Final Workshop:

Climate Change Resilient Farming in Vermont Program

March 23rd, 2015

Hosted by the University of Vermont

Vermont Farm Resilience in a Changing Climate Initiative

Photo by Sam Mayfield

Agroecology & Rural Livelihoods Group (ARLG)
The University of Vermont

Presenters & Facilitators

- UVM Agroecology & Rural Livelihoods Group
  - Kate Westdijk, M.S., Food Systems Research Specialist
  - Martha Caswell, M.P.P., Research & Outreach Coordinator
  - Rachel Schattman, PhD. Candidate and Farmer
- UVM Center for Sustainable Agriculture
  - Joshua Faulkner, PhD., Farming & Climate Change Coordinator
  - Jennifer Colby, M.S., Pasture Program Coordinator
  - Linda Berlin, PhD., Director
  - Ginger Nickerson, PhD., GAPS Program Coordinator

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Climate Change Resilient Farming in Vermont Program 2014-15

Participant Introductions

- Name, affiliation, primary expertise
- What are your remaining questions that you hope to have answered through this program?




Workshop Outline

- Welcome, VAR Initiative Updates, Program Review
- Review Observed and Projected Climate Impacts
- Discuss Key Strategies: CC Adaptation on VT Farms
  - Preliminary Results from the VT Ag Resilience in a Changing Climate Initiative
  - Report out from Participants (winter professional development)
- Practice Tools: Communicating these to VT Farmers
- Participant Goal Setting for 2015 Field Season
- Feedback to us on this New Program

Climate Change Resilient Farming in Vermont Program 2014-15

Our Goals for Participants

- Deepened relationships with peers
- Increased ability to:
  - conduct holistic farm climate change resilience assessment including recommendations for the farm and a tool kit of strategies
  - assess farmer knowledge and desire to learn about CC implications for their farm
- Increased understanding of climate change adaptation and/or mitigation strategies
- Increased number of farms they serve implementing recommended strategies

Climate Change Resilient Farming in Vermont Program 2014-15

Our Goals

- Increased understanding of participant goals- specifically what they need to be better able to serve farmers.
- Validate perceived outcomes that participants want based on past research with stakeholders.
- Broaden network of service-providers aware of our initiative and prepared to translate our findings to on-farm management decisions.
- Evaluate and improve program for future offering.

Climate Change Resilient Farming in Vermont Program 2014-15

Our Goals for Vermont Farmers

Farmers served by program participants, not farm field day hosts

- Increased adoption of appropriate farm management practices by VT farmers to enhance climate change resilience (*requires understanding their farm context and which BMPs are a good fit*)
- Increased understanding of climate change adaptation and/or mitigation strategies

Participant Generated Key Words: Farm Resilience

Wordle.com; October 2014

October 30th Farm Day

Islandacre Farm

Health Hero Farm

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Climate Change Resilient Farming in Vermont Program 2014-15

- Webinar
- Farm Day (10/30)- *CEC eligible*
- November- March: Attend self-identified professional development opportunities (mini-grants available)
- Workshop (March 2015)- *CEC eligible*
- Share with Farmers (Season 2015 and beyond)

Program made possible by the High Meadows Fund

The Vermont Farm Resilience in a Changing Climate Initiative

An action-oriented approach.
Working with farmers, extensionists and researchers
to face the challenges of climate change.

Farm Practices Being Evaluated:

- Focus for Farm Sampling:
  1. Cover Crops
  2. No Till
  3. Stormwater runoff management
  4. Wetland conservation
  5. Rotational grazing

- Considering broadly:
  1. Hoop houses/high tunnels
  2. Green manure
  3. Timely manure incorporation
  4. Pest/disease management
  5. Invasive species management
  6. Irrigation
  7. Nutrient Management Plans
  8. Conservation buffer strips
  9. Drainage tile
  10. Animal diversity
  11. Animal feed management
  12. Agroforestry
  13. Alternative energy
  14. Insurance

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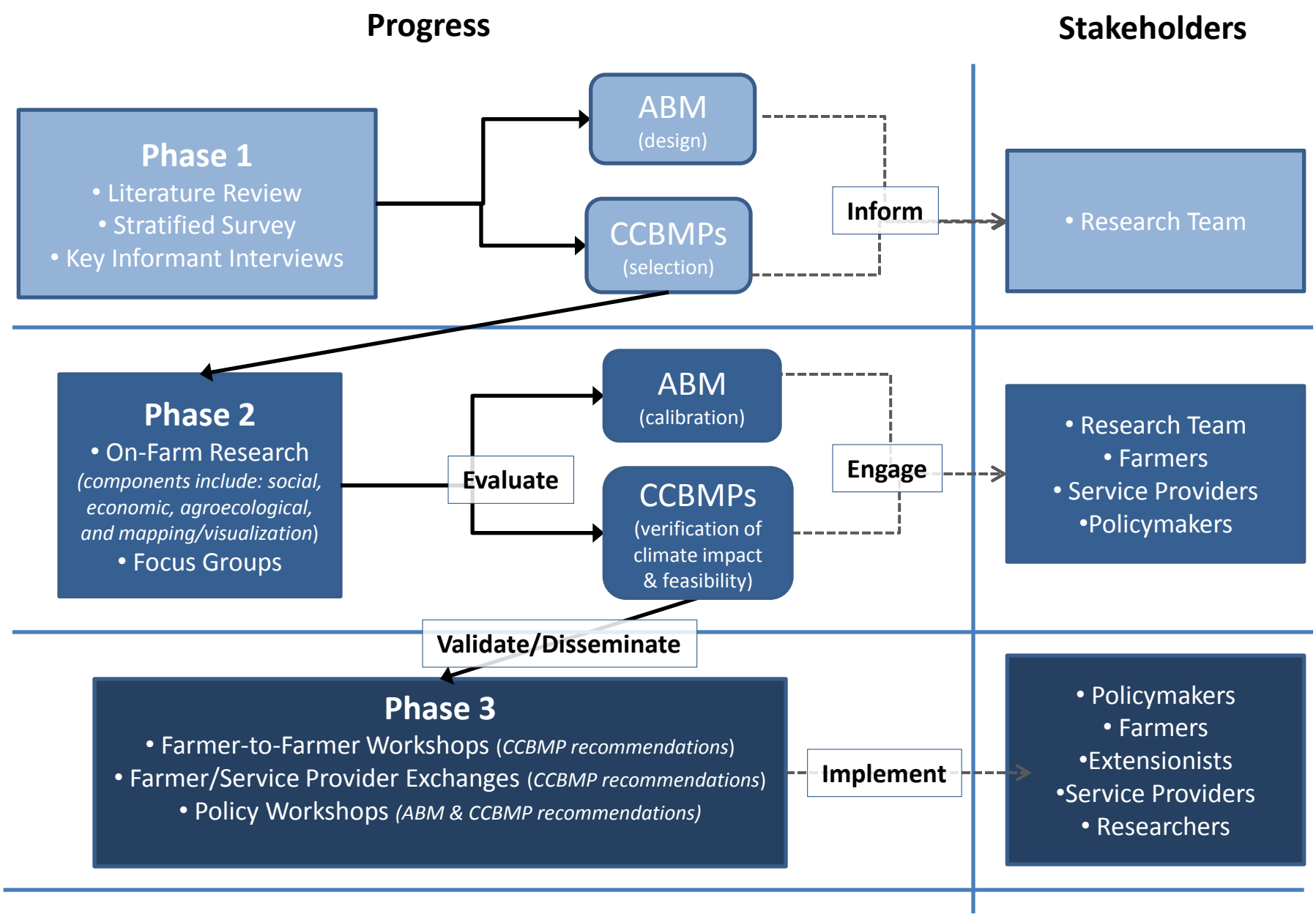
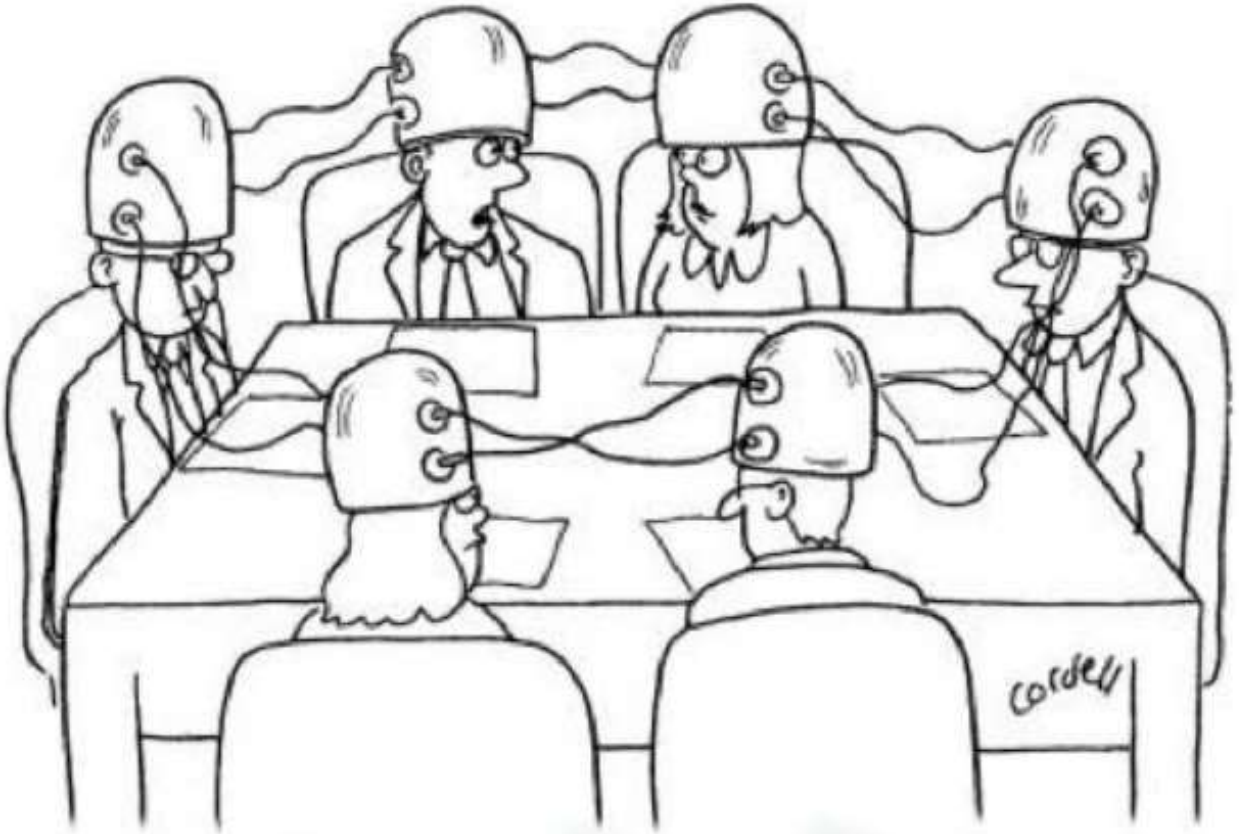


Research Integration



"Frankly, I'm not sure this whole idea-sharing thing is working."

