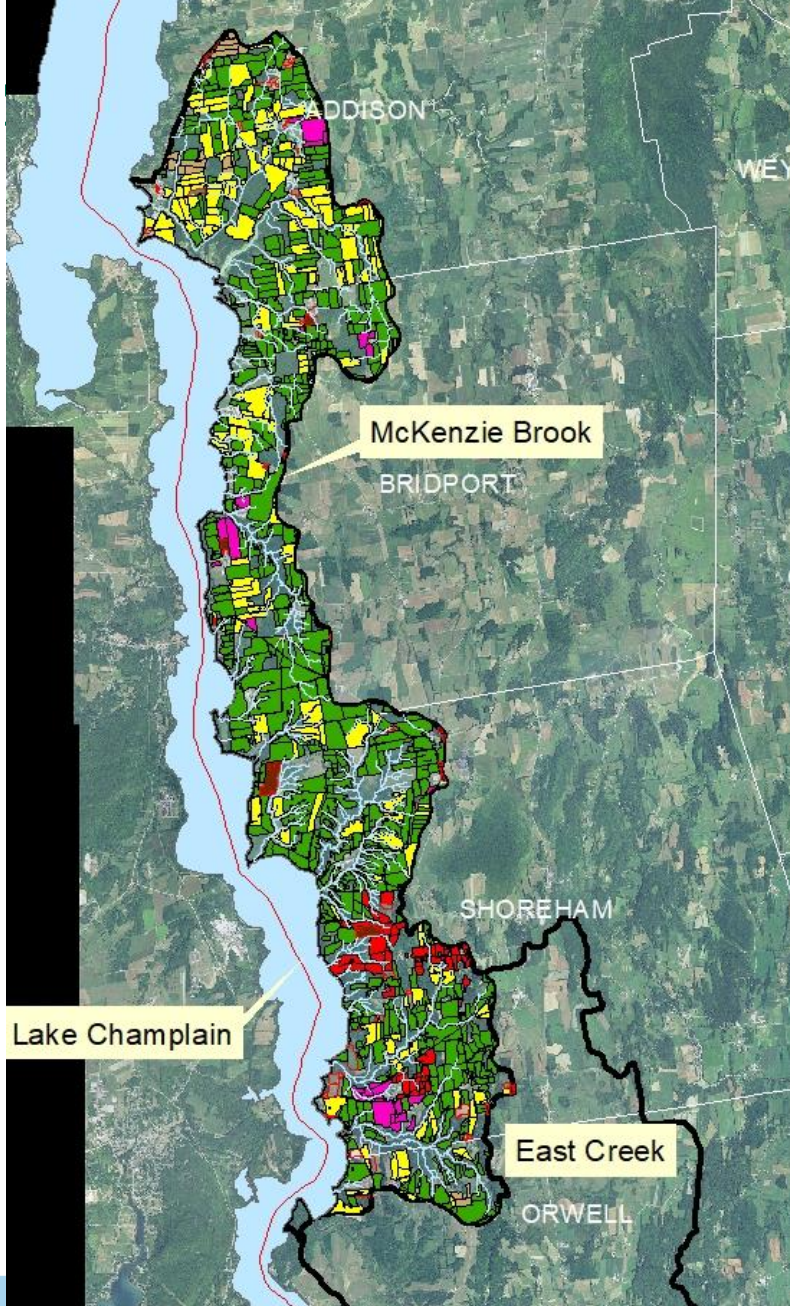
- Goal 63% P reduction / year

McKenzie Brook Watershed

- 76% in Agriculture
- 26 Farms
- 962 Fields
- 14,542 Crop acres

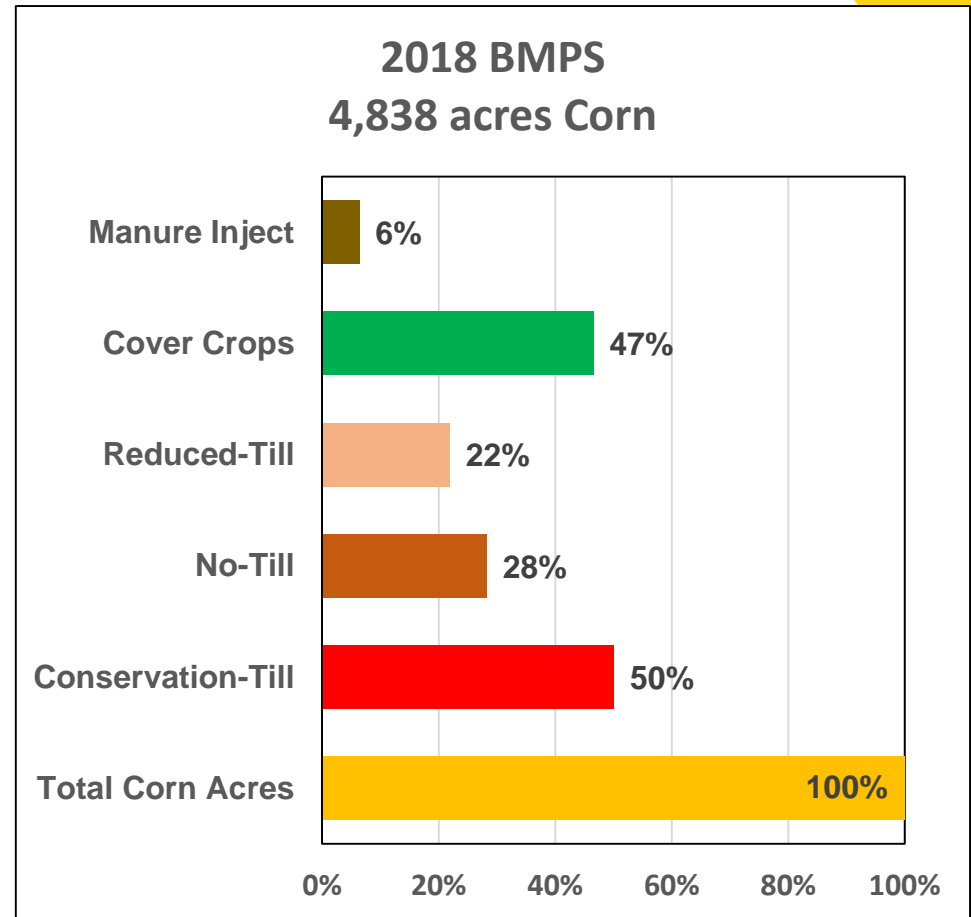
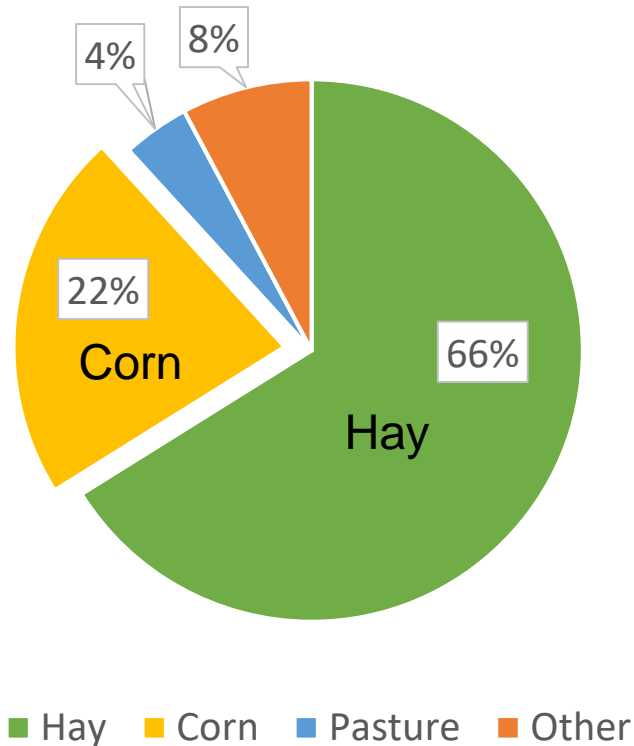
East Creek Watershed

