Professor Molly Anderson
ENVS 0401 B
Spring 2016 Project Statements

Food Systems and Sustainability

Our home state of Vermont is the sixth smallest and one of the most rural states in the country. Its population in 2015 was estimated by the US Population Census to be 626,042. Only Wyoming has a smaller population; and Montpelier, the state capital, is the least populous state capital in the US. Vermont is also one of the most racially homogeneous states, although this is slowly changing: between 1980 and 2010, the percentage of people of color went from 1.5% to 5.7% (National Equity Atlas 2016).

Vermont is a state with wide and growing income disparities, like the United States as a whole. Since 1979, income for full-time workers at the 10th percentile changed 4.5 percent while income for those at the 90th percentile changed 18.3 percent. About 3,000 more people (a total of 74,058) were living below the poverty level in 2013, compared to 71,084 in 2012 (Rathke 2014). People living below the poverty threshold make up 12.5 percent of Vermont's rural population (ERS 2016). Household food insecurity in the state was 12.6% in 2014, with 6% experiencing hunger through the year. About one in five children in the state lives in a food-insecure household, and people living in rural areas and in families headed by a single parent tend to experience higher rates of food insecurity than others (Coleman-Jensen et al. 2015).

It may seem ironic, given Vermont's level of food insecurity, that agriculture is such an important state industry. The 2012 Census of Agriculture listed 7,338 Vermont farms, and 22.4% of the farmers are women; Vermont is one of very few states in which the number of farms increased since 2002. The average farm size is 171 acres, and the average age of a farmer is 57.3. Slightly over half of the farmers list farming as their full-time occupation. While Vermont is the leading producer of maple syrup in the United States, dairy brings in more money:

	Farm receipts $1,000	**Farm receipts % of State**	**Farm receipts % of U.S.**
1. Dairy products, Milk	676,005	68.1	1.4
2. Miscellaneous crops	106,344	10.7	0.6
3. Cattle and calves	83,540	8.4	0.1
4. Maple products	44,550	4.5	38.1
5. Turkeys	33,683	3.4	0.6
All commodities	992,220		0.2

In the second half of the 1900s, Vermont responded to development pressure with a series of laws and pioneering initiatives to prevent the loss of Vermont's dairy industry. However, the number of Vermont dairy farms has declined more than 85 percent from the 11,206 dairy farms operating in 1947. In 2003 there were fewer than 1,500 dairy farms in the state; in 2006 there were 1,138; and in 2015 only 868. Most (82%) of these farms have less than 200 cows, quite small by national standards. Yet Vermont continues to produce 63% of all the milk in New England, and between 6,000 and 7,000 jobs are tied to the dairy industry in Vermont (Vermont Dairy Promotion Council, 2015).

Vermont is a leader in the percentage of value-added produce and the percentage of agricultural sales that go directly to consumers, through farmstands, farmers' markets or Community Supported Agriculture (USDA-

NASS 2015). Support for agriculture is high among Vermont's citizens; and the natural beauty of Vermont's farmland and food products and businesses attract tourists. An important and growing part of the state's economy is the manufacture and sale of artisan foods and fancy foods trading in part upon the Vermont "brand". Examples of these specialty products and businesses include Cabot Cheese, Vermont Butter and Cheese Company, several micro-breweries, a growing wine industry, ginseng, Lake Champlain Chocolates, King Arthur Flour, Keurig Green Mountain Coffee and Ben & Jerry's ice cream. Vermont leads the nation for value of organic sales as a percentage of farm sales. In addition, food processing is the second largest manufacturing industry in Vermont; food production, processing, and distribution are responsible for over 56,000 jobs in Vermont, about 13 percent of all jobs (State of Vermont 2016).