Research Integration

Research Validation & Sharing

- Publications
- Farmer Conferences
- All of you!
- Initiative Advisory Committee:
  - VT Grass Farmers Association
  - VT Vegetable and Berry Association
  - Friends of Northern Lake Champlain
  - VT Agency of Agriculture
  - SARE/Extension
  - VT NRCS
  - Stone Environmental
  - VT Farm to Plate Initiative
  - VT State Climatologist
  - UNH Assistant Professor of Agroecology

Future Interests of ARLG in Vermont and New England

- Expanding and deepening On-Farm work with BMPs
- Outreach and Action for Research Impact
  - Repeat this Program in Vermont?
- Sharing Our Approach with other Northeast Land-grant Universities (*with USDA Hub*)



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Questions?

www.vtfarmresilience.org

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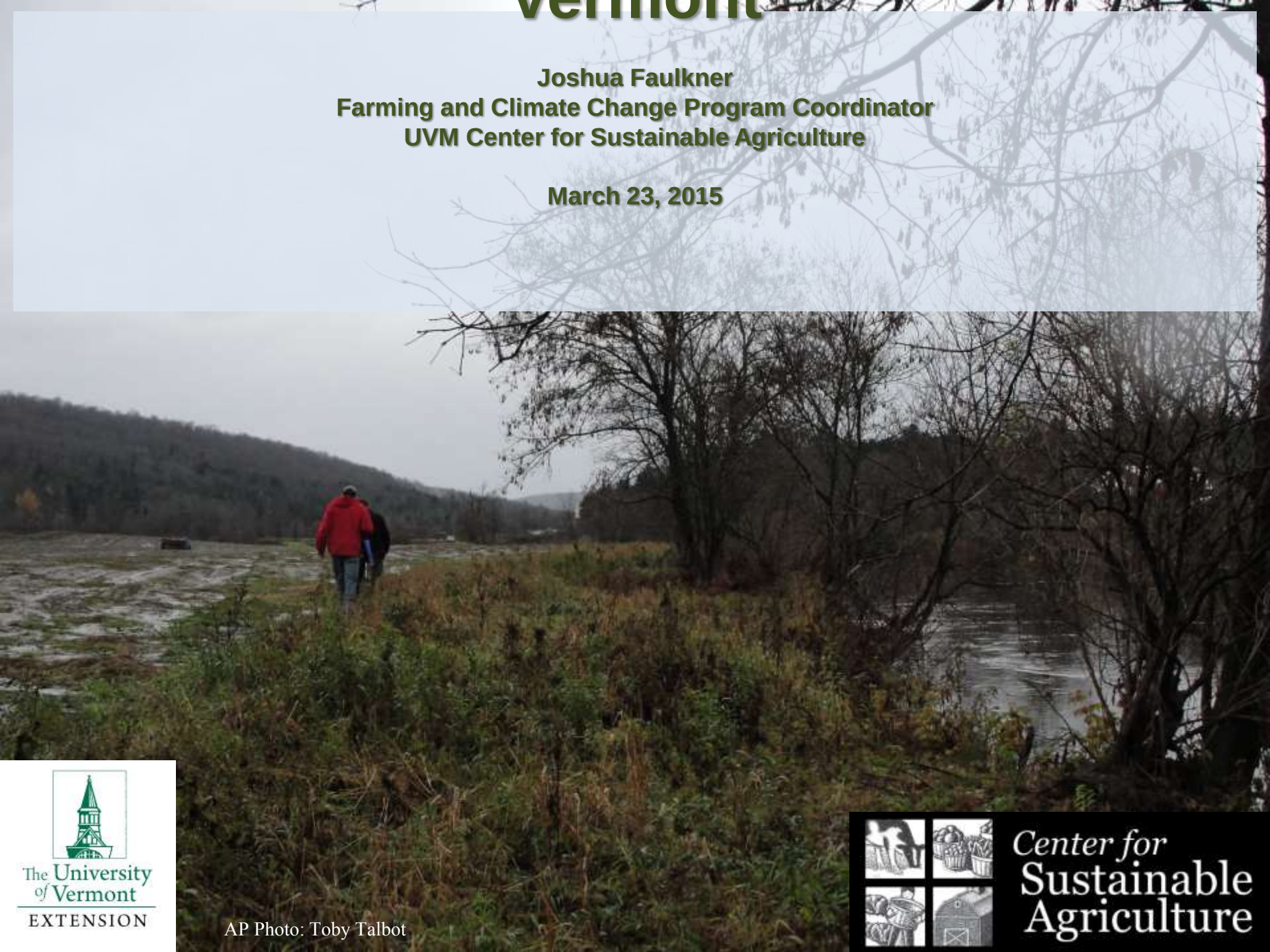
Review of VT Climate Change Impacts and Projections

Joshua Faulkner, PhD.

Vermont

Joshua Faulkner
Farming and Climate Change Program Coordinator
UVM Center for Sustainable Agriculture

March 23, 2015

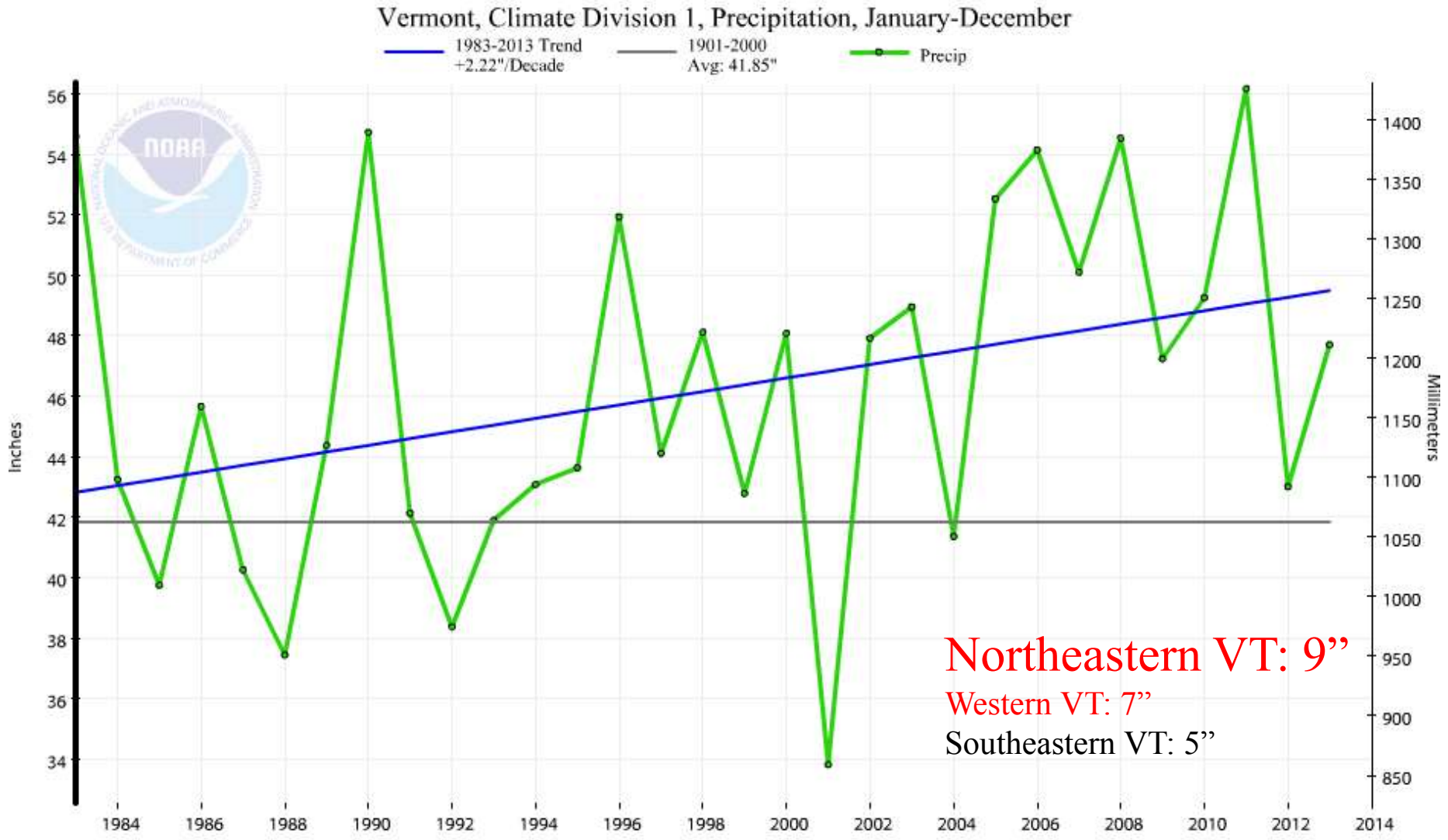


The University of Vermont EXTENSION

AP Photo: Toby Talbot

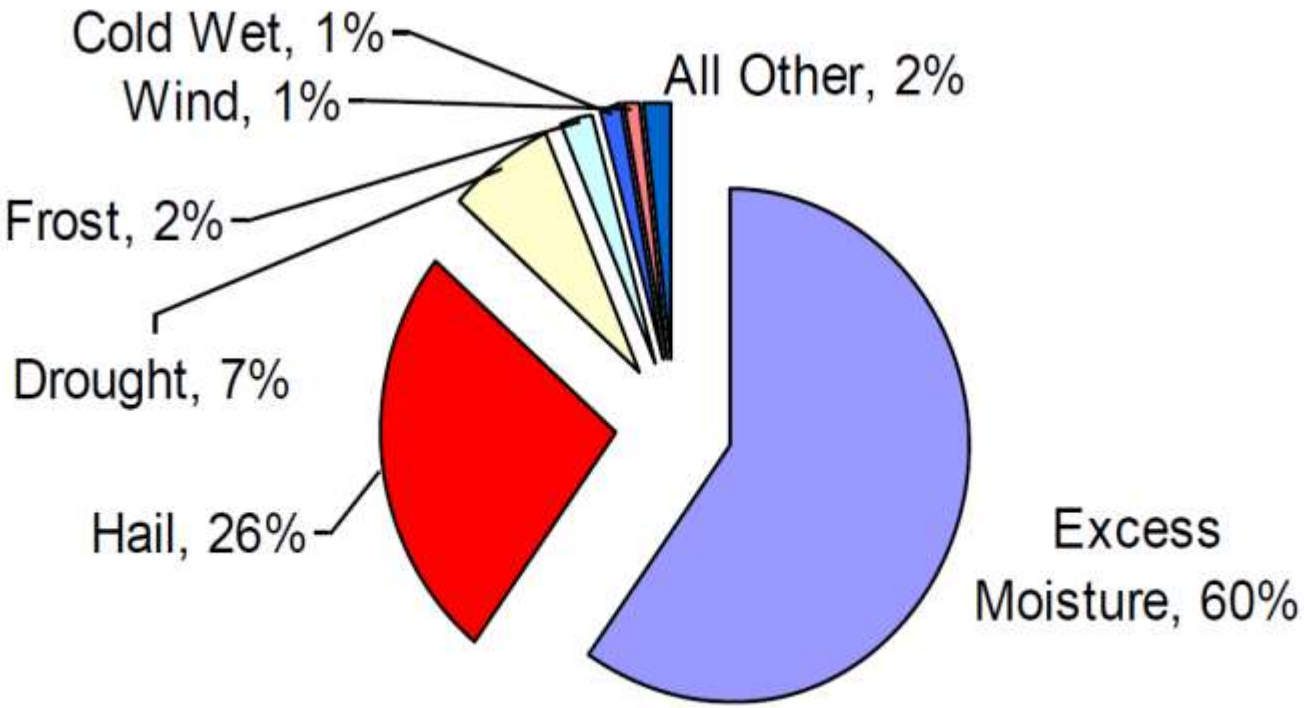
Center for Sustainable Agriculture

Precipitation in Northeastern Vermont (1983-2013)