- 46% in Agriculture
- 24 Farms
- 558 Fields
- 7,414 acres



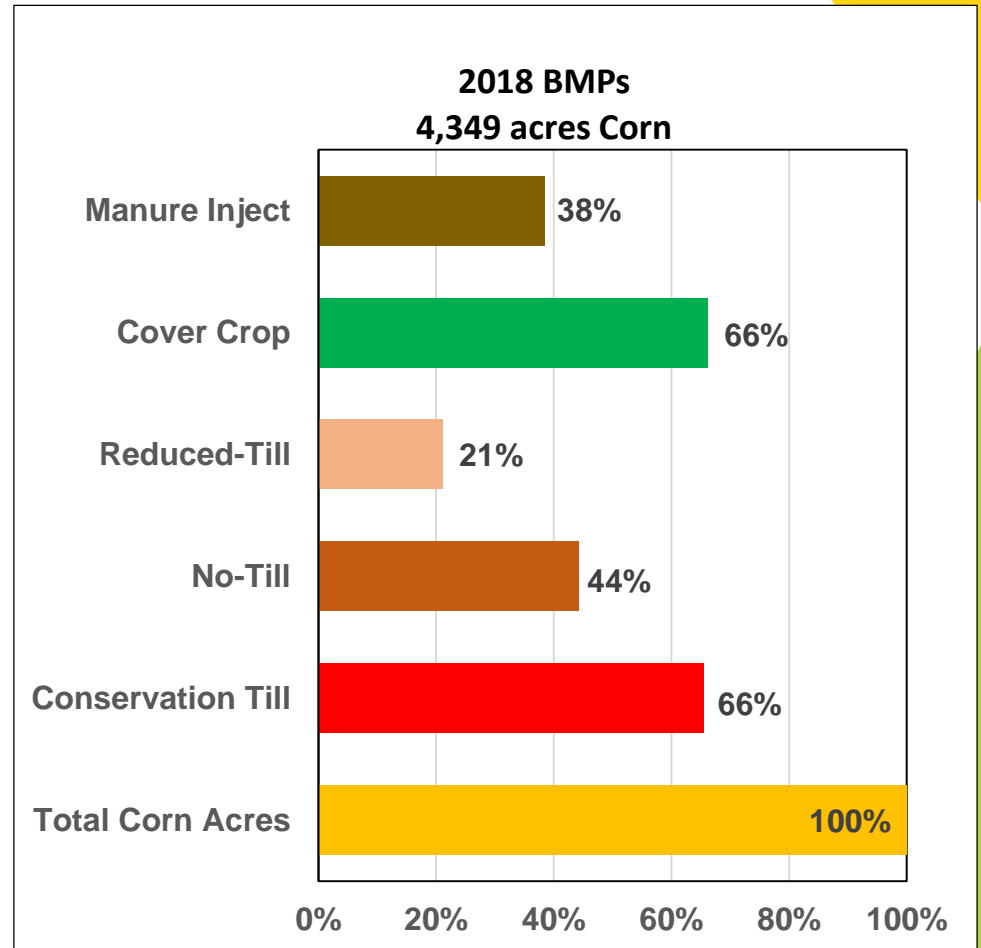
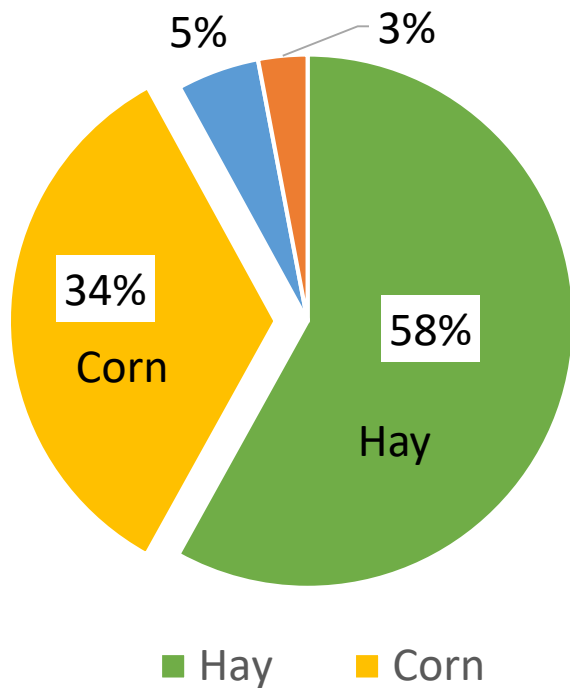
McKenzie Brook & East Creek Watersheds – 50 Farms

