

Best Management Practices for On-Farm Climate Change Resilience in the Northeast: Social, Ecological, and Economic Implications

Presenters: Rachel Schattman and David Conner, PhD
University of Vermont
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The University of Vermont



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Background

Climate change forecasts for the Northeastern United States:

- ↑ Increases in precipitation averages
- ↑ Frequency of extreme weather events
- ↑ Elevated levels of atmospheric CO₂
- ↑ Increases in humidity
- ▲ Changing plant and animal communities

These changes will undoubtedly impact farm viability and farmer livelihoods.

Vermont Agricultural Resilience in a Changing Climate Initiative (VAR)

- Identify BMPs
- Information to farmers about GHG mitigation
- Outreach and education
- Assess future needs
- Policy and governance tools



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.*



A collaboration among The UVM Agroecology and Rural Livelihoods Group (ARLG),
The UVM Center for Sustainable Agriculture, UVM Extension,
The Rubenstein School for Environment and Natural Resources, and
Community Development and Applied Economics.
Visit our website at vtfarmresilience.org



Overview

Current adaptation strategies

Research questions and approach

Qualitative analysis of on-farm adaptive approaches

Quantitative ranking of BMPs (farmer and technical service provider perspectives)

Next steps

The economics of adaptation

Factors influencing farmer adoption

Public and private benefits of CCBMPs

Public Goods as a Market Failure

Public subsidies and farmer costs

Willingness to Accept survey

On-farm measurement

Discussion

Current Adaptation Strategies

Background and relevant bodies of literature:

1. Farmer adaptation of practices
2. Farmer perceptions of climate change

Farmer adoption of practices

Why do farmers adopt new practices?

Education level, capital, income, farm size, access to information, positive environmental attitudes, environmental awareness, and utilization of social networks have positive associations with BMP adoption rates.

Prokopy, L.S., K. Floress, D. Klotthor-Weinkauff, and a. Baumgart-Getz. 2008. "Determinants of Agricultural Best Management Practice Adoption: Evidence from the Literature." *Journal of Soil and Water Conservation* 63 (5): 300–311. doi:10.2489/63.5.300.



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Access to and quality of information, financial capacity, and being connected to agencies or local farmer networks.

Baumgart-Getz, Adam, Linda Stalker Prokopy, and Kristin Floress. 2012. "Why Farmers Adopt Best Management Practice in the United States: A Meta-Analysis of the Adoption Literature." *Journal of Environmental Management* 96 (1). Elsevier Ltd: 17–25. doi:10.1016/j.jenvman.2011.10.006.



Farmer perceptions of climate change:

Scottish Dairy Farmers (Barnes & Toma, 2012)

Variable in belief of climate change.

Variable ability to adapt.

Indiana, US (Gramig, Barnard & Prokopy, 2013)

79% believe climate change is happening, 45% believe in anthropogenic causes, 31% are unsure.

Yolo County, CA, US (Niles, Lubell & Haden, 2013)

76% of farmers confident in their ability to adapt to climate change conditions, 8% unsure of their ability to adapt.

Farmer perceptions of climate change

What do farmers believe about climate change?

Varying degrees of belief in climate change and its causes.

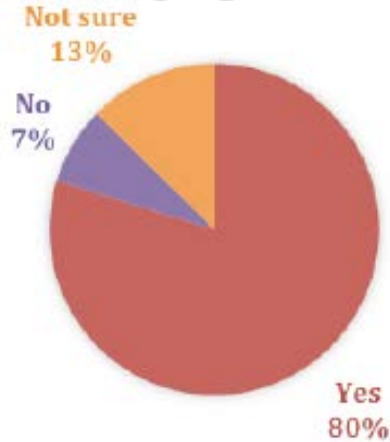
Potentially higher rates of farmers who believe in areas that have experienced greater impacts (Australia)

Policy environment may influence belief (Niles, 2013)