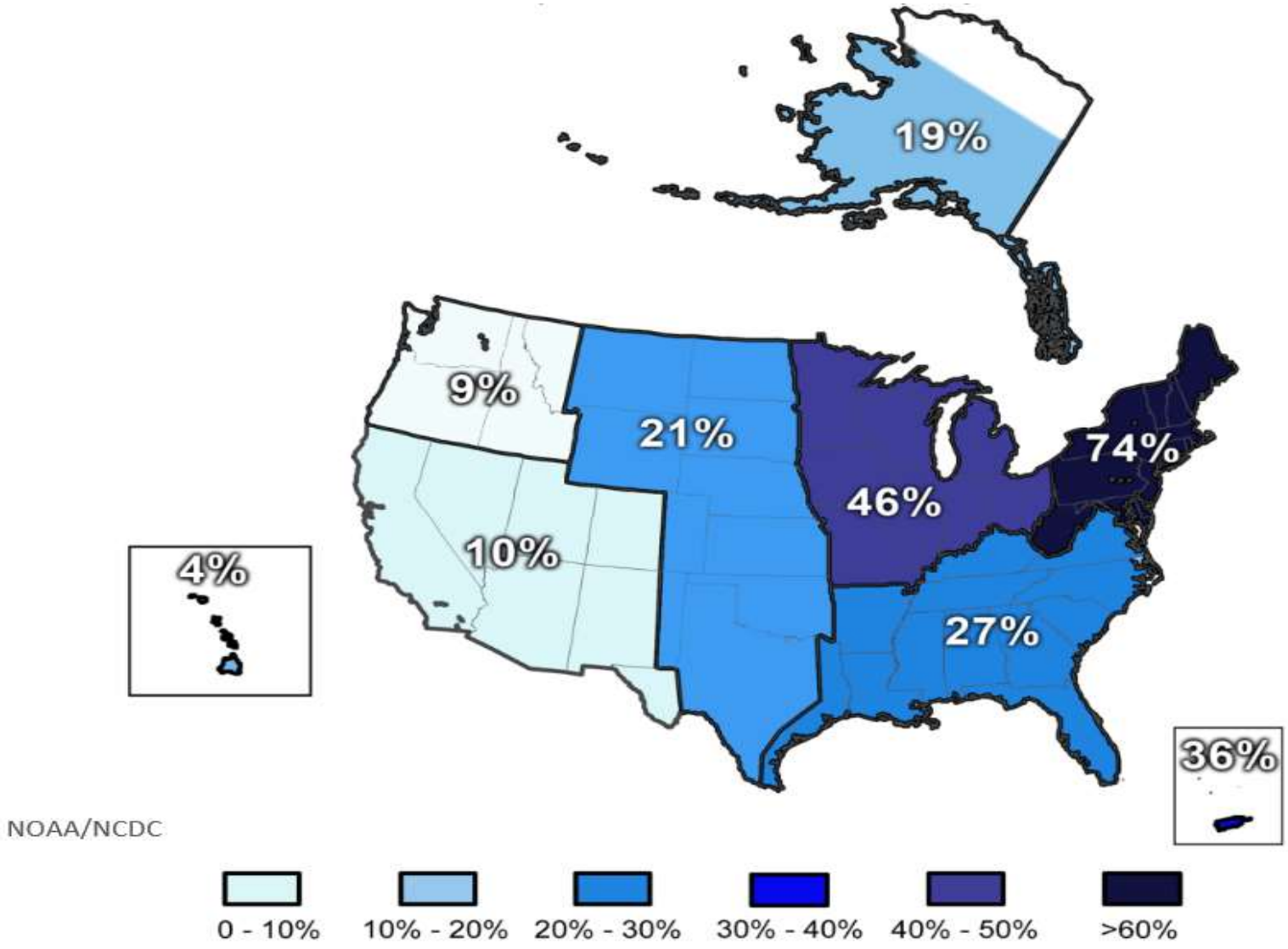
Why Vermont Crops Fail (2001-10)

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



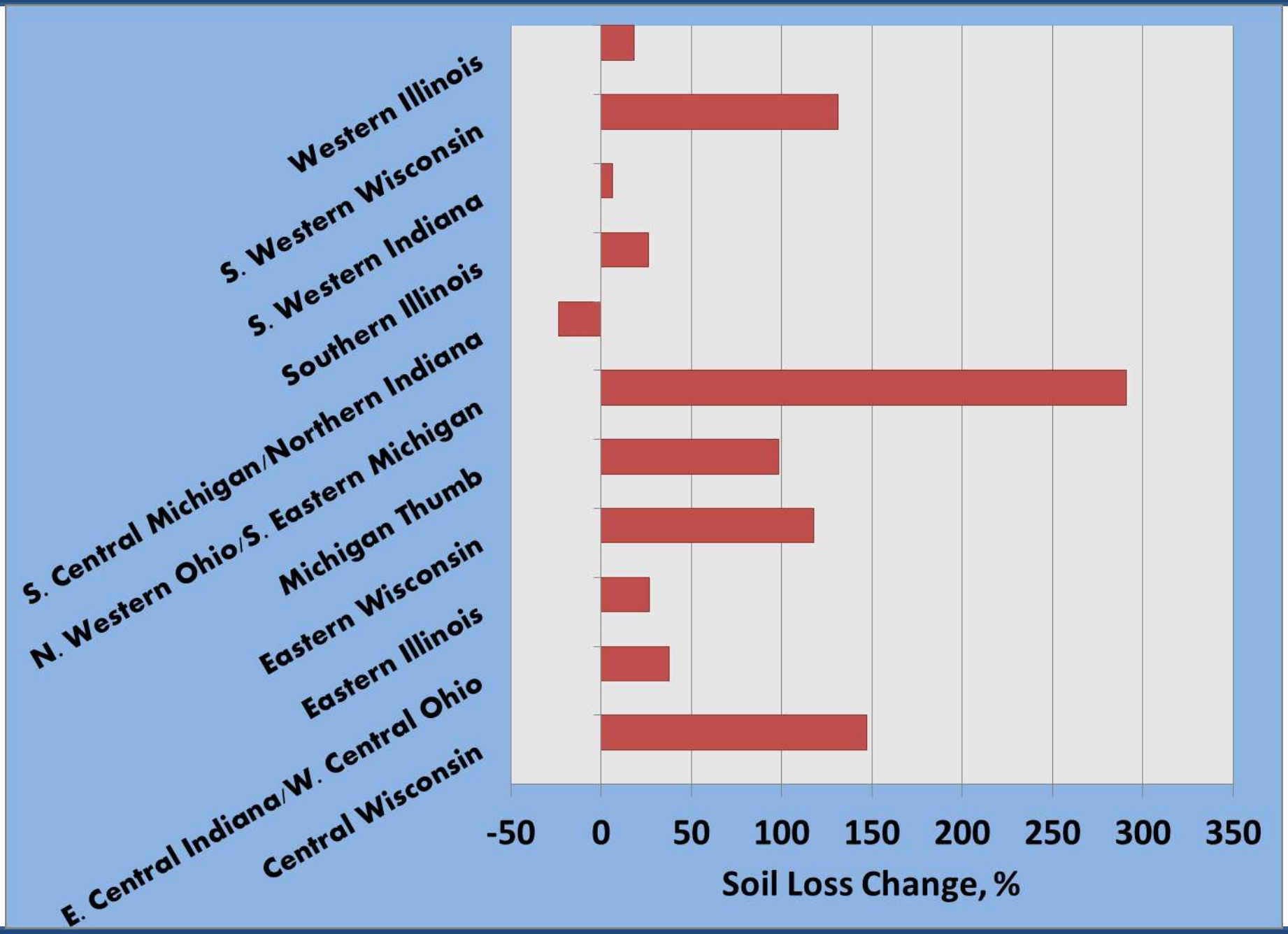
RMA, 2012

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



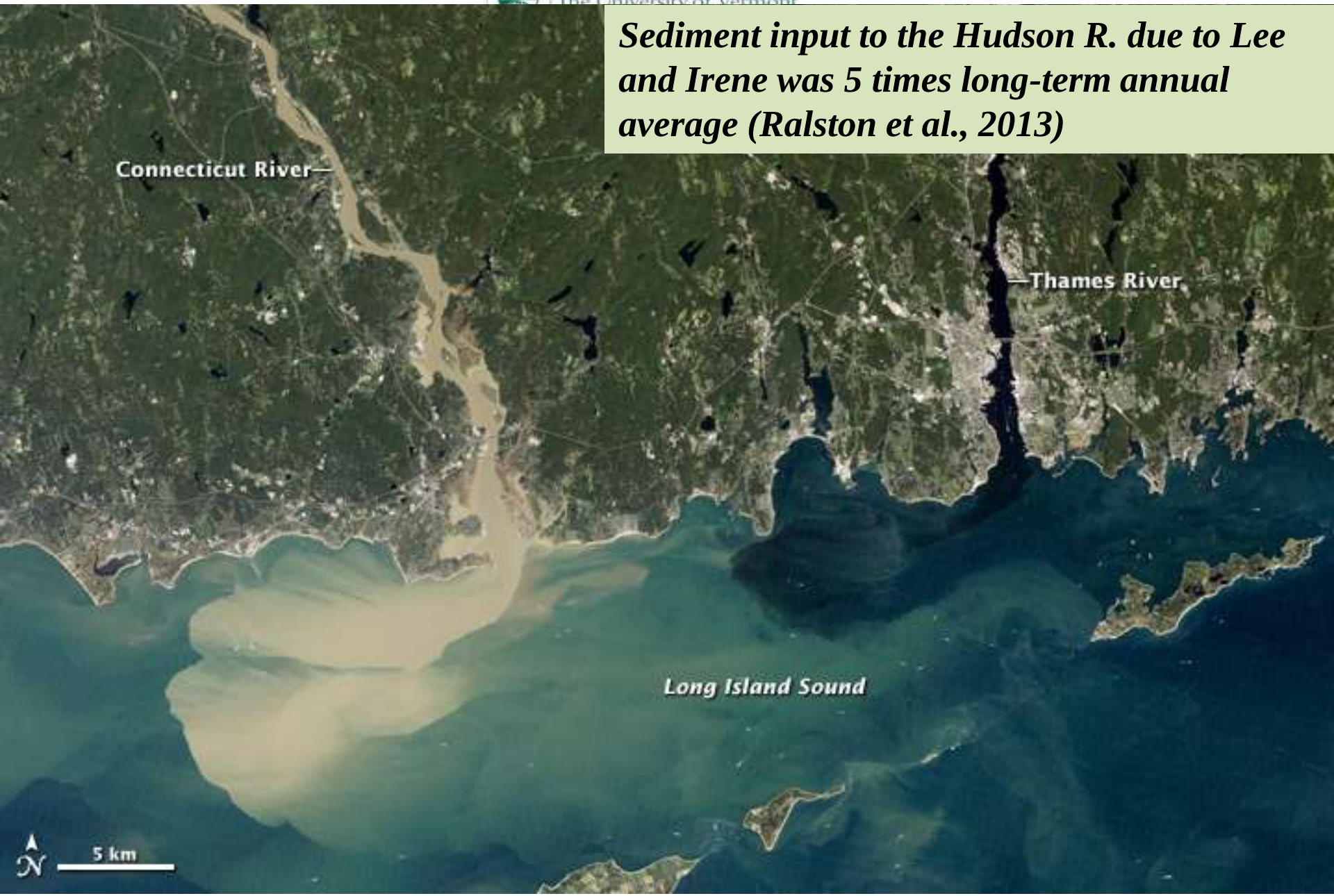
‘In general, erosion increases at a rate 1.7 times annual rainfall increases’

(Nearing et al., 2004)