21,893 acres Cropland



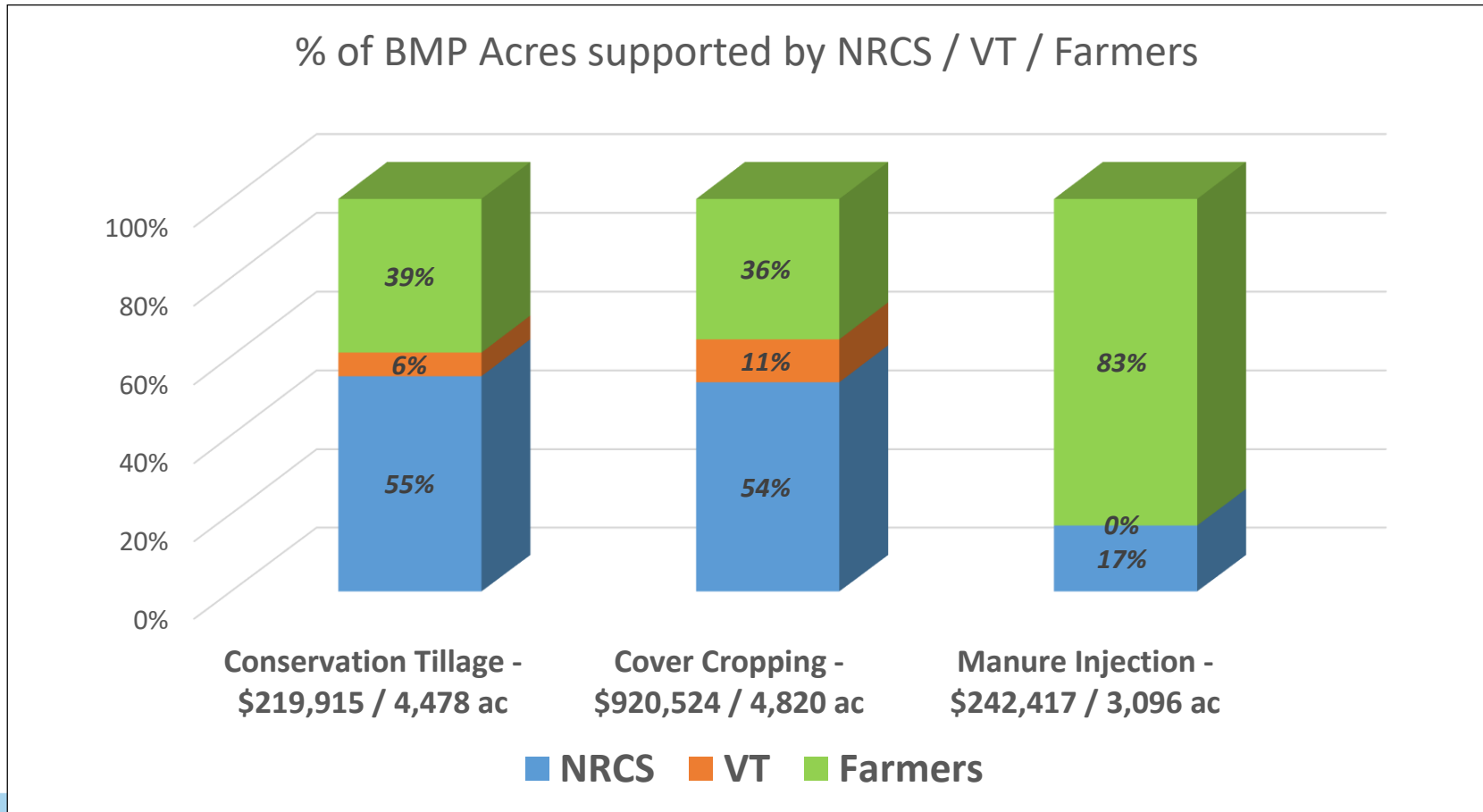
CVFC – Board of Directors - 13 Farms

19,527 acres Cropland



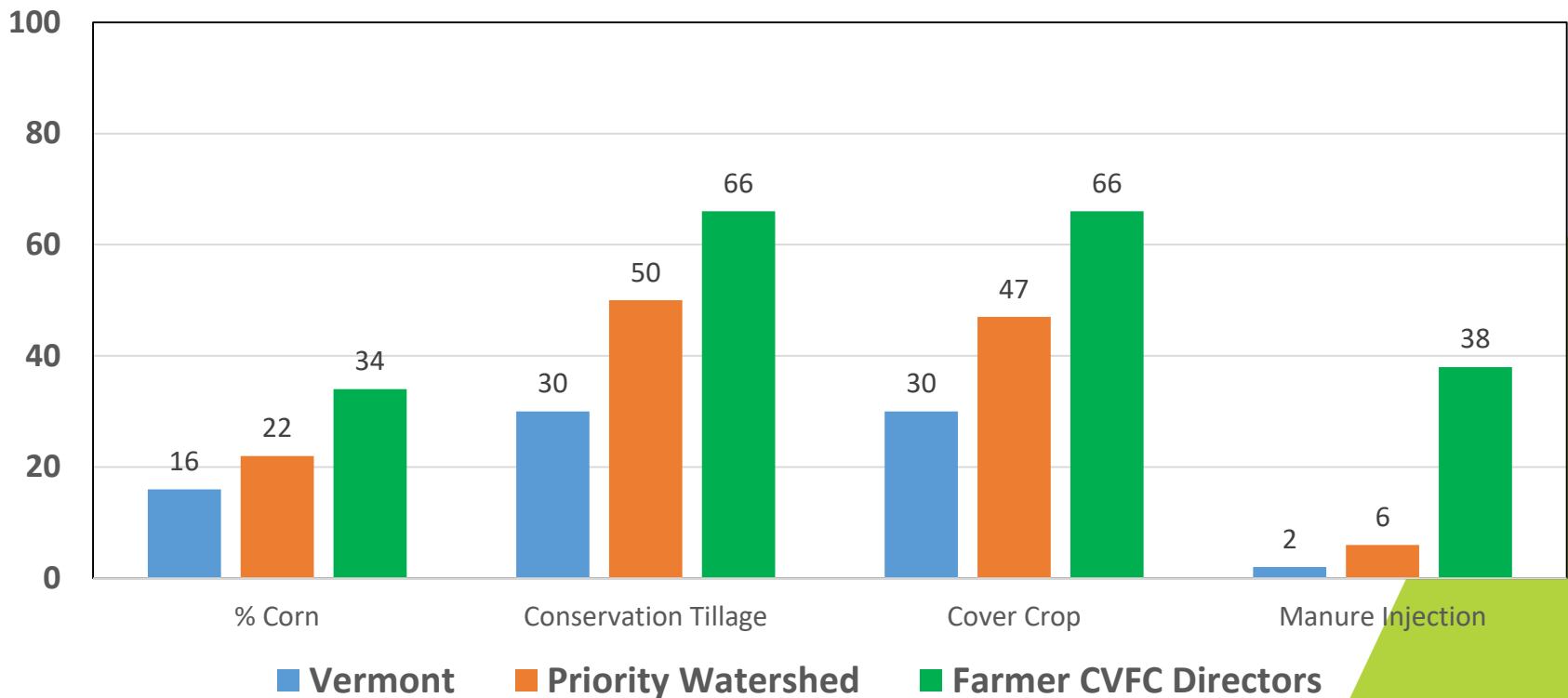
CVFC Director Farms – 19,529 acres

Field BMP Implementation for P Reduction



Farmer Adoption of Field BMP Practices

2018 - % Adoption Rate for Conservation BMP Implementation



What is it Worth ? CVFC Directors - 13 Farms

	Acres	BMP Cost*	P Reduction lb/yr	Soil Carbon Increase	Energy Use Reduction	GHG / Other
Conservation Tillage	4,478	\$ 219,915	7,137	--	--	-
Winter Cover Crop	4,820	\$ 920,524	5,750	--	--	--
Manure Injection	3,096	\$ 242,417	331	--	--	--
Total		\$1.38 M	13,218	?	?	?

Ecosystem Services 

* BMP Cost from NRCS BMP Scenario Tool for TMDL reduction planning



Soil Management



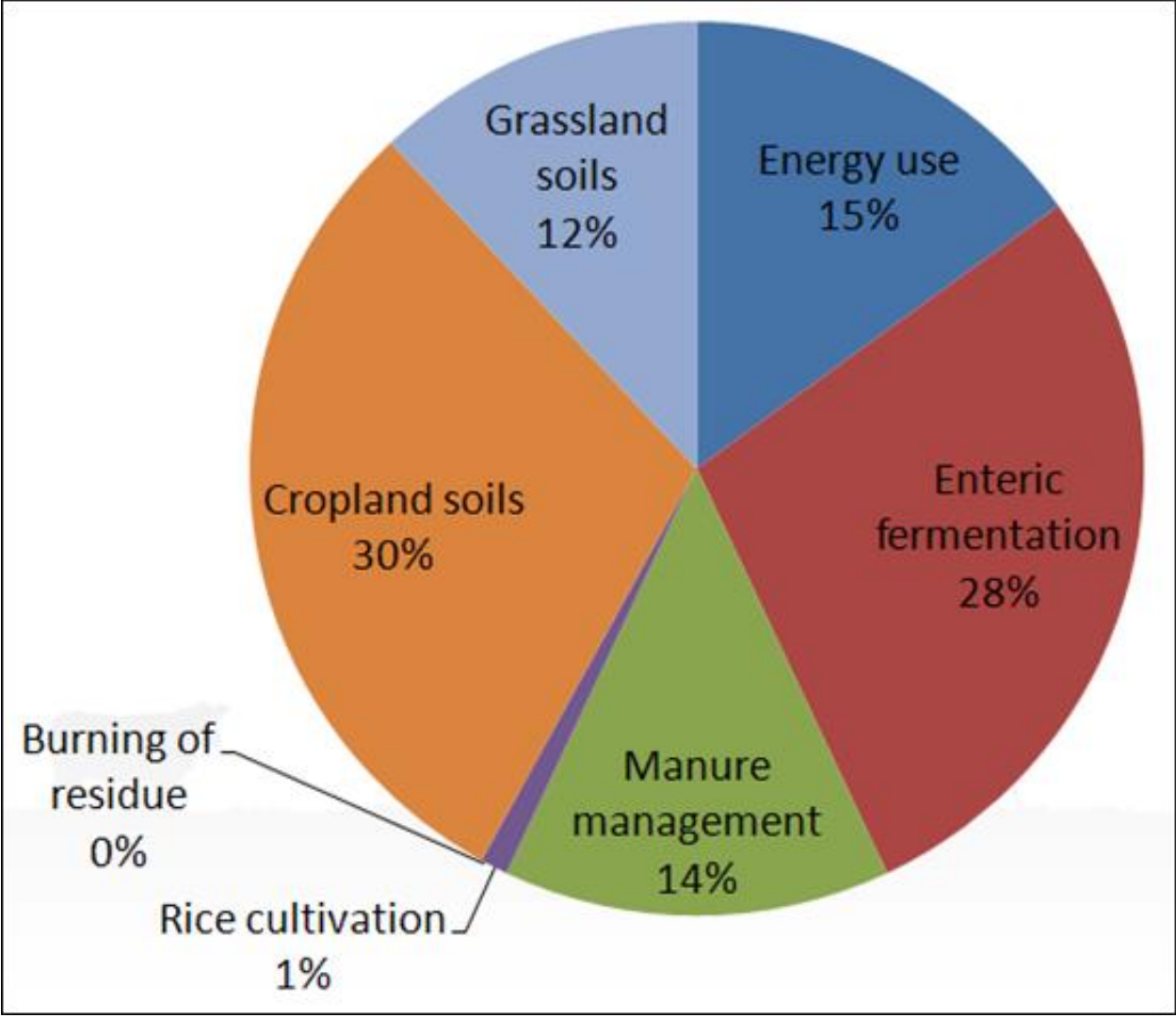
Mitigation Opportunities

Water Quality Improvement

Climate Adaptation

How does agriculture impact climate change?