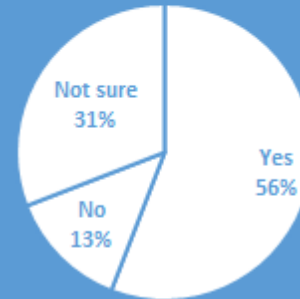
Prokopy, L.S., J.G. Arbuckle, A.P. Barnes, V. R Haden, A. Hogan, M.T. Niles, and J. Tyndall. 2015. "Farmers and Climate Change: A Cross-National Comparison of Beliefs and Risk Perceptions in High-Income Countries." *Environmental Management* 56. Springer US: 492–504. doi:10.1007/s00267-015-0504-2.

VAR survey of VT farmers, 2013

In your opinion, is the climate changing? n=78



IF YOU BELIEVE THE CLIMATE IS CHANGING, DO YOU BELIEVE THIS WILL AFFECT YOUR FARM IN A NEGATIVE WAY?



n=81

Methods

RESEARCH QUESTIONS:

How are farmers adapting to climate change?

What do farmers know/believe about climate change?

Does farmer beliefs about climate change influence their ability to adapt?



Photo by Hannah Aitken

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Methods

- **Semi structured interviews in 2013-2014.**
- **Recorded and transcribed**
- **Analyzed using Hyperresearch, double-coder approach**
- **Grounded theory used to explore emergent themes and information**
- **Sustainable Livelihoods theory used to evaluate BMPs from farmer perspective.**

Farm Type	N
Dairy	5
Vegetable	4
Meat	1
Highly diversified	6
Total	N = 15

How are farmers adapting to climate change?

- 1. Diversification**
- 2. Improvement of Soil Health**
- 3. Newly Adopted Production Systems**

Diversification

Markets	<p>“We do several different kinds of marketing. We do some whole-sale, um CSAs certainly help with risk management a lot. If you have a crop failure or anything like that, you can still make up the value of the share with other crops and not lose that market because you didn't have a specific crop or maybe a specific time of year you didn't have enough because of weather disasters of whatever.” (Diversified farm produced vegetables, meats and eggs.)</p>
Products	<p>“It is not all just vegetables, I guess that is another way we have diversified too. We have year round income because of egg collection and hoop houses. We sell vegetables and shares year round so if I lose everything in the main growing season it would be hard but it is not the end.” (Diversified Producer.)</p>
	<p>“Also when it comes to managing risks faced by pests/diseases. If one crop gets hammered, you are not so specialized that you can't make up the income with another crop.” (Diversified veggie farm that grows 30+ crops.)</p>

Diversification

Household income

“I build high tensile electric fence on other farms. A lot of times through local state, federal or watershed groups. Trying to exclude cows from rivers, stuff like that. And [anonymous] does a little off farm work as a photographer working with advocacy groups for people with disabilities. She works for a non-profit foundation. I would say that’s 25% of our total income.” (Dairy and meat producer.)

“(Anonymous) worked for 22 years. That paid the mortgage and let us invest in a lot of things for the farm. I think we put \$100,000 just into our barns to keep them up. You have to have an off-farm job to keep that up if you are an organic farmer. (Dairy producer.)

Land-base

“I guess if that was the only piece of land that you had and you were at risk of flooding every year I would probably think differently. Because we have a couple pieces, I know that if I lose the crops on that piece one year, I am still going to have other income because we have livestock too.” (Diversified producer.)



