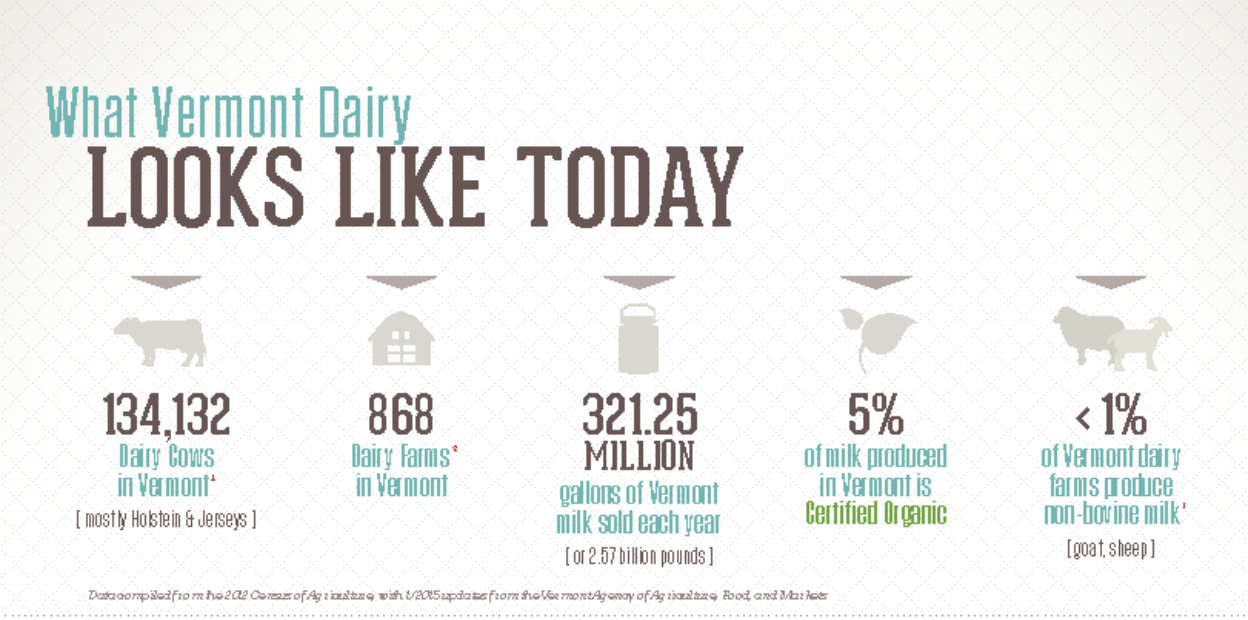
Fall 2016 ENVS 0401
Mez Baker-Medard

A Holistic Exploration of Vermont's Dairy Industry

The 2012 Census of Agriculture listed 7,338 Vermont farms. The average farm size is 171 acres, the average age of a farmer is 57.3 and 22.4% of the farmers are women. 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 represents ~70% of all state farm receipts compared to maple's 4.5%. No other state has a single commodity that accounts for such a high percentage of its total agricultural sales.

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. Although the number of dairy farms has declined, there has been a dramatic increase in the number of cows per farm. While most (82%) of Vermont's farms have less than 200 cows, quite small by national standards, a small number of farms have dramatically increased their herd size over time. Vermont continues to produce 63% of all the milk in New England, between 6,000 and 7,000 jobs are tied to the dairy industry in Vermont, and over 80% of Vermont's farmland is devoted to dairy and the crops grown for dairy feed (this represents 900,000 acres or 15% of Vermont).



Two-thirds of Vermont's dairy farms are concentrated in three counties – our very own Addison County and then also Franklin and Orleans counties. Addison County also represents the largest percentage of milk sales statewide:

County	# of farms	# of dairy cows	% of dairy cows	milk sales (in $ millions)	% of milk sales
Addison	124	32,493	24.2%	$132.1	26.2%
Franklin	184	35,736	26.6%	$132.0	26.1%
Orleans	131	21,081	15.7%	$77.5	15.3%
State total	868	134,132	100%	$504.9	100%

While Vermont dairy is an extremely important economic force and an undeniable part of the state's cultural identity, it is not without challenges. These include water quality challenges, intensive energy use & high energy prices, complex labor and immigration issues, generational farm transitions, and volatile milk prices. The four projects for this seminar will explore each of these pressing issues.

Sources

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Project #1 – Water Quality in the McKenzie Brook Watershed

Project Partners:

- Kristin Williams, Agronomy Outreach Professional & Jeff Carter, Agronomy Specialist and Field Crops & Nutrient Management Specialist, both with University of Vermont-Extension
- Ethan Swift, Watershed Coordinator & Marli Rupe, Vermont Clean Water Initiative Program, both with the Vermont Department of Environmental Conservation, Watershed Management Division
- George Tucker, Soil Conservationist, USDA/NRCS

Resource Contact:

- Annalise Carington '15, South Lake Conservation Planner, Vermont Association of Conservation Districts