**Agriculture =
9% of Total
U.S. GHG
Emissions**



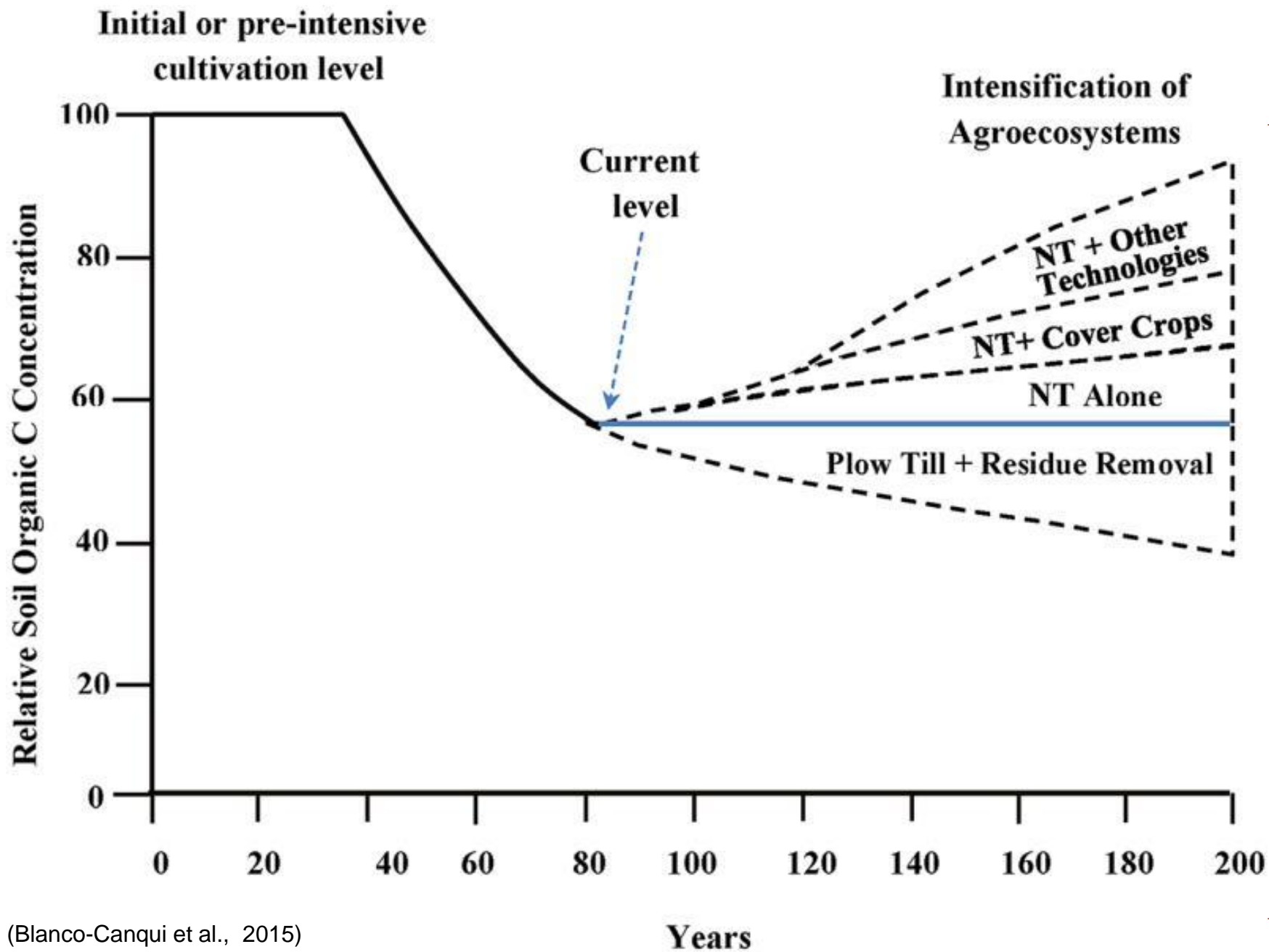
U.S. agricultural greenhouse gas sources (Adapted from Archibeque et al., 2012)



Conservation Tillage

Reduced erosion of carbon

Reduced gaseous loss of carbon



(Blanco-Canqui et al., 2015)



Cover Crops
Reduced erosion of carbon
Additions of carbon to the soil
Other ecosystem services...

(Photo: Kirsten Workman)

Based on most recent estimates, cover crops on Vermont cornfields could sequester:

Estimate level	Carbon sequestered (ton CO ₂ eq/yr)	Equivalent passenger vehicles (per year)	Current value in carbon market (per year)
Medium	44,800	9,600	\$688,000
High	240,000	51,200	\$3,700,000

*Sequestration estimates from Tellatin and Myers, 2018

**Carbon pricing as of 1/22/19 from CA (calcarbondash.org); \$15.35/ t CO₂ eq.

***Does not include value of other ecosystem services



Perennial Forage

- 338,000 acres, not including pasture
- Carbon sequestration, wildlife habitat, and pollination services
- Ecosystem services of \$33.90 per acre per year (The Trust for Public Land, 2018)
- Total of \$11.46 million/year value to Vermont