In our projects this semester, we will be exploring aspects of the sustainability of Vermont agriculture, especially ways to reduce reliance on fossil fuels, to increase water quality in surface waters and Lake Champlain, and to reduce the amount of food waste that is not recovered. These projects are linked through Vermont Farm to Plate, a comprehensive strategic plan for Vermont's food system that is coordinated through Vermont Sustainable Jobs Fund. They are also linked because they are driven by similar processes of citizen action informed by scientific reports, which led to recent state legislature to protect natural resources, which is leading now to implementation plans with profound impacts on farming and food businesses. We think that all of the projects will help you draw connections between food systems and sustainability, and help to show you the interactions between environmental practices and policy.

REFERENCES

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Project #1: Water Quality in the McKenzie Brook Watershed

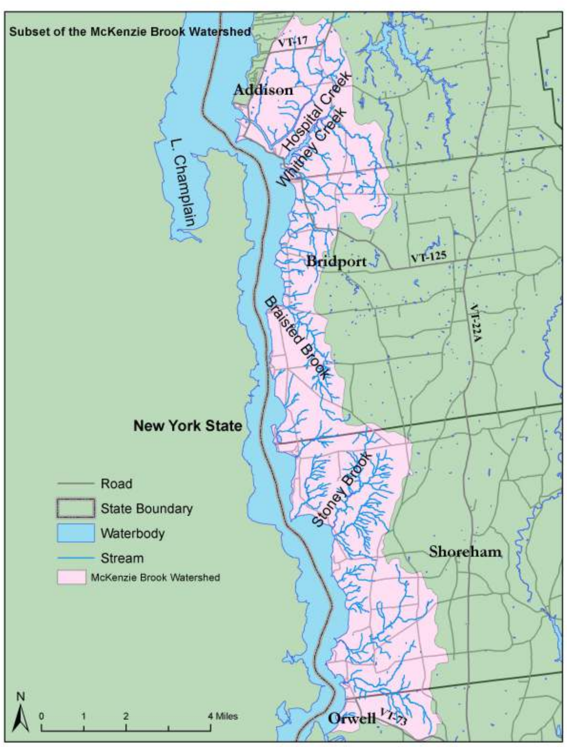
Project Partners:

- Marli Rupe, Vermont Clean Water Initiative Program, & Ethan Swift, Watershed Coordinator, both with the Vermont Department of Environmental Conservation, Watershed Management Division
- Jeff Carter, University of Vermont Extension Assistant Professor, Agronomy Specialist and Field Crops & Nutrient Management Specialist

The Vermont Clean Water Act (Act 64) that was signed into law by Governor Shumlin on June 16, 2015 with the goal of reducing sediment and nutrient (phosphorus and nitrogen) pollution flowing to Lake Champlain in order to come into compliance with the EPA's phosphorus TMDL (total maximum daily load) and meet the goals of the Lake Champlain Restoration Plan. Efforts will be focused on six primary sectors including agricultural runoff, stormwater runoff from developed lands and roads, river corridors and floodplains, wetlands management, and forest lands management (Clean Water Vermont Initiative; Restoring Lake Champlain). Actions in the restoration plan specific to agricultural lands include:

- Require a minimum of 25 -foot buffers along streams and 10-foot buffers along field and road ditches;
- Prevent gullies from forming and eroding valuable agricultural land;
- Require farmers to develop plans and implement actions to keep manure, fertilizer and top soil from running into waterways;
- Build fences to keep livestock out of streams and rivers;
- Train and certify businesses that apply manure to fields to minimize runoff in nearby waterways;
- Increase support and funding to help farmers undertake water quality improvements on farms;
- Target support and funding to farms in the northern and southern segments of Lake Champlain Basin, where phosphorus pollution from agricultural sources are particularly significant;
- Increase farm inspections to ensure compliance with state agricultural water quality rules;
- Evaluate and employ technical and educational options for tile drain management

(Lake Champlain TMDL Agricultural Lands Management Fact Sheet)