Improvement of Soil Health

1. Nutrient management
2. Irrigation
3. Organic matter (OM) management
4. Erosion control

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Newly Adopted Production Systems

Plastic mulch



Photo by Rachel Schattman

Newly Adopted Production Systems

Hoop houses (high tunnels)



Photo by Hannah Aitken

Newly Adopted Production Systems

Robotic milking



Photo from dewikipedia.org - labeled for non-commercial reproduction

Newly Adopted Production Systems

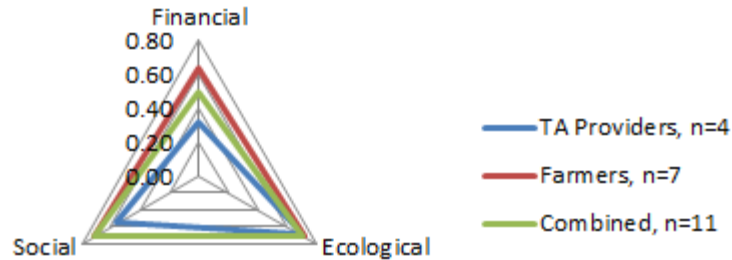
New (or different) crops

- short(er) season
- low pre-harvest investment
- intensive rotations
- flood-resistance habit

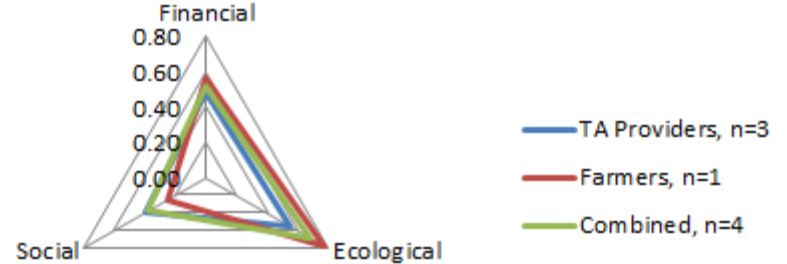


Photo by Rachel Schattman

Cover Crops

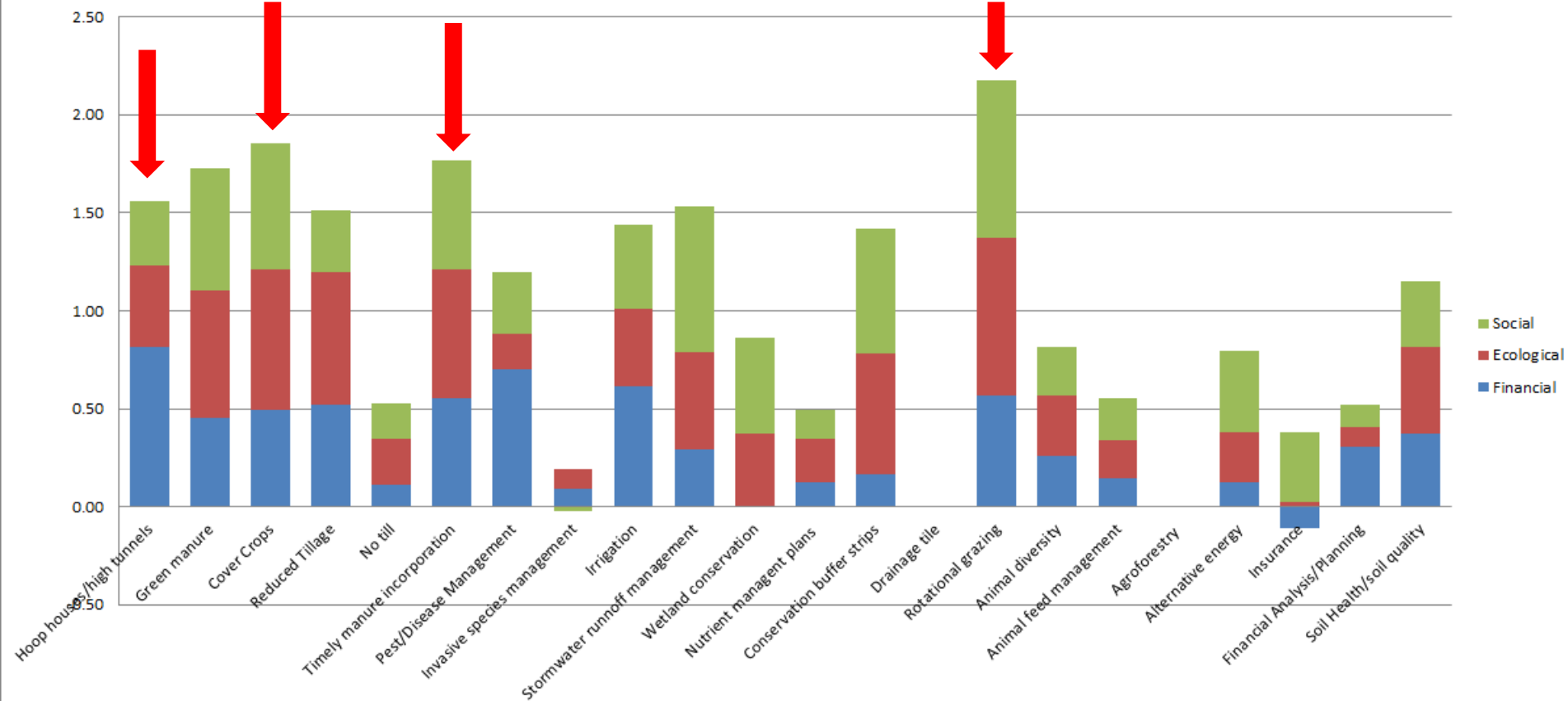


Reduced Tillage



4 BMPs rise above as CCBMPs: Rotational grazing, cover crops, hoop houses/high tunnels, and timely manure incorporation.

Farmer and Technical Service Provider Perceptions of BMPs (n=27)



BMP	Financial Attributes			Ecological Attributes			Social Attributes		
	Variance/ DF	T test result	P- value	Variance/ DF	T test result	P- value	Variance/ DF	T test result	P- value
Hoop houses	equal/12	0.11	0.92	equal/12	-1.99	0.07	equal/10	0.55	0.59
Green manure	equal/3	0.47	0.67	equal/3	-1.78	0.17	inequal/2	-1.00	0.42
Cover crops	equal/9	1.78	0.11	equal/9	0.10	0.93	equal/9	1.14	0.28
Storm water run-off management	equal/3	-1.68	0.19	inequal/2	-0.96	0.44	equal/3	0.44	0.69
Rotational grazing	equal/10	0.27	0.79	inequal/10	-1.72	0.11	inequal/5	-1.15	0.3
* Must have more than 1 response in both farmer and TSP categories									

Next steps

Now we know what farmers are doing, can we help them decrease the risks they face because of climate change?