Facebook



Twitter



Share



Print



Email

First-Ever Rice Farming Carbon Credits Sold to Microsoft

JUNE 14, 2017 01:56 PM

Like 4 Share Tweet

FOOD

Save the climate, pay a farmer

By Nathanael Johnson on Oct 16, 2014

Tweet

Share

ENERGY & ENVIRONMENT | SPECIAL REPORT: FOOD FOR TOMORROW

A Boon for Soil, and for the Environment

By BETH GARDINER MAY 17, 2016

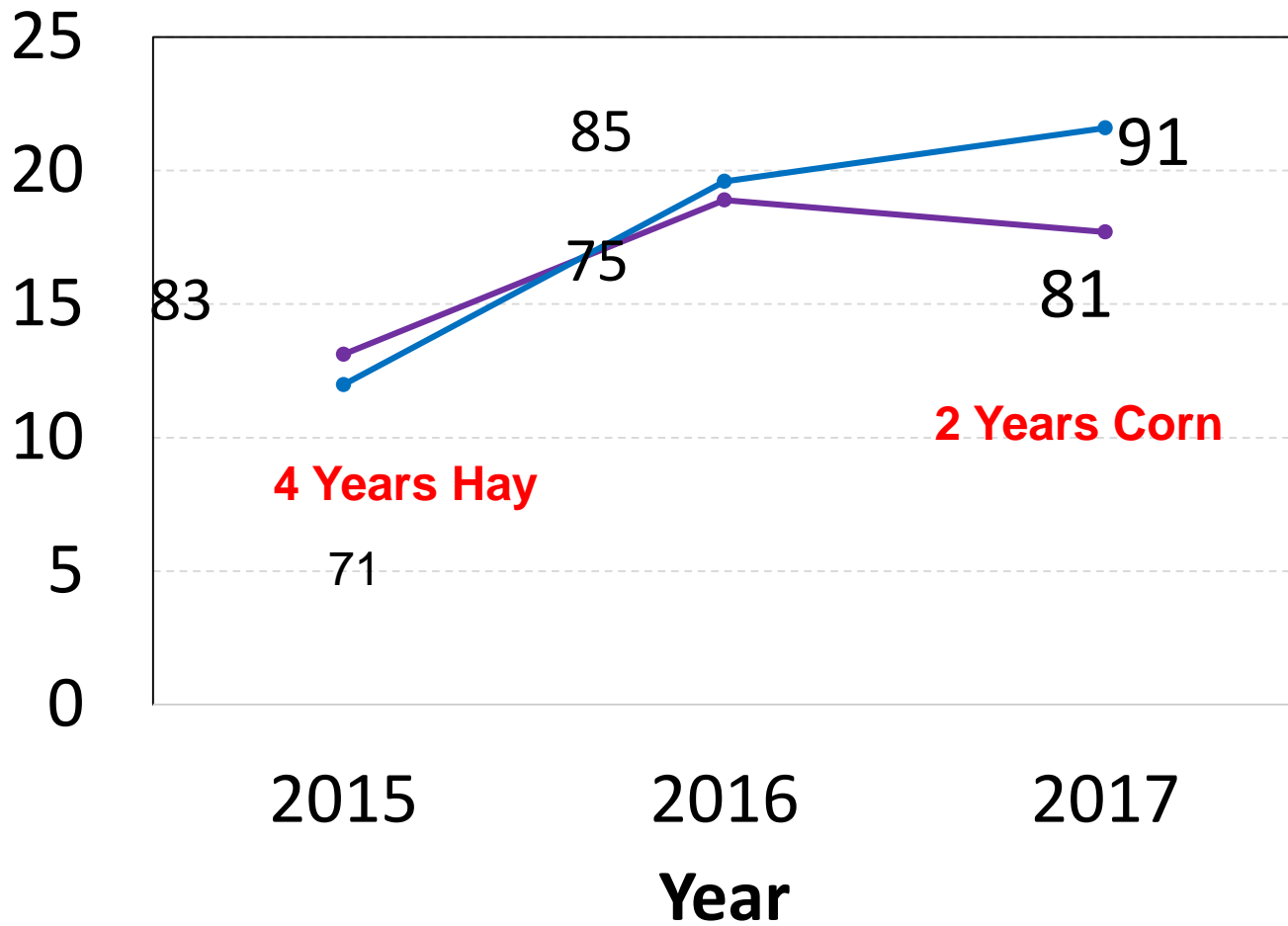
...e speed toward





Prescriptive Farming – Technical assistance & Regulation
Increased Buffers, cover crops, no-till

Yield acre-1 (35% DM)



+1.3% with improved grazing management

Healthy soils have high water holding capacity



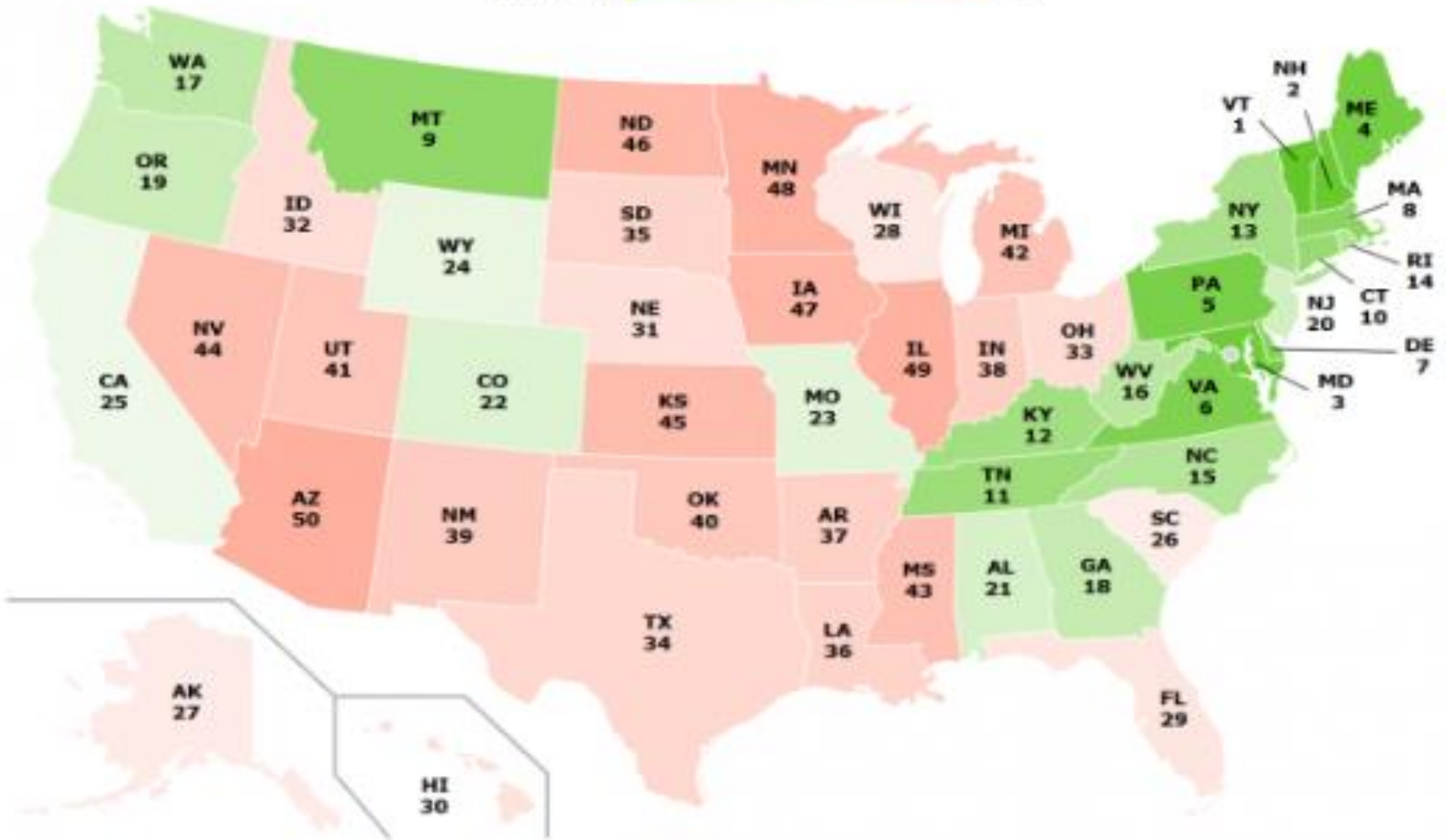
Every **1%** increase in organic matter can result in up to **20,000** gallons of available soil water per acre*