A coalition of partners from University of Vermont-Extension, the Natural Resources Conservation Service, the Vermont Agency of Agriculture and the Vermont Department of Environmental Conservation, seeded with funding from the USDA-NRCS's Regional Conservation Partnership Program, are working together and with farmers to bring agricultural lands into compliance with Vermont's new Clean Water Act. The early phases of this coalitions' work have been focused on improved agricultural management practices for priority watersheds, i.e. those that are known to have higher levels of nutrient runoff. One of these priority watersheds is the McKenzie Brook Watershed in western Addison County. This watershed includes Hospital Creek, Whitney Creek, Braisted Brook, and Stoney Creek and spans the western edge of the towns of Addison, Bridport, Shoreham, and Orwell (May 7, 2015 "Flow" blog post). One practice of particular interest for this watershed are tile drains, which are a network of pipes attached to drain systems that farmers use to lower the water table for their fields, thereby improving crop production on fields that would otherwise be too wet (Agricultural Tile Drains).

The summary of work for this project will focus on two main areas:

1. Water sampling, water sampling result analysis, and outreach materials related to water quality concerns in the McKenzie watershed
2. Outreach to farmers who have or are installing tile drains, conducting end of pipe sampling where allowed, and interviewing farmers about their management practices related to tiles in order to identify correlations between these practices and water quality.

There has been a lot of discussion about potential regulations of tile draining in the near future, and the farming community is concerned, and in some areas, reacting by not allowing any tile sampling. That said, our partners see a real need to evaluate tile-related management practices, and will assist with identifying farms in Addison County that are solution-oriented. Another potential resource could be the Champlain Valley Farmer Coalition, a group of farmers committed to "thriving agriculture and a clean Lake Champlain." Please note that tile drain sampling will only be possible on farms where explicit permission has been given and our partners will also dictate an appropriate protocol for this sampling based on their conversations with the farmers surrounding confidentiality or any other concern. For all sampling (general water quality or tile drains in particular), we will discuss a respectful approach for accessing sampling locations.

This work will consist of a research phase and a sampling phase to accommodate the seasonality of water sampling.

Feb–March:

- Gather prior water quality results from this area and analyze data, summarize, map etc.
- Develop outreach materials – e.g. posters that summarize areas of concern for presentations, a short handout
- Develop a survey instrument and talk to a select number of farmers about tile drains, how installed, their management, attitudes, etc.
- Research information related to correlation between tile drain management and related practices, and water quality impacts

April–May:

- Conduct sampling at pre-determined sites in watershed based on a strategy designed with our partners (e.g. weekly sampling, pre-/post-rain events, etc.)
- Take samples from tile drains *as/if allowed – complete farmer agreement must be given*
- Evaluate samples (general water quality or tile samples) with flow data and/or correlated to rainfall events

Final report

- Summary of all water quality data and recommendations based on results
- Copies of outreach materials
- Summary of tile drain results and farmer interviews

Starting references:

Clean Water Vermont Initiative web site
What Does the Vermont Clean Water Initiative Mean?
Restoring Lake Champlain web site
2015 State of the Lake Report from the Lake Champlain Basin Program
South Lake Champlain Tactical Basin Plan

Project #2 – Greenhouse / Season Extension: Cost-Benefit Analyses and Model Practices

Project Partners:

- JJ Vandette, Vermont Farm to Plate Energy Crosscutting Team Chair and Strategic Planning Manager for Efficiency Vermont
- Other members of the Energy Crosscutting Team

"The use of greenhouses, and greenhouse heating, are on the increase in Vermont as growers respond to increased demand for local food throughout the year. Greenhouse production is also on the rise because it allows growers to protect against extreme weather events such as heavy rain or drought, and it affords better control of the growing environment, leading to improved yield and quality. However, using fossil fuels to control the growing environment is costly and these fuels also contribute to greenhouse gas emissions. Vermont greenhouse growers produce $24.5 million in crops using 2.6 million square feet of growing area at an estimated annual heating cost of $1.8 million. Many of these growers are interested in alternatives to fossil fuels for heating in order to improve their profitability and/or reduce their environmental impact" (http://blog.uvm.edu/cwcallah/).