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Goal: Design and deliver better outreach and education for farmers

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Goal: Design and deliver better outreach and education for farmers

1. Resilient farmer typology (Schattman, Mendez)
2. Farmer networks and peer learning (Niles, Schattman)
3. Climate change technical assistance training integration (Faulkner, Schattman)
4. Beginning farmers (Niles, Hurley, Faulkner, Mendez, Schattman)
5. Extreme weather and outreach timing (Faulkner, Schattman)
6. Farmer perceptions of climate risk (Schattman, Conner)

Q&A Break

The Economics of Adaptation

Overview

Factors influencing farmer adoption

Public and private benefits of CCBMPs

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Willingness to Accept survey

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Discussion

Farmer adoption

Embedded in farmers' social, biophysical, institutional, and economic environments

Likely CCBMP adopters: educated, environmentally aware, knowledgeable of impacts, networked with peers, larger scale

Perceive clear benefit from health of land

Farmer adoption

Attributes of CCBMPS likely to be adopted

Low in complexity

Compatible with existing farming systems

Triable

Observable

Economic motivations

Benefits must outweigh both direct and opportunity costs

Timely benefits

Opportunity cost of time, land, lag

Low risk

Saleable co-product

Opportunity for joint adoption for risk mitigation: collective action and knowledge/resource sharing

Benefits of CCBMPs

Private and Public

Soil fertility and conservation

Water management

Pest management

N,P,C and water cycles

Many others...