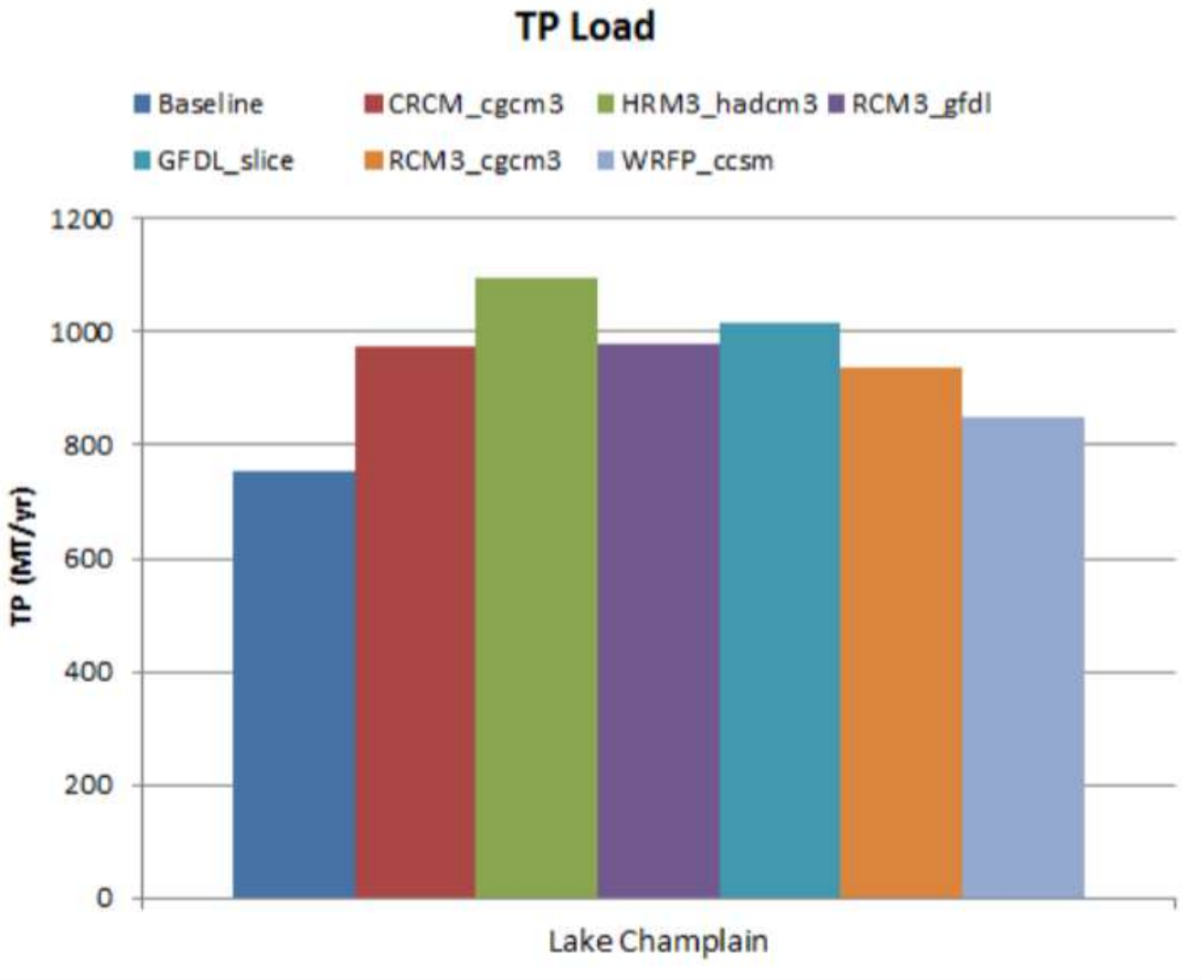
(O'Neal et al., 2005)

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

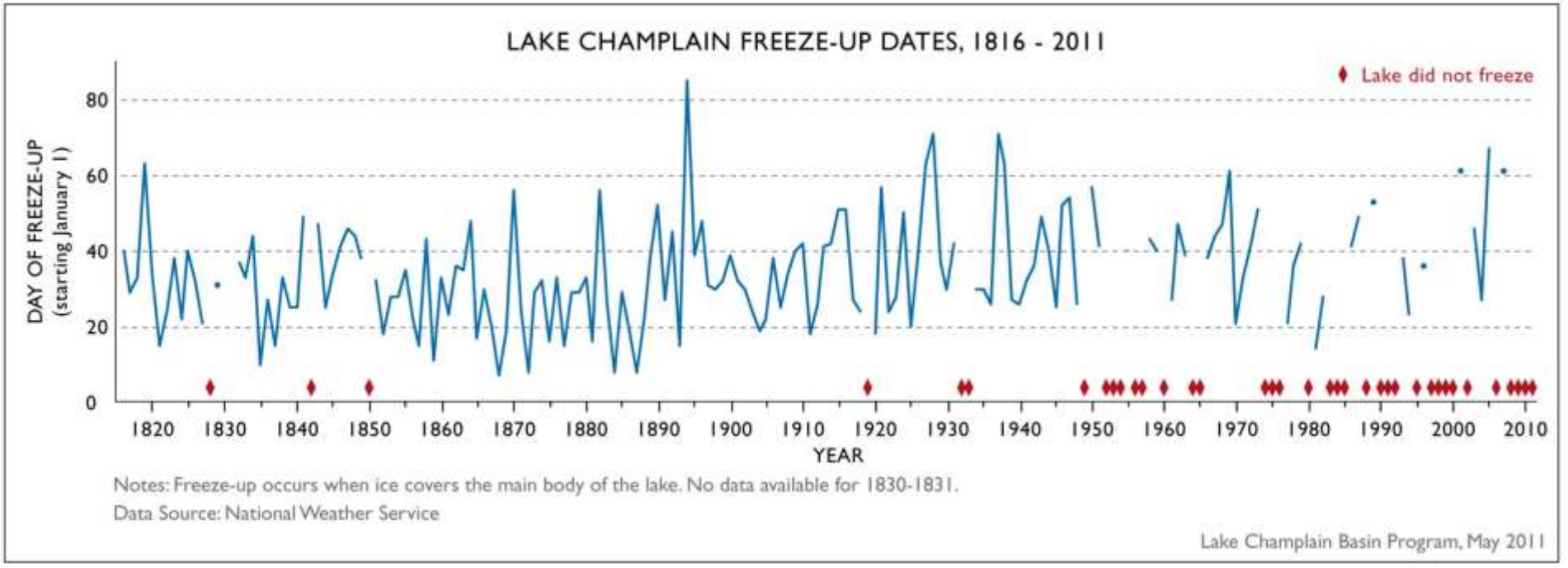


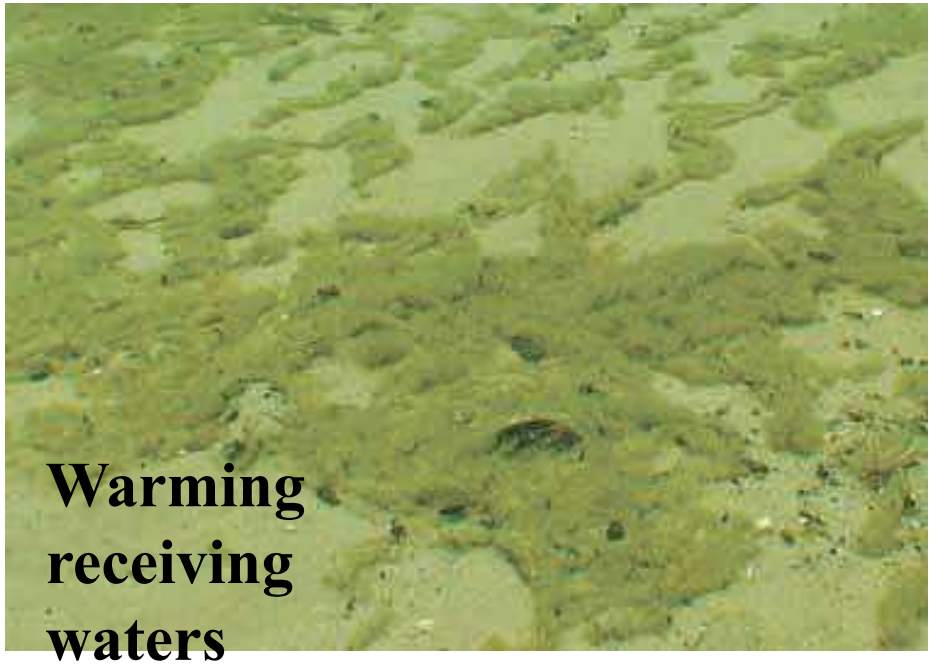
(Source: earthobservatory.nasa.gov))

Modeled Total P: Six Climate Scenarios



(Tetra Tech, 2013)





Warming receiving waters

[illegible]

Metric	Season	Base Avg	2040–69			2070–99		
			2.5%	50%	97.5%	2.5%	50%	97.5%
Freezing days (day)	Annual	117	83	85	87	69	72	74
	Nov–Dec	38	25	26	27	20	21	22
	Jan–Feb	53	43	45	46	38	39	41
	Mar–Apr	24	13	14	15	11	11	12
Snowfall (cm)	Annual	676	413	432	450	321	340	359
	Autumn	68	29	32	35	18	21	23
	Winter	477	305	328	351	242	263	285
	Spring	131	64	72	80	48	56	63
Above 32.2°C (day)	Annual	6	23	24	25	35	37	40
Heat index (°C day^{-1})	Annual	130	449	475	501	540	553	555
	Summer	118	389	416	442	597	642	687
Growing season (day)	Annual	141	166	169	171	181	184	186
Maple sap production (day)	Annual	60	52	53	54	48	49	50
	Autumn	19	12	12	13	9	9	10
	Winter	14	20	21	23	22	23	24
	Spring	27	18	19	20	15	16	17
Heating requirements (°C day^{-1})	Annual	5294	4216	4307	4398	3785	3885	3985
	Autumn	1153	897	916	935	778	800	823
	Winter	2527	2159	2197	2235	1992	2033	2074
	Spring	1395	1078	1106	1133	965	995	1024
Cooling requirements (°C day^{-1})	Annual	0	11	13	15	35	40	46
	Spring	0	0	0	0	1	1	1
	Summer	0	10	12	14	32	37	43
	Autumn	0	0	0	1	1	2	3
rPPET (ratio)	Summer	1.14	1.10	1.15	1.20	1.06	1.11	1.16