*USDA-NRCS



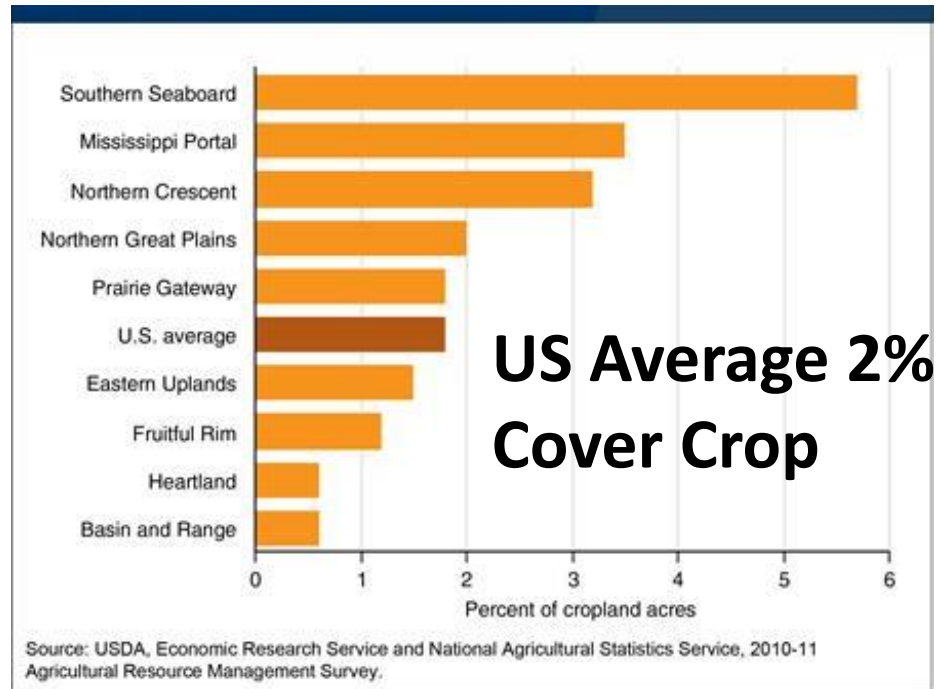
RANKINGS BY USE OF CONSERVATION PRACTICES

RANK: 1  50

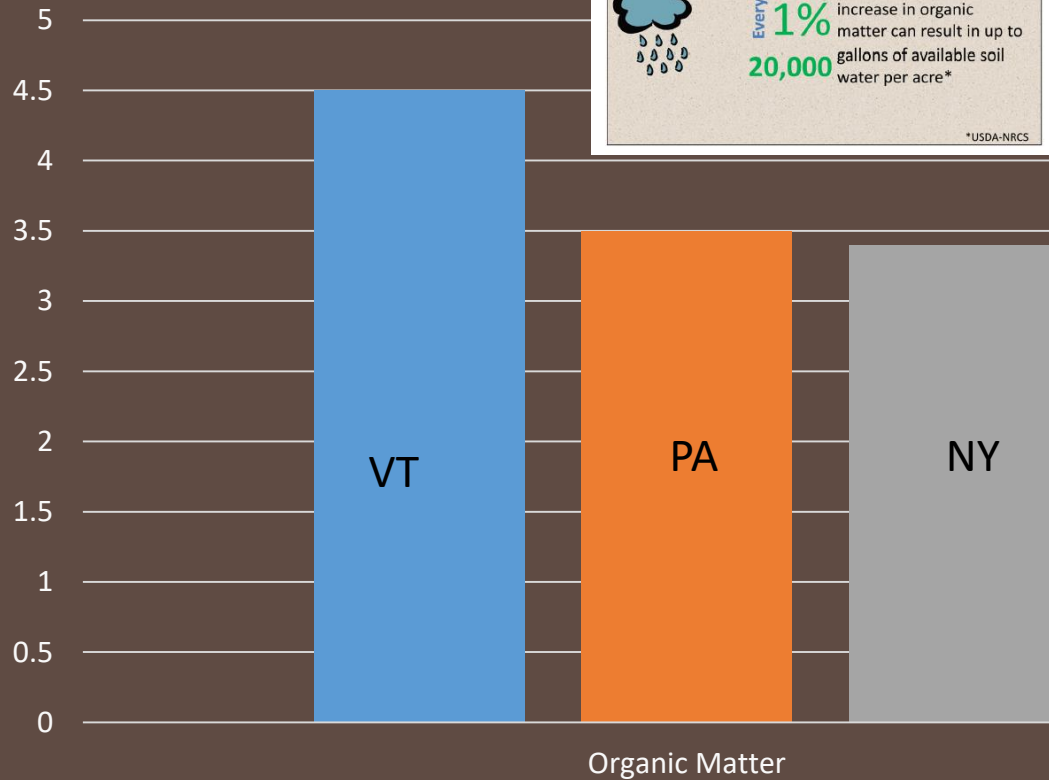
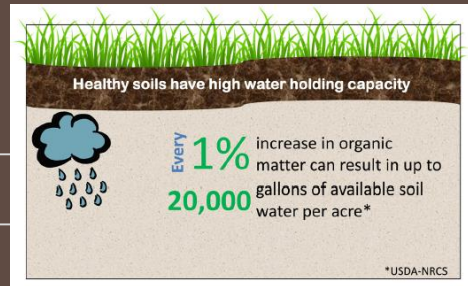