Public Goods

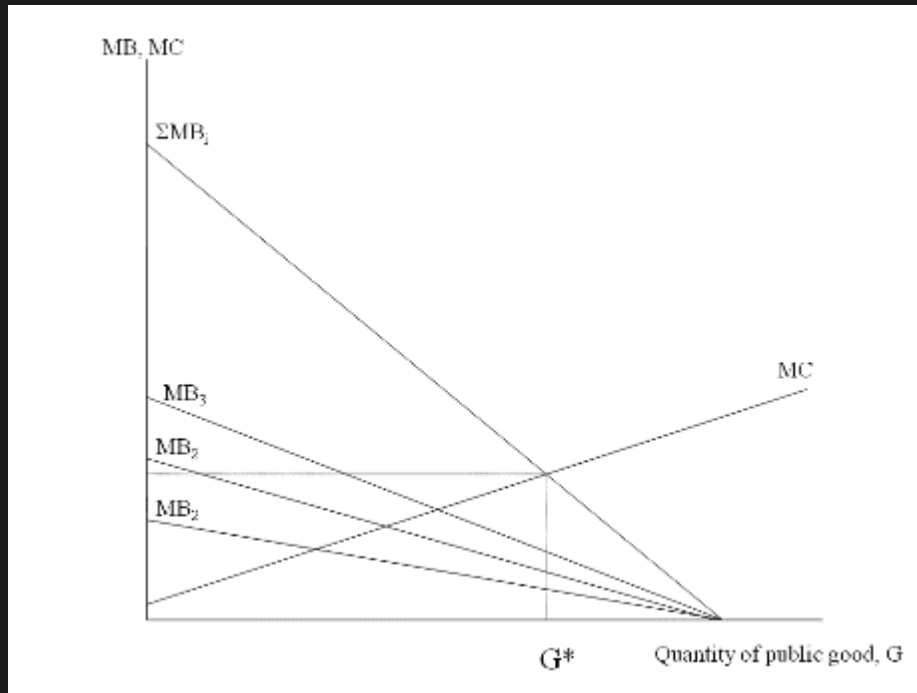
Non-excludable and Non-rival

As avoided external costs

Insufficient incentive to provide to socially optimum level due to free rider problem

Need to address farmer profitability and risk

Market Failure



Public Subsidies

High enough to cover costs and risks

Low enough to be cost effective

How to measure?

Farmer willingness to accept

Costs of implementation

Measurement Strategies

Methods

Results

Discussion

Methods

Method 1

Farmer survey N=140

Conjoint Analysis questions: Rank preferences on packages of payments for cover crops, low till and buffer strips

Method 2

On-farm data collection: three CCBMPs (cover crop, rotational grazing and buffers) on 12 farms

Results: Conjoint analysis-WTA

Option	Practices	\$/A - Offered	\$/A – WTA
1	Tillage	30	85.99
2	Cover cropping*	90	125.16
3	Buffers	105	168.33
4	Tillage & Cover cropping*	120	211.15
5	Tillage & Buffers*	170	254.32
6	Cover cropping & Buffers	175	293.49
7	Cover cropping, Tillage, & Buffers	205	349.48

Results: On Farm Measurement

Average annual costs

Cover crops: \$129/acre

MIRG: \$80/acre

Buffers: \$807/acre

Discussion: Comparisons

Practice	WTA (\$ per acre)	WTP (\$ per acre)	Average Cost (\$ per acre)	WTP - Cost (\$ per acre)
Cover Crop	125.16	79.45*	129.24	-49.79
MIRG	N/A	23.91**	79.82	-55.91
Buffer Strip	168.33	763.68***	807.33	-43.65

Discussion: Options

Higher payments

Better articulation of benefits and risks

Co-product development

Collective action

Questions?

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