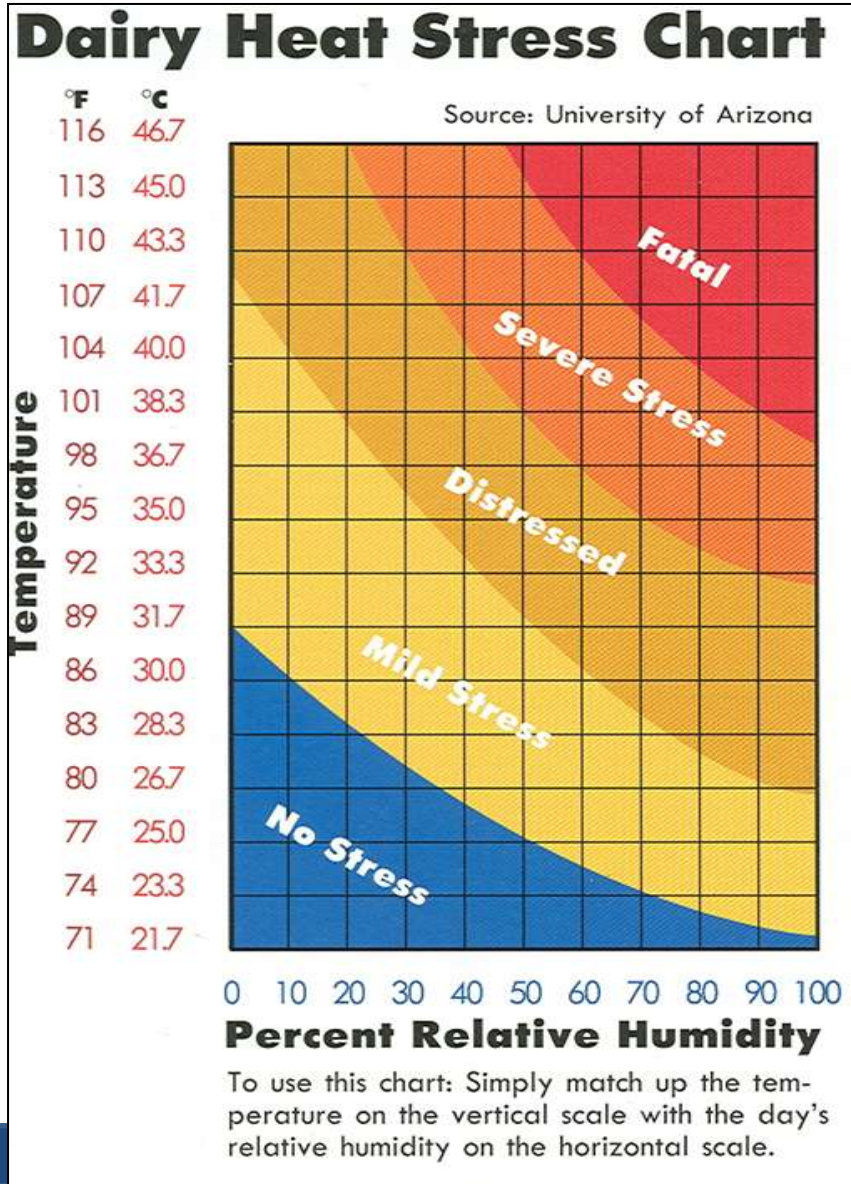
Guilbert et al., 2014: *Impacts of projected climate change over the Lake Champlain basin in VT*

How does climate change impact crops? (VT)

- Cool-season crops will be of lower yield or quality
  - Sweet corn
- Reduced grain yield (rapid maturation and moisture)
  - Field corn, nutrient content…
- Reduced vernalization lower some fruit yields; increased frost risk?
  - Apples
- New pests are able to over-winter, emerge early; increased pesticides
  - Flea beetle, SWD?
- Some warmer season crops will do better
  - Red wine grape, peaches, watermelon
- Water stress in crops…

How does climate change impact livestock?

- Warming Temperatures
  - Livestock
    - Heat stress in dairy cattle
  - Higher body temperatures
  - Increased respiration rates
  - Less activity
  - Increased water intake
- Performance
  - Dry matter intake down by 10-20%
  - Milk production down by 10-25%
  - Reproductive processes decrease



Adaptation from a Soil and Water Perspective

Outreach

Education

Research

Technical Assistance

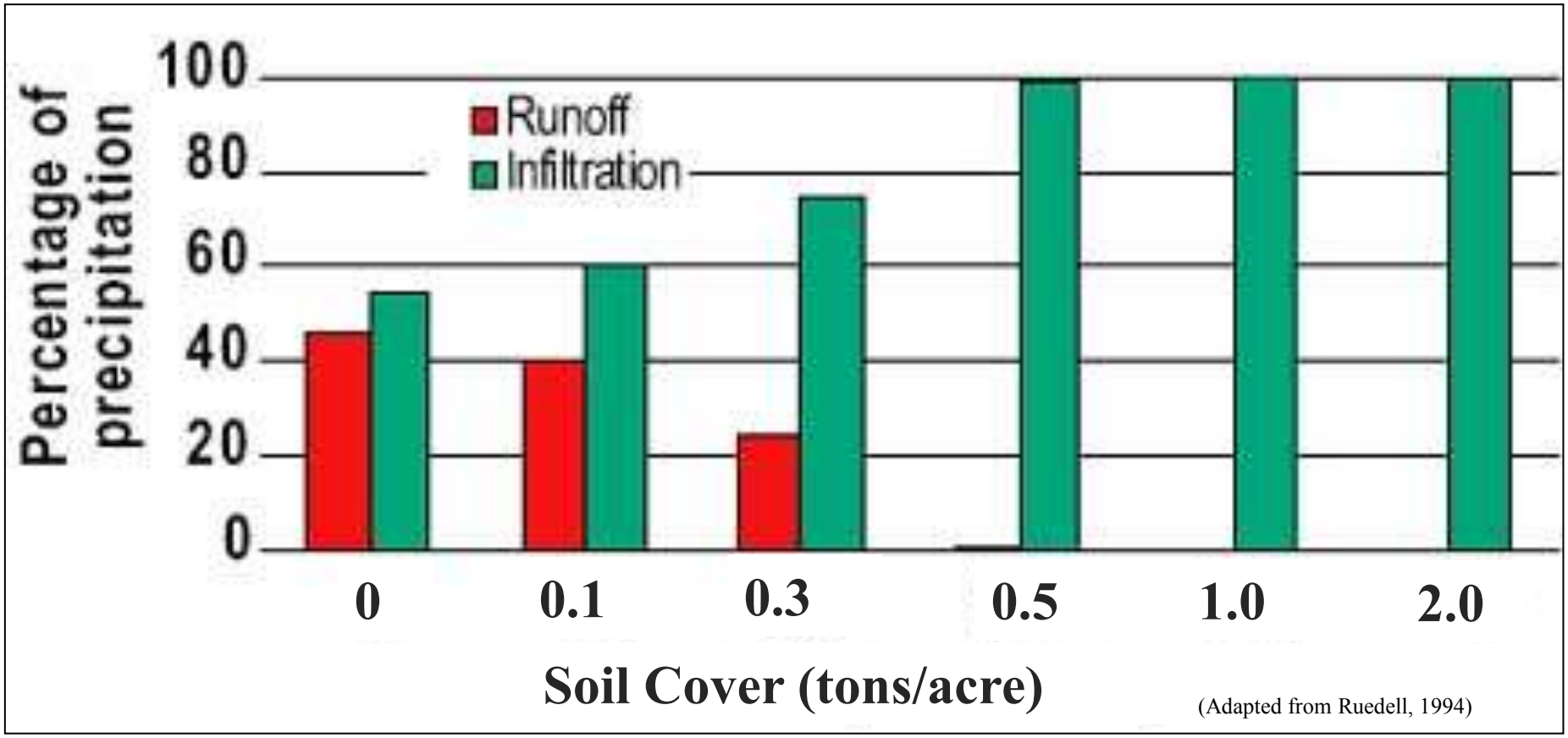
AP Photo: Toby Talbot

1. Management for Landscape Storage

Shift focus from treating runoff, to promoting infiltration

- **Reduces runoff volumes**
- **Reduces peak flow and flooding risk**
- **Helps prevent erosion and nutrient loss**
- **Allows for nutrient cycling to occur**
- **Reduces drought risk**

Soil Cover: Residue, mulch, or cover crops



- **Physically prevents raindrop impact**
- **Slows runoff down, allowing more time to infiltrate**