Greenhouse efficiency is one of a variety of topics of interest to the Energy Crosscutting Team. This project will aim to research a range of non-fossil fuel based models for heating greenhouses and other techniques for season extension. These could include—but are not limited to—biomass fuels, ground source and air source heat pumps, animals, and compost.

For each model:

- Provide a cost-benefit analysis that considers upfront cost (inclusive of technology itself and infrastructure modifications), anticipated payback rate (include consideration of a change in fossil fuel costs under Vermont's proposed carbon pollution tax in your payback calculations), some metric of efficiency tied to the scale of a farm's operation, and ease of use.[1]
    - Compost is of particular interest to our partners as they note that it is always pointed to as a great "free" resource, but are under the impression that it is only feasible for limited applications.
- Synthesize current disparate research. For example after reviewing Chris Callahan's and UNH's work (see starting references), for what applications might heat pumps be more/less feasible than biomass (or compost or traditional fossil fuels)?
- Identify what kind of financial incentives/support programs might be needed to help more farms transition to low-carbon technologies.

Another goal of the Energy Team is to capture and document energy success stories. These success stories are critical for peer-to-peer mentoring in the adoption of new technologies! In the course of your research keep an eye out for existing renewable or efficiency innovations for greenhouses and season extension that farms have already incorporated into their operations. Two of the categories of stories they are looking to complement their existing Energy Success Stories are "Ground Source Heat Pumps for Heating and Cooling" and "Efficiency in a Greenhouse".

Starting references:

2016 Vermont Comprehensive Energy Plan
Promoting Adoption of Biomass Fuels for Heating Vegetable Greenhouse in Vermont (September 2015)
Agrilab Technologies Compost Powered Heat (Enosburg Fall, VT Company)
Heat Pumps Show Promise for Reducing Greenhouse Heating Oil Consumption

[1] An extensive study to this effect for the biomass fuel model was conducted from 2008-2015 and you can draw upon this work as you develop you method for exploring the other options

While several of the below resources assume fossil-fuel use, they represent an abundance of energy efficiency ideas:

Bartok, John W., 2001. Energy Conservation for Commercial Greenhouses. Natural Resource, Agriculture, and Engineering Service, University of Wisconsin-Madison.

Increase the Efficiency of your Greenhouses

Greenhouse Energy Cost Reduction Strategies

Greenhouse Energy Conservation Strategies: Technologies

Project #3 – Energy Innovations and Carbon Pollution Tax Implications for Maple Farms

Project Partners:

- JJ Vandette, Vermont Farm to Plate Energy Crosscutting Team Chair and Strategic Planning Manager for Efficiency Vermont
- Resource contact: Johanna Miller, Vermont Natural Resources Council Energy Program Chair

Vermont is the largest producer of pure maple syrup in the United States, accounting for 41% (1.1 million gallons) of total U.S. production in 2011. Vermont Farm to Plate Maple Chapter

"Climate change threatens the long-term viability of Vermont's maple industry. According to the U.S. Global Change Research Program, 'The Northeast is projected to face continued warming and more extensive climate-related changes, some of which could dramatically alter the region's economy, landscape, character, and quality of life. Over the next several decades, temperatures in the Northeast are projected to rise an additional 2.5 to 4°F in winter and 1.5 to 3.5°F in summer.' Furthermore, 'Agricultural production, including dairy, fruit, and maple syrup, are likely to be adversely affected as favorable climates shift...The climate conditions suitable for maple/beech/birch forests are projected to shift dramatically northward, eventually leaving only a small portion of the Northeast with a maple sugar business and the colorful fall foliage that is part of the region's iconic character.' Most forest cover models show the composition of Vermont's forest species changing from maple-beech-birch to oak and hickory by 2100." Vermont Farm to Plate Maple Chapter