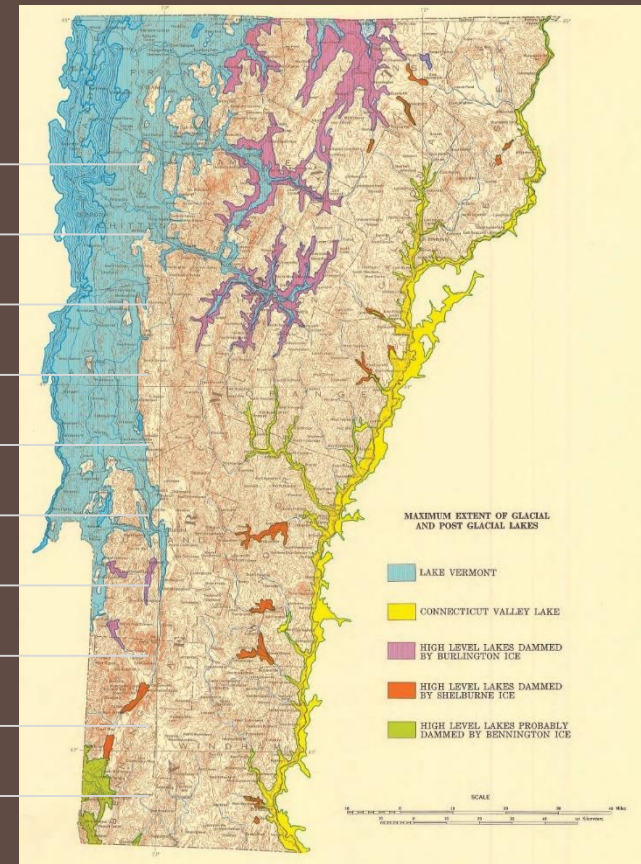
**35% with
cover crop**



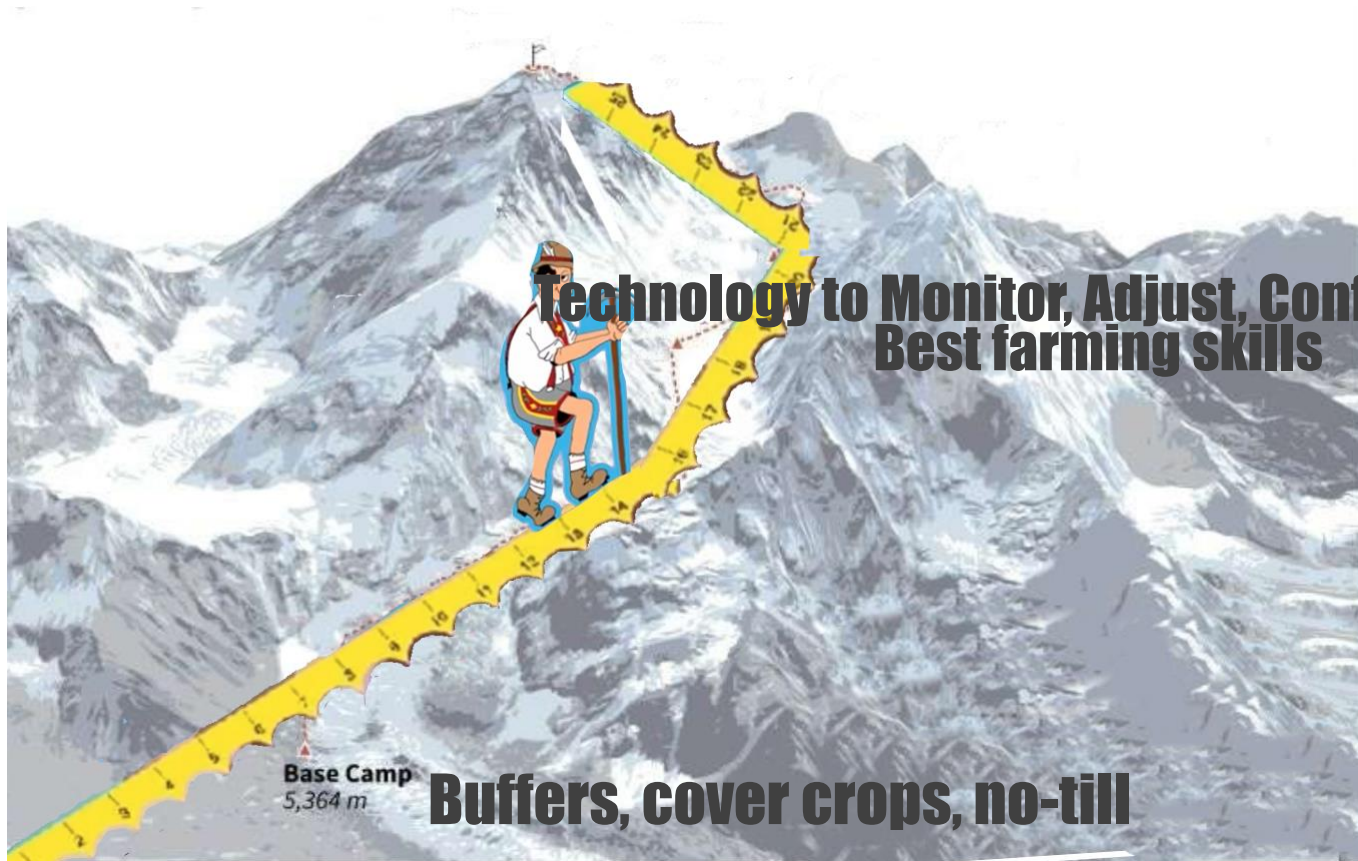
Vermont Soil Health Database



■ VT ■ PA ■ NY



Winter 2018
Joseph Amsili



**Technology to Monitor, Adjust, Confirm, Achieve
Best farming skills**

**Base Camp
5,364 m**

Buffers, cover crops, no-till

Technology to Measure and Monitor





\$\$\$

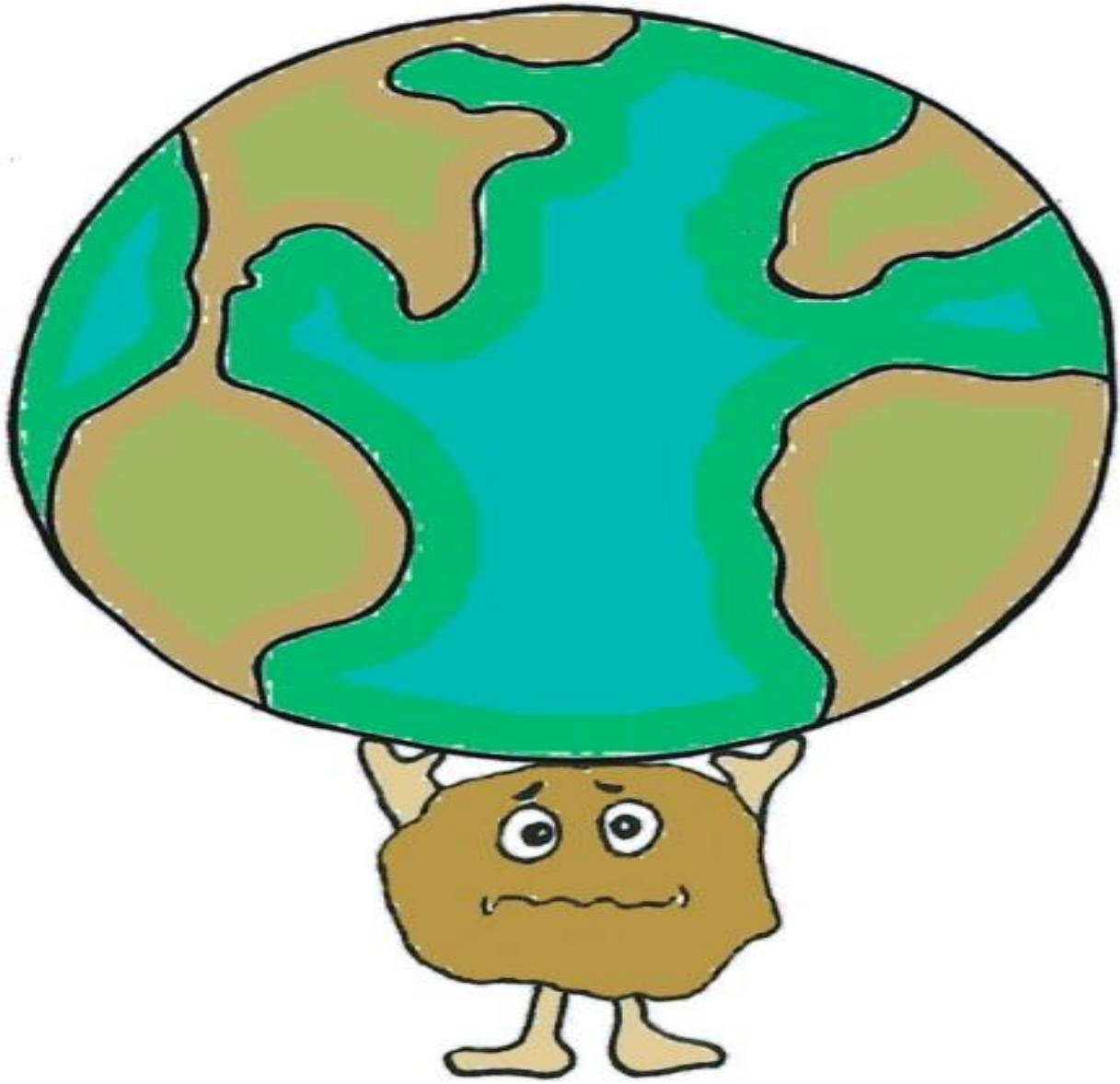
Viability

Best farming skills

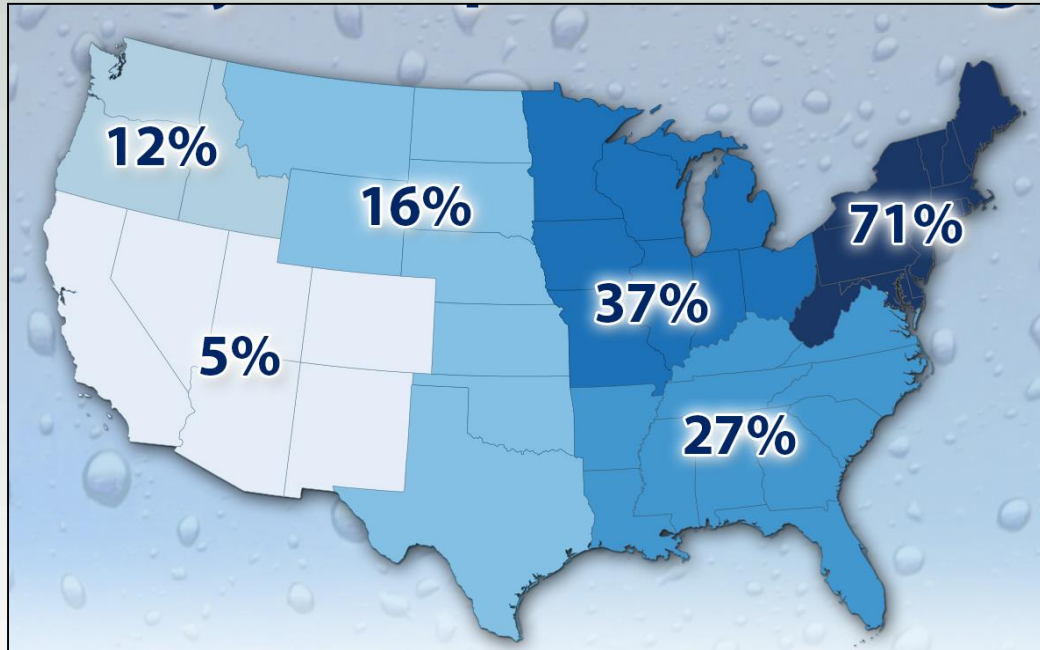
Proper Direction

Base Camp
5,364 m

Buffers, cover crops, no-till



Trends in Extreme Precipitation



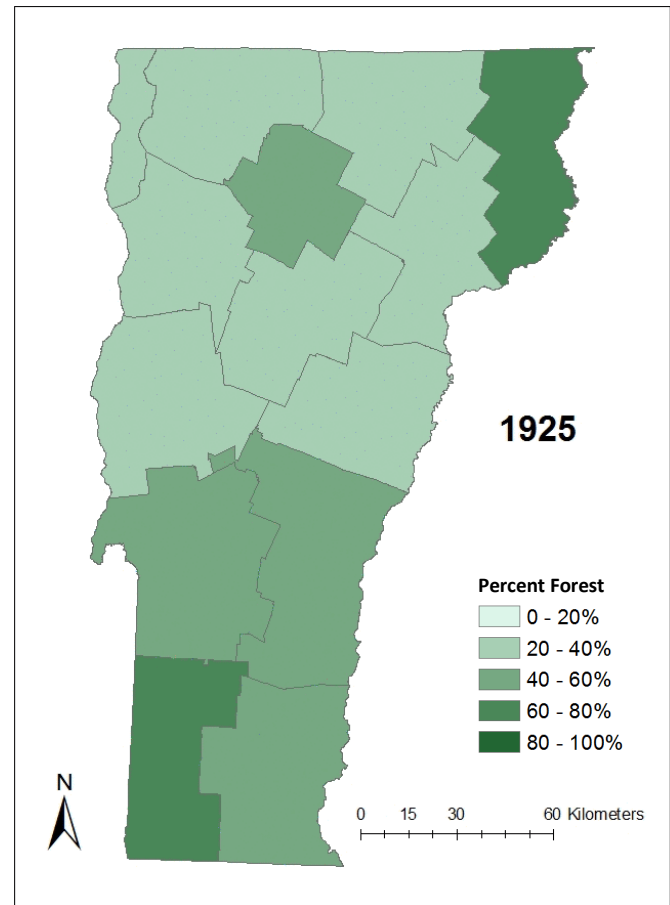
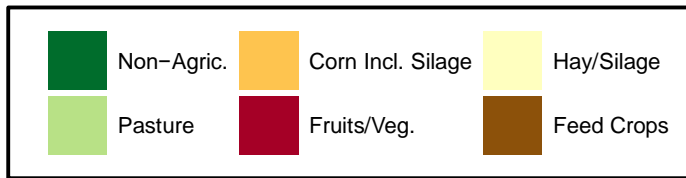
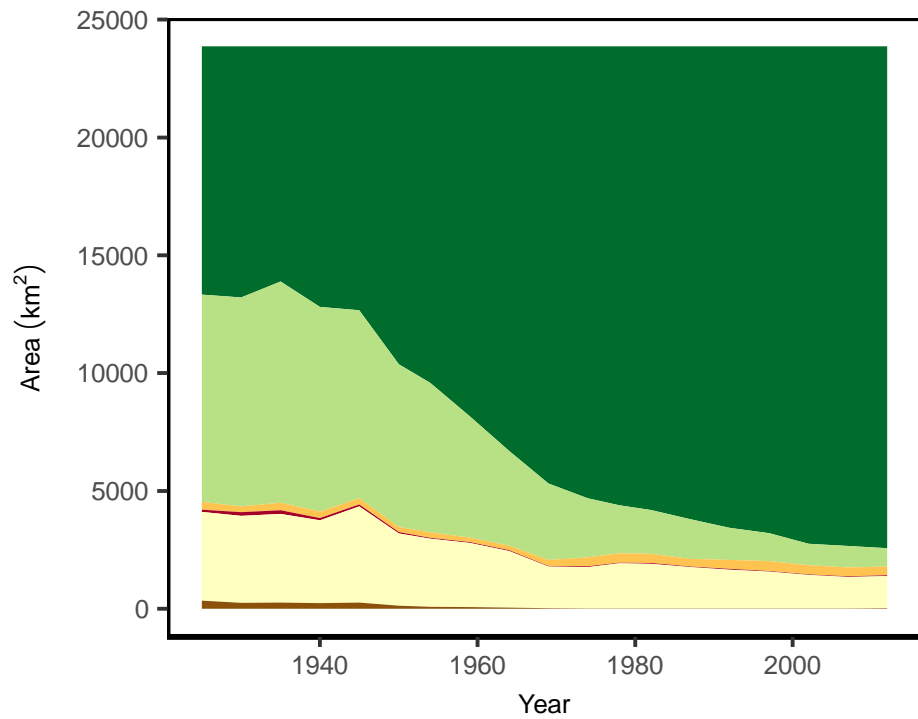
Increase in the number of 2" rainfalls per year from 1958 to 2011



Some People Wake Up to an Alarm







ECOSYSTEM SERVICES



Provisioning

- FOOD
- FRESH WATER
- WOOD AND FIBER
- FUEL
- ...

Supporting

- NUTRIENT CYCLING
- SOIL FORMATION
- PRIMARY PRODUCTION
- ...

Regulating

- CLIMATE REGULATION
- FLOOD REGULATION
- DISEASE REGULATION
- WATER PURIFICATION
- ...

Cultural

- AESTHETIC
- SPIRITUAL
- EDUCATIONAL
- RECREATIONAL
- ...

LIFE ON EARTH - BIODIVERSITY


- Food and forage
- Increased soil-water-holding-capacity
- Water-purification
- Groundwater recharge