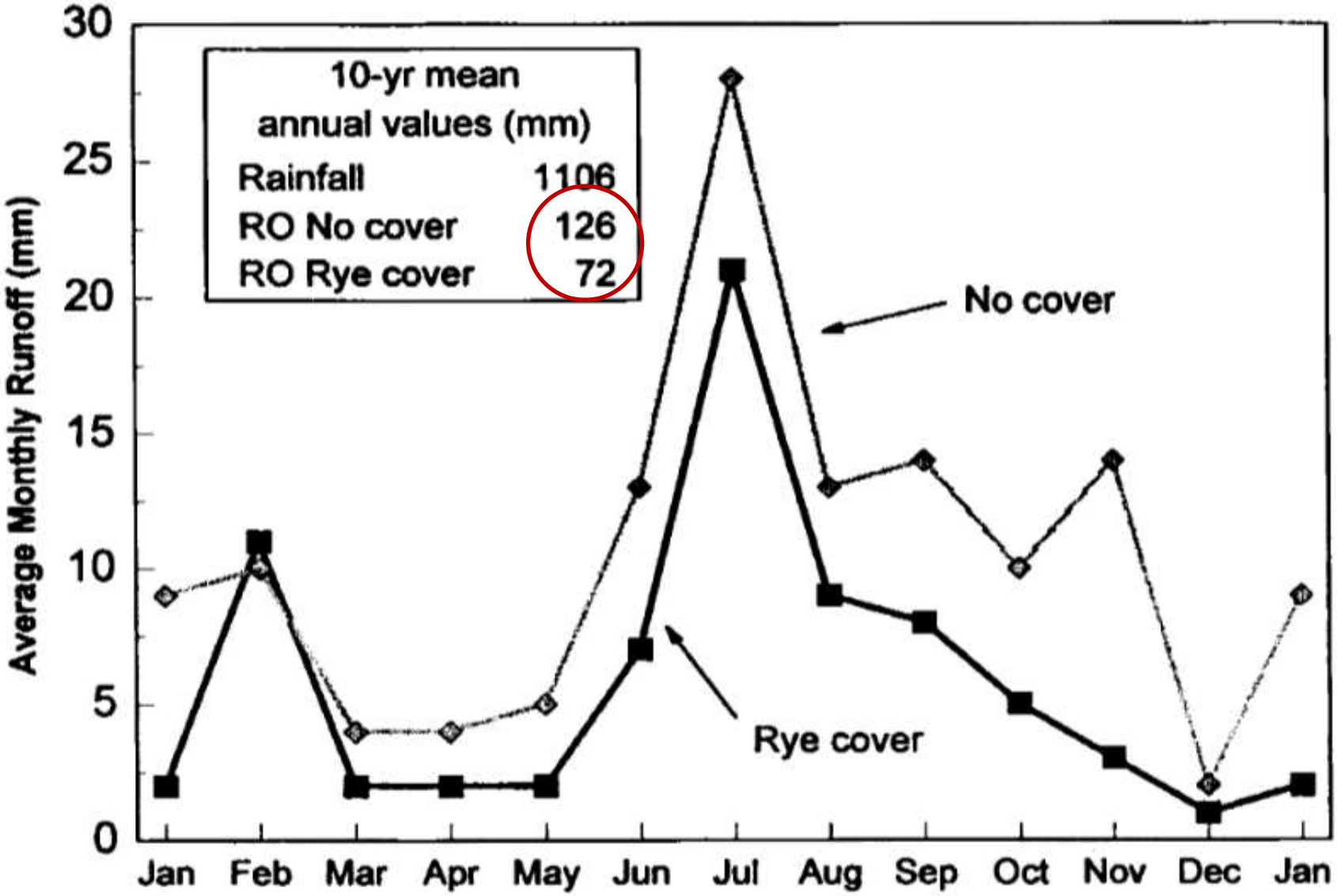


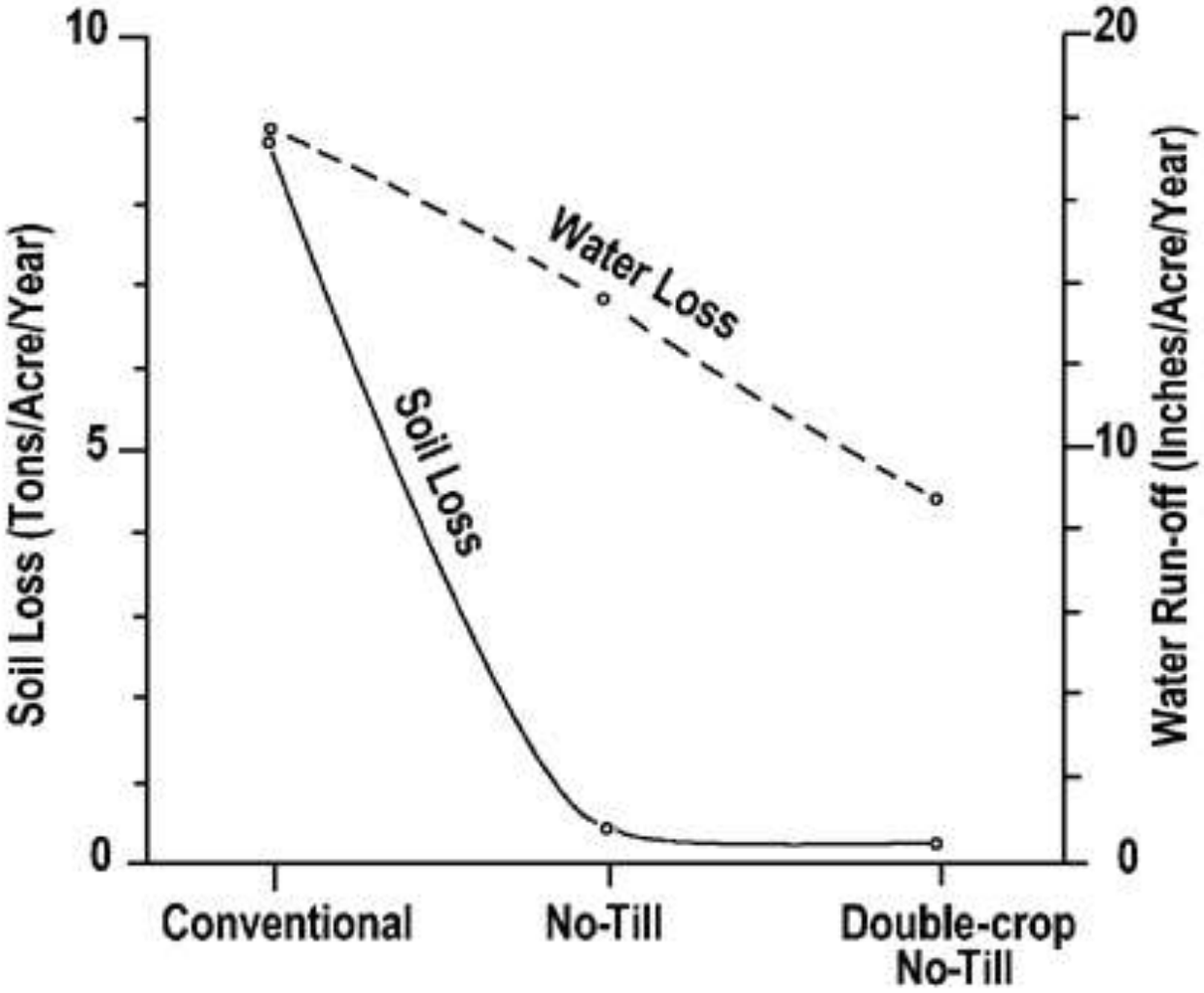
Figure 2. Averaged over 10 years and three vegetable cropping systems, a winter rye cover crop reduced runoff throughout the year on a Freehold loamy sand with 3% slope in New Jersey (Brill and Neal 1950)

(Dabney, 1998)

Reduced Tillage and Infiltration

- No-, zone-, strip-, ridge-till, etc.
- Less macro-fauna disturbance (i.e., earthworms)

(Dan Brainard, msue.anr.msu.edu)



(Source: Herbek, AGR-101; www2.ca.uky.edu)

Organic Matter and Infiltration

Cum. Infiltration (m^3/m^2)

0.12
0.10
0.08
0.06
0.04
0.02
0.00

0 30 60 90 120 150 180 210 240 270 300

Minutes

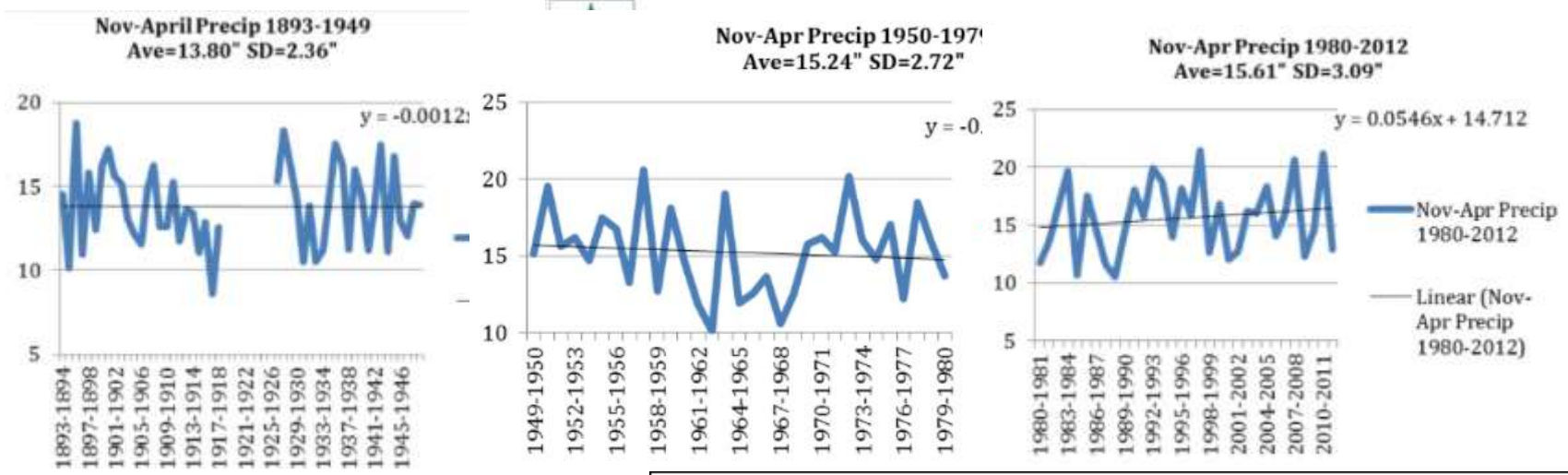
High O.M.

Low O.M.

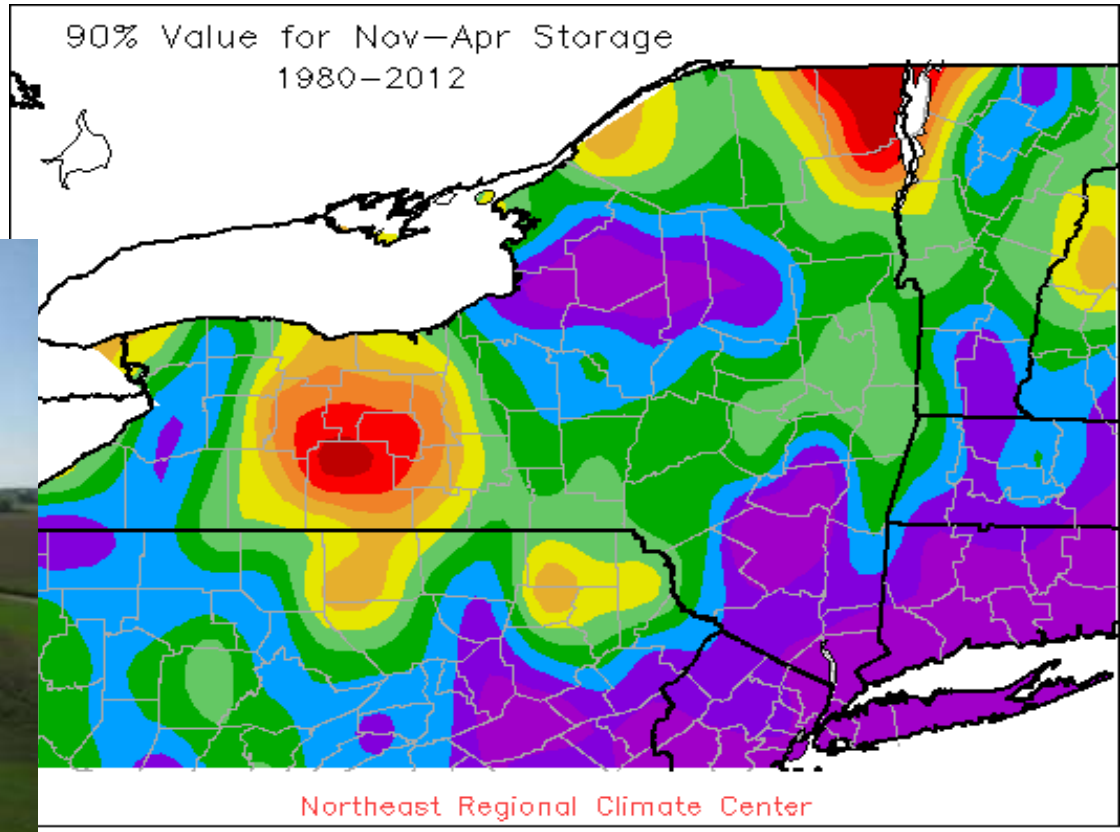
(Colla et al., 2000)

Structural Approaches to Landscape Storage

(Courtesy USDA-NRCS)



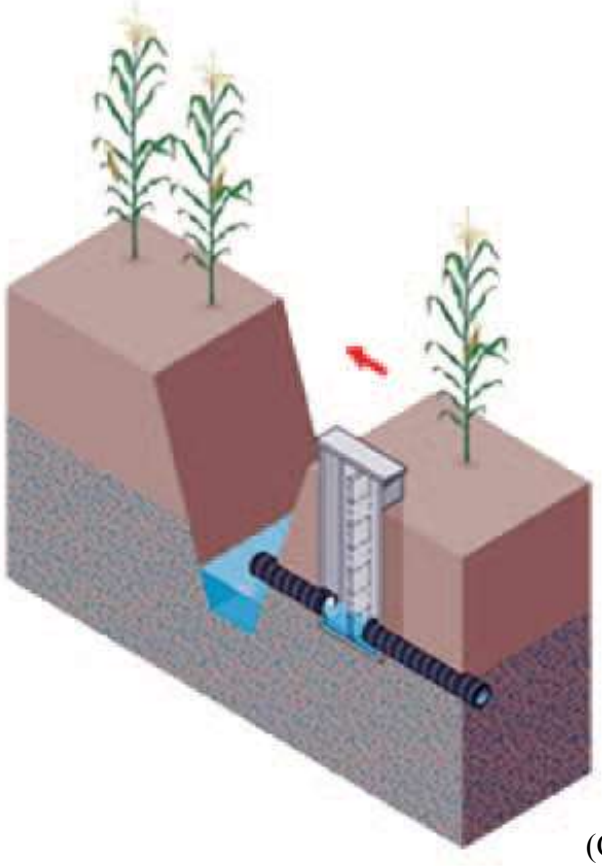
(Wright et al., 2013)

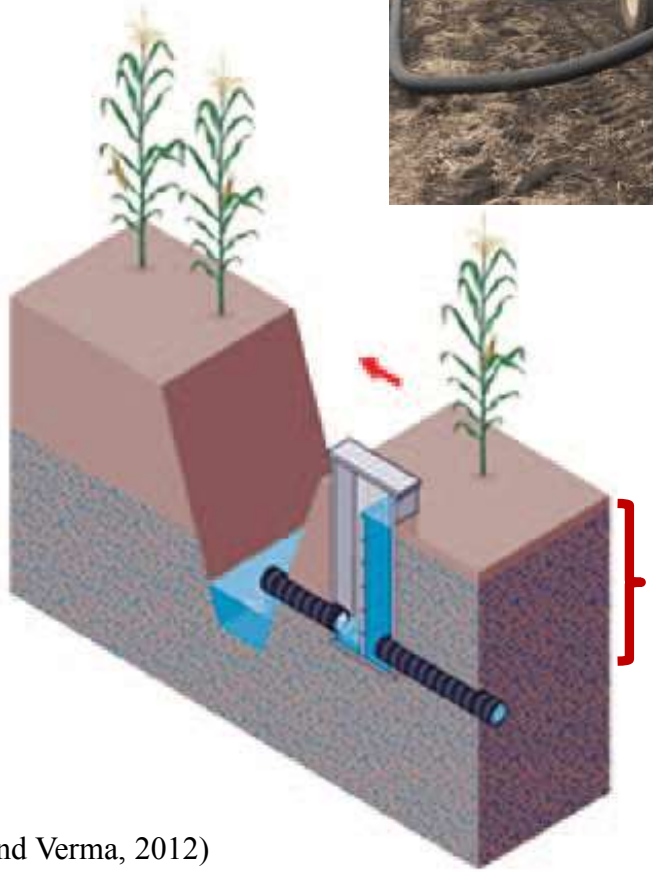


Woodchip Heavy Use Area

Controlled Drainage

Coordinated networks for flood regulation? Drought protection?