To address this and other climate-related threats, in the Spring 2015 legislative session, legislators introduced two bills related to establishing a carbon pollution tax—H.412 and H.395 (H.395 is more aggressive than H.412, with H.412 emerging as the preferred approach after the first legislative session). Energy Independent Vermont (EIV) is a coalition of environmental organizations, Vermont businesses and business associations, academic leaders, low-income advocates, and Town Energy Committees supporting this proposed legislation. EIV has summarized the policy objectives as follows:[2]

1. Reduce Vermont's carbon emissions at a rate that helps us meet our state greenhouse gas (GHG) reduction goal (75% GHG reduction by 2050), and goals for weatherization and renewable energy
2. Do so in a way that is a net economic benefit to Vermont
3. Do so in a way that is equitable for all Vermonters

However, agriculture in Vermont relies heavily on fossil fuels for farm operations as well as processing and transporting goods; therefore EIV is particularly interested in understanding the potential impacts of the proposed policy on this sector. Students from the Fall 2015 section on ENVS 0401 researched potential impacts for a range of agricultural types, but there is a need to look more closely at the maple industry.

In order to dig more deeply into the costs/benefits/impacts of a carbon pollution tax on Vermont's maple industry consider the following research questions:

- How much are maple farms currently relying on fossil fuels? Are their evaporators fueled by oil (which tends to be the case for larger producers) or cord wood?
- Are there (affordable) alternatives?
  - For example, electric evaporators are new to VT; the province of Quebec has incentivized this technology as a carbon reduction measure—what lessons can we learn from them?
- What would producers need to reduce their fossil fuel use and what might that evolution cost?
- What kind of incentives/programs could be supported on maple farms to aid the transition to low-carbon technologies?
- What are the barriers for adopting these new technologies—access, cost, other?

[2] http://www.energyindependentvt.org/wp-content/uploads/2015/03/2015-03-Pollution-Tax-Bill-Overview.pdf

- What would a net-zero "e-Maple Farm"[3] look like? How much solar would it take to get to "net-zero"? Could a large maple operation actually get there?

As noted in project #2, another goal of the Energy Team is to capture and document energy success stories. These success stories are critical for peer-to-peer mentoring in the adoption of new technologies! In the course of your research keep an eye out for existing renewable or efficiency innovations that maple farms have already incorporated into their operations. Two categories of stories they are looking to complement their existing Energy Success Stories are:

- Efficiency at a Sugarhouse
- Solar Energy at a Processing Facility – e.g. the Solar Sweet Maple Farm!

Starting references

2016 Vermont Comprehensive Energy Plan
Overview of Vermont's proposed Carbon Pollution Tax
Fall 2015 ENVS 0401 report: Carbon Pollution Tax: Implications for Vermont Agriculture
Vermont Farm to Plate Maple Chapter
UVM Proctor Maple Research Center
Vermont Maple Sugar Makers Association
Massachusetts Farm Energy Best Management Practices for Maple Sugaring

[3] Modeled after Green Mountain Power's eHome Project

Project #4 – Regional Food Rescue Assessment Tool

Project Partners:

- Pat Sagui, Director, Composting Association of Vermont
- Katy Davis, Nutrition Education & Outreach Director, Hunger Free Vermont

The percentage of low food security (i.e., reduced quality, variety, or desirability of diet) and very low food security households (i.e., indications of disrupted eating patterns and reduced food intake) have increased in every New England state. The percentage of food insecure, particularly very low food secure, Vermont households increased from an average of 9.1% (greater than 22,000 households) from 1999 to 2001 to an average of 13.2% (greater than 34,000 households) from 2011 to 2013 (Chapter 4: Food Security in Vermont). This percentage went down slightly to 12.7% for the 2012-2014 time period (Katy Davis, personal communication).