- Increased stream-baseflow
- Increased soil-carbon
- Reduced:
 - Flooding
 - Drought
 - Eutrophication and water-pollution
 - Infrastructure damage

TABLE A1. ESTIMATED ANNUAL PER-ACRE VALUE OF NATURAL GOODS AND SERVICES BY LAND COVER TYPE

Land cover type*	Natural goods and services	Annual value per acre (2018\$)
Deciduous Forest	Air pollution removal, carbon sequestration, carbon storage, erosion control/water quality	\$180.00
Mixed Forest	Air pollution removal, carbon sequestration, carbon storage, erosion control/water quality	\$174.00
Pasture/Hay	Carbon sequestration, habitat/biodiversity, livestock/livestock products, and pollination services	\$58.80
Evergreen Forest	Air pollution removal, carbon sequestration, carbon storage, erosion control/water quality	\$168.00
Cultivated Crops	Food production, pollination services	\$63.10
Woody Wetland	Flood protection, habitat	\$590.00
Shrub/Scrub	Habitat/biodiversity, carbon sequestration	\$19.40
Emergent Herbaceous Wetland	Flood protection, habitat	\$590.00

**477,000 Acres Hay & Pasture
Compliments of the Livestock Industry**





**Farmers have met changing
market-demand through history**

**Timber. Potash. Sheep. Syrup. Horse-hay. Cheese. Butter. Milk.
Birdsfoot Trefoil Seed.**

Next: ECOSYSTEM SERVICES