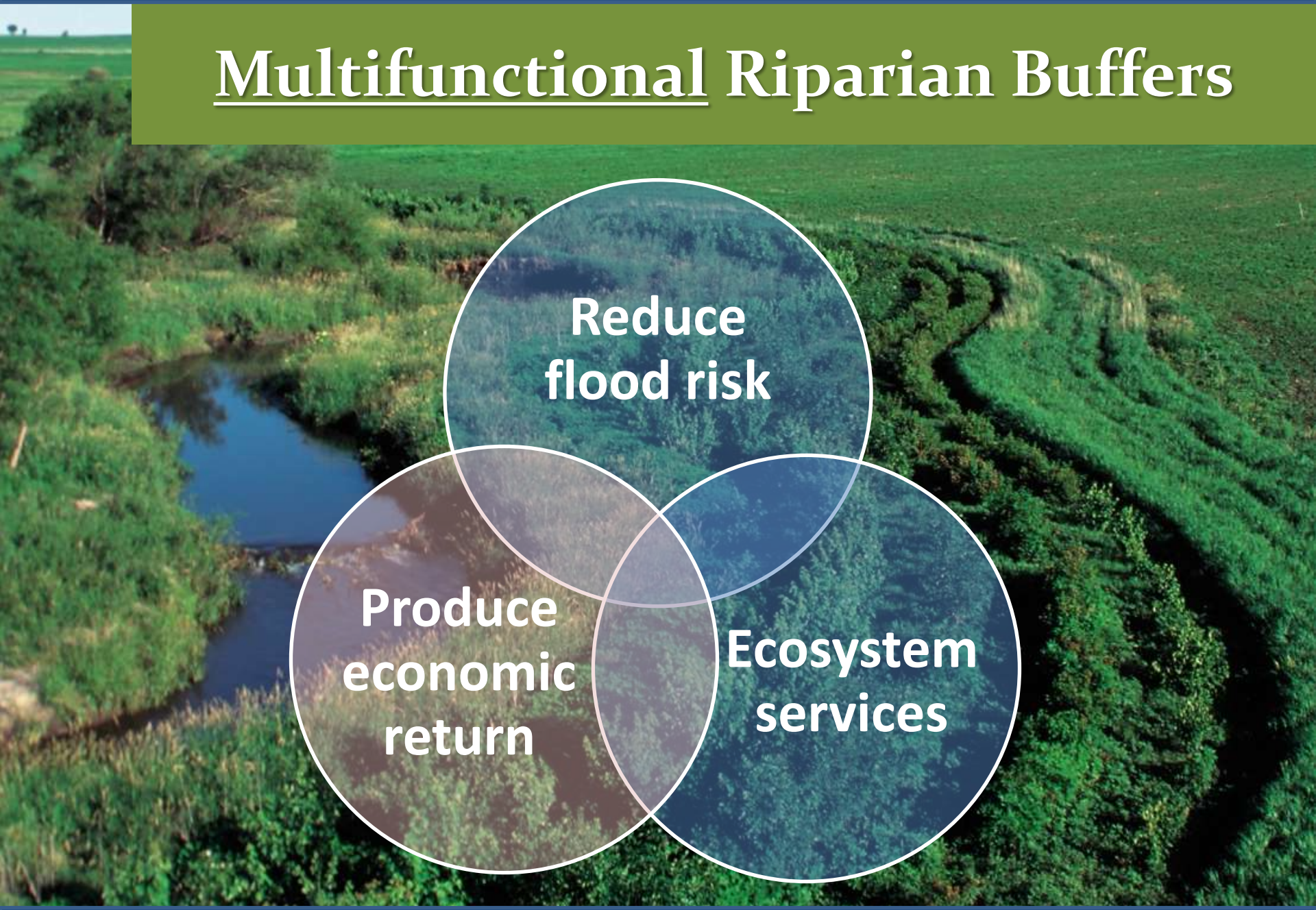


Adjustable Storage Capacity

(Cooke and Verma, 2012)

AP Photo: Toby Talbot

Multifunctional Riparian Buffers



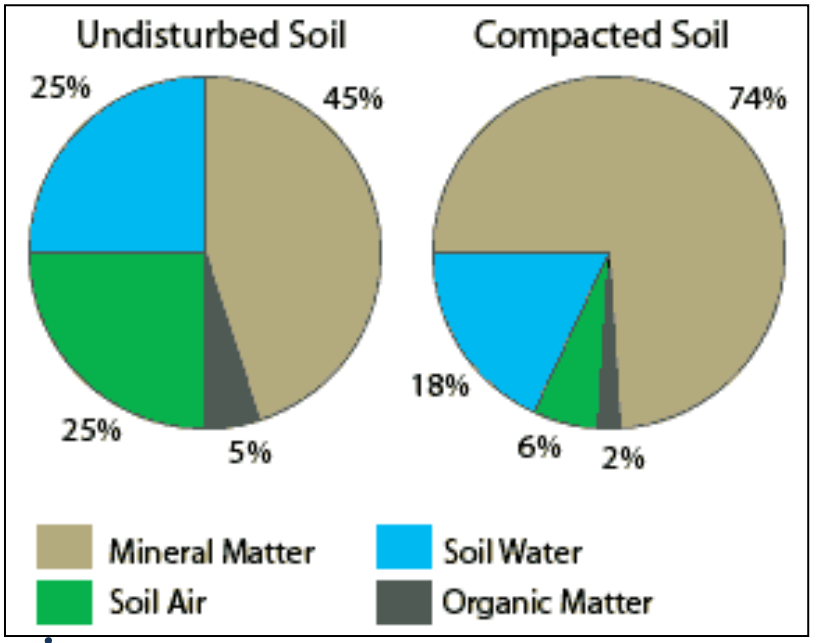
(Photo: NRCS)

3. Water Management for Production

(McDonald and Girvetz, 2013)

Drought Resilience

- Crops can't use water that doesn't infiltrate
- Organic matter
  - For every 1% increase in OM, another inch of water available (Emerson, 1995)
- **Avoiding compaction**
  - Deep moisture
  - Increased storage
  - Increased conductivity
- **Role for moisture sensors**
  - Drought and compaction prevention



(Courtesy USDA-NRCS)

Subsurface Drainage

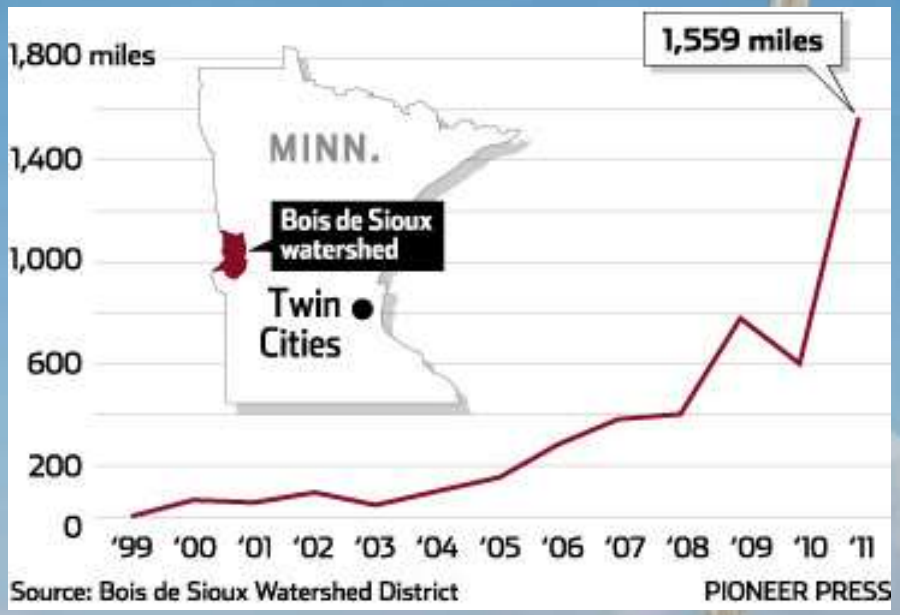


Photo: Dwight Burdette.

Anecdotally: "All the gullies I used to have, they're gone, now that I put in tile drainage"

4. Nutrient Management Strategies

Climate Stressor	Nutrient Management Vulnerability and Response
Increasing temperatures	• Increased volatilization of N, leading to increased need for incorporation • More rapid nitrification, leading to increased leaching and need to manage
Drought	• Reduced nutrient use efficiency, leading to residual P and N in soil in winter
Extreme rainfall events	• Increased runoff and nutrient/sediment transport • Manure storage structures potential overflow • Stressing of all BMPs linked to water cycle

Adapted from: Delaware Climate Change Impact Assessment: Ch. 7, Agriculture. 2014

Questions?

The University of Vermont EXTENSION

Joshua.faulkner@uvm.edu

Additional Resources:
http://www.uvm.edu/~susagctr/

Center for Sustainable Agriculture

Interviews, 2013-2014 (Rachel Schattman)

15 farmers,12 technical service providers

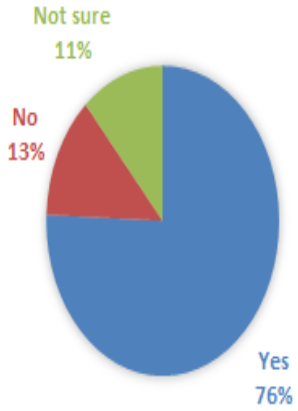
Three categories of BMPs:

1. Diversification
2. Water management
3. New cropping systems

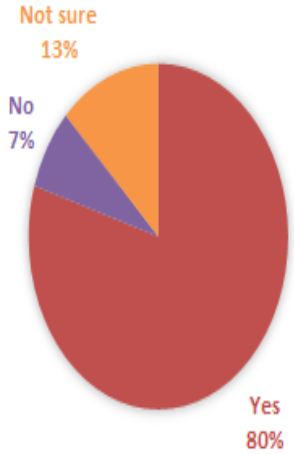
Do farmers adopt BMPs to mitigate climate change impacts?