The Food Cycle Coalition is a group of organizations and individuals with expertise in food rescue, agriculture, solid waste management, composting, and energy production. They are committed to tackling issues of low food security and have a vision "to divert food and organic materials that would otherwise be wasted and convert them into a valuable resource to support our local food system." Part of this diversion is in the form of "food rescue" which refers to close-to-code, perishable, and shelf-stable food being rescued from Vermont farms, restaurants, stores, bakeries, cafeterias, food manufacturers, and distributors. This is on the rise in Vermont, having increased 67% from 2011 to 2013 and standing at about 1000 tons of food rescued annually.(Chapter 4: Food Security in Vermont). The coalition also has a strong eye towards the co-benefits of these efforts including diverting organic materials from the landfill, creating jobs, reducing fossil fuel dependence and greenhouse gas emissions, protecting waterways and soil, sustaining local food systems, and building stronger communities (Farm to Plate announcement of Food Cycle Coalition).

The Food Cycle Coalition's linking of food systems and waste management has particular importance since the passage of Vermont's Universal Recycling Law, or URL (Act 148), in 2012. The URL has a phased implementation plan with the ultimate goal of all food scraps being diverted from landfills by 2020 (URL Implementation Timeline). Not all of this diverted food is suitable for human consumption and therefore the URL has also put forth a hierarchy of preferred ways to manage food scraps and food residuals as detailed in the graphic below (Vermont's Universal Recycling Law).

1. Reduce the amount of food residuals being generated at the source
2. Direct extra food of high quality to feed people by donating to food shelves and other similar strategies
3. Use lower quality food residuals for agricultural uses, such as food for animals
4. Direct food residuals for compost, anaerobic digestion, and land application
5. Process residuals for energy recovery

One tool for thinking about any given community's capacity for food rescue or recovery is through a community food assessment. These assessments are "a process for discovering community food needs and assets, with the goal of developing projects and policies that will improve food security for all residents" (Chapter 4: Food Security in Vermont). Vermont Farm to Plate's strategic plan prioritizes supporting and expanding these assessments throughout Vermont to "allow towns to consider how they will include community food security and issues around access, availability, and utilization of food in their town plans —

including everything from the use of agricultural lands, to public transportation routes, to providing for citizens during emergencies" (Chapter 4: Food Security in Vermont).

Your charge for this project is to research and provide recommendations for an optimal food rescue assessment tool that can be utilized by regional food/hunger councils[4] or other regional entities in Vermont as they attempt to optimize both food security and food recovery goals. This includes, but is not limited to:

- Conducting literature and case reviews for models Vermont might want to draw on
- Identifying the best practices for assessment tools that will work for a diverse group of stakeholders and for diverse communities/regions
- Recommending optimal designs for user-friendly formats for the tool, e.g. manual and checklist, web-platform, etc.
- In the course of your research, keep an eye towards how others have executed assessment tools. i.e. what have / what do successful implementation plans look like ?

The ultimate goal is to develop a tool that can be used by any localized group interested in increasing food rescue in order to increase capacity for nutritious and healthy food, keep food out of landfills, and be more respectful of the earth.

Starting references:
A Place at the Table documentary (available at Davis Library)
Food Cycle Coalition
Food Cycle Coalition is the Farm to Plate Task Force Linking Food Systems and Waste Management
Food Cycle Coalition Asset Mapping and Strategic Planning Report
Chapter 4: Food Security in Vermont (Vermont Farm to Plate 10-year Strategic Plan for Vermont's Food System)
Vermont's Universal Recycling Law
Vermont Gleaning Collective
Food Rescue Capacity Study (Santa Clara, CA)

[4] Food councils bring together stakeholders from diverse sectors to examine how a food system is working and develop recommendations on how to improve it; they can also be particularly effective at integrating food security issues into government policies. As of March 2016, all of Vermont will be covered by 10 Hunger Councils, focused at either the county or regional level.