Results: 2013 Farmer Survey

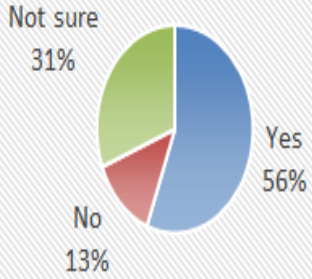
IN YOUR OPINION, ARE THERE MORE EXTREME WEATHER EVENTS NOW THAN 10 YEARS AGO?



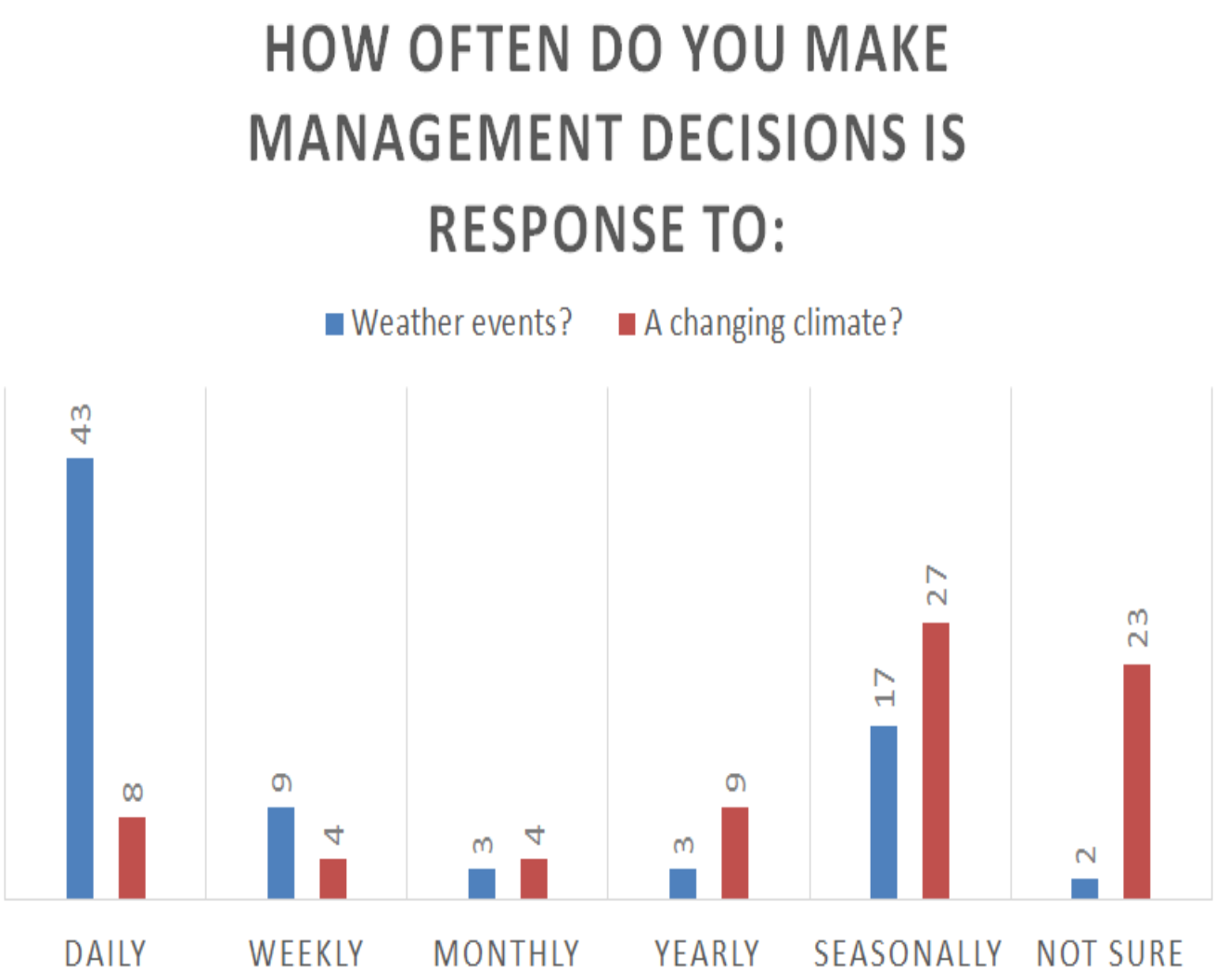
IN YOUR OPINION, IS THE CLIMATE CHANGING?



If you believe the climate is changing, do you believe this will affect your farm in a negative way?



Results: 2013 Farmer Survey

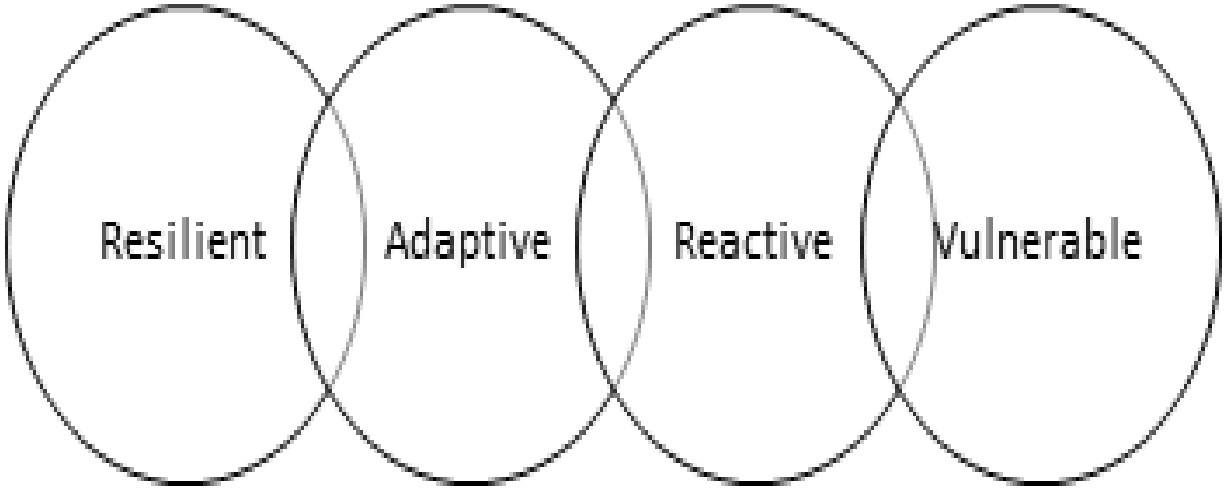


Towards a *Resilient Farmer Typology*

Grower types	Grower Characteristics
Resilient Farmer	Strategic, educated, nimble, long-term planner
Adaptive Farmer	Strategic, educated, nimble
Reactive Farmer	Incremental changes, short term planner, mid-term adopter
Vulnerable Farmer	Incremental changes, short term planner, late-adopter

Code	Definition
Educated	Either formal or informal. The farmer seeks out information specifically related to agriculture and climate change.
Nimble	Farmer is able to change course quickly, incorporate new information, flexibility in the farm system.
Strategic	Farmer has accurate foresights and ability to plan several steps out. Ability to evaluate potential risks and gains, and sees the steps needed.
Long-term planner	Farmer makes investments (including physical infrastructure, land, education, retirement, etc.) in the future of the farm business or their personal livelihood.

Towards a *Resilient Farmer Typology*



What factors influence farmer decisions to adapt to climate change?

Zia, A., S. Hurley, Y. Tsai, J. Miller, C. Koliba, C. Adair, D. Connor, L. Berlin, K. Westdijk, R. Schattman, & E. Mendez. (forthcoming 2015). *An Assessment of Prevalence and Social Psychological Determinants of Farmer Nutrient Management Practice Adoption Behaviors: Evidence from Lamoille and Missisquoi Watersheds in the Lake Champlain Basin.* Journal of Environmental Management.

2013 Farmer Survey

- Anonymous survey of commercial farms
  - >10K income; Mississquoi & Lamoille Watersheds
- All farms were invited, 80 farmers completed full questionnaire (7% response)



Who responded?

Farm Type	Our Sample	USDA 2007 Census for the Region
Conventional	72% (n=58)	86% (n=1100)
Organic	27% (n=22)	14% (n=178)
Small	23% (n=18)	28% (n=361)
Medium	74% (n=57)	69% (n=885)
Large	2% (n=2)	2% (n=32)

Results were weighted for analysis based on 2007 farmer census for these regions

Who responded?

- Majority (79%) of respondents were between the ages of 45 and 74.
- Majority (55%) had been farming for 20-40 years.
- Level of education varied, with the largest proportion (36%) having achieved a Bachelor's degree.




We asked about…

- Farmer level of adoption and intent to adopt
- Factors that influence farmer intent to adopt a particular BMP
  - Attitudes, norms, perceived ability to implement
- *Focus on NMPs versus CCBMPs*
  - NMPs are a subset of BMPs
  - NMPs allow farmers to offset the negative impacts of climate change in addition to other benefits

Farm Practices Being Investigated:

- Focus for Farm Sampling:
  1. Cover Crops
  2. No Till
  3. Stormwater runoff management
  4. Wetland conservation
  5. Rotational grazing

- Considered in this Survey:
  1. Planned Crop Rotations
  2. Strip Cropping
  3. Cover Cropping
  4. Reduced Tillage
  5. Conservation buffer strips
  6. Soil Test Every 3 Years
  7. N, P, & K application at rates recommended by soil tests
  8. Timely manure and fertilizer incorporation
  9. Applying fertilizer at recommended rates
  10. Applying manure at recommended rates and times
  11. Manure spreading setbacks

Selected Results

- Conservation easements significantly affect farmer behavior related to the adoption of nutrient management plans
- Farmer age and education level did not have a significant effect on adoption
- Net financial loss showed significant reduction in nutrient/manure application and planned crop rotations



Selected Results

- All NMPs- perceived behavioral control directly influences intent to adopt
  - PBC= better knowledge, skill set, and control of implementation
  - suggests technical assistance will make a difference!
- In 7 of 10 NMPs- past adoption predicts future intent to adopt
  - Planned crop rotations, Strip Cropping, Buffers, Cover Cropping, Reduced Tillage, Timely manure incorporation, Manure spreading setbacks



Key Takeaways

- Willingness to adopt a new practice is most likely if farmers feel skilled and in control to implement it
- Understanding and helping a farmer navigate these barriers is key to influencing implementation
- Does this align with your experience?



Participant Goal Setting: 2015

- Specific, measurable
- Examples:
  - "Talk with 5 farmers about riparian buffers and CC adaptation."
  - "Support 2 farmers to adopt buffers on their farms."



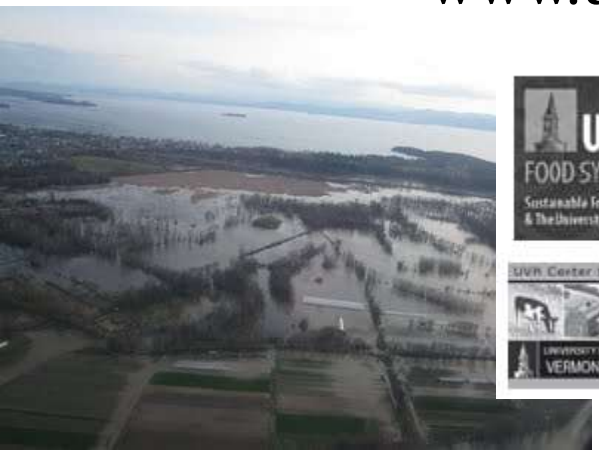
Agroecology & Rural Livelihoods Group (ARLG)
The University of Vermont

THANK YOU

for being a willing first cohort in this experiment!

www.vtfarmresilience.org

www.uvm.edu/sustainableagriculture/



UVM FOOD SYSTEMS
Sustainable Food Systems & The University of Vermont

USDA

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