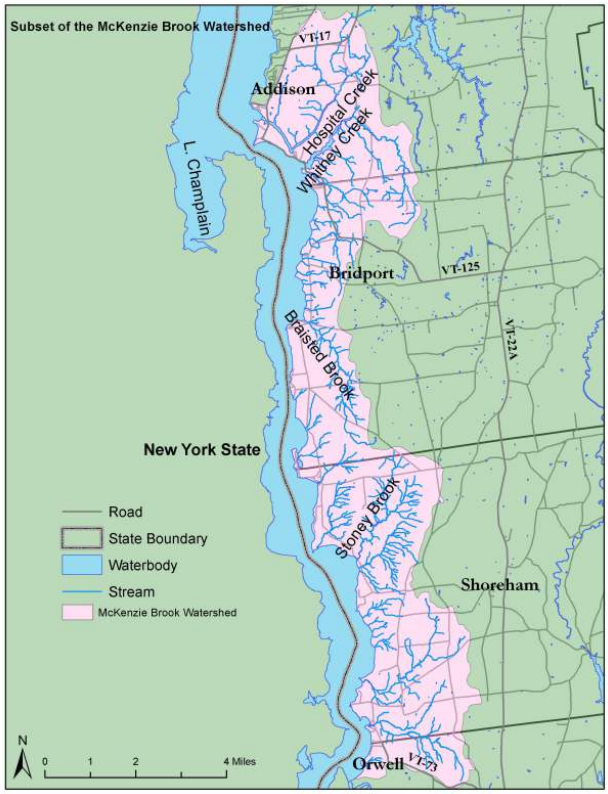
The Vermont Clean Water Act (Act 64) that was signed into law by Governor Shumlin on June 16, 2015 with the goal of reducing sediment and nutrient (phosphorus and nitrogen) pollution flowing to Lake Champlain in order to come into compliance with the EPA's phosphorus TMDL (total maximum daily load) and meet the goals of the Lake Champlain Restoration Plan. State 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.

Actions in the Restoration Plan specific to agricultural lands include a suite of Required Agricultural Practices (RAPs), defined as "farm and land management practices that will control and reduce agricultural nonpoint source pollution and subsequent nutrient losses from farm fields and production areas to surface and ground waters of the State or across property boundaries." For dairy farms in particular, these RAPs aim to to prevent manure from running into waterways and emphasize things such as training and certifying manure applicators in order to minimize manure runoff. Draft RAP rules were put forth in May 2016 and are undergoing public comment and review throughout the summer before being finalized this fall.

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 focused on improved agricultural management practices for *priority watersheds*, i.e. those that are known to have higher levels of nutrient runoff.

2016 Priority Watershed Estimated Agricultural Phosphorus Loadings and Targeted Reductions (August 2015 Draft)

Watershed Name	Watershed Area (acres)	Total Estimated Ag P Loading (lbs/yr)	TMDL Reduction Goal	Ag P Reduction Goal (lbs/yr)
Rock River	22,743	19,248	83%	15,976
Pike River	25,088	9,599	83%	7,967
St. Albans Bay	33,515	23,047	35%	8,066
McKenzie Brook	21,222	43,276	60%	25,965



One of these priority watersheds—the McKenzie Brook Watershed—lies 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. 76% of the watershed is in agricultural land use and there are 47 active farmsteads.

The current phosphorus reduction goal for the McKenzie Brook Watershed is 36% for all land uses, though the EPA has assigned a targeted reduction of 60% for agriculture lands in the watershed.

In May 2016, The McKenzie Brook Watershed Team (comprised of the agency partners noted above as well as farmer representatives from the Champlain Valley Farmer Coalition) developed a five-year implementation plan for the watershed. As part of this plan the Team identified a phosphorus reduction goal that meets 50% of the Total Maximum Daily Load (TMDL) goal for the watershed (13,000 lbs/yr) within 5 years.

This project team will build on the work of a team of ES 401 students from Spring 2016 and will assist the partners in their ongoing work to achieve the desired phosphorus reductions. This team will add to the knowledge-base about conservation practices and their efficacy vis-a-vis water quality improvements in order to be strategic about where resources are expended to have "most bang for the buck". While details will be finalized between you and your partners, work will center around the following:

- Detailed sub-watershed GIS mapping including—but not limited to—the following variables: land use, land cover (inclusive of crop type), which best management practices (BMPs) have been implemented (e.g. till vs. no-till, cover cropping, buffers, etc.), the BMP coefficient of efficiency, soil type, and topography from LIDAR data.
    - It is important to establish this detailed mapping in order to help track and compare water quality improvements in relation to BMP installation over time. You can begin this process by analyzing current/existing water quality data against the variables you mapped (e.g. percentages of land use in different practices and buffers are of particular interest). This spatial representation of existing water quality data tied to land use and BMP implementation will be a useful tool for our partners.
- There are a range of modeling tools that the state uses to determine various phosphorus reduction scenarios in order for watersheds to meet their target phosphorus levels. For *one* of the sub-watersheds, you can take a more detailed look at a scenario modeling tool. This could include:
    - Identifying the gap between best management practices already in place (known from your mapping) vs. what the model indicates is needed.

    - Is the model recommendation feasible – i.e. is their enough acreage to put into BMPs to meet the model target? If not, is there a combination of practices that could fit the available land?
    - Lastly, model inputs can be estimates, averages, or generalized/simplified factors. You could "ground-truth" model inputs against practices occurring on the ground (again, known from your mapping) to improve the output.
- Develop protocol for tile drain sampling. To get the most accurate assessment possible of tile drainage's role in phosphorus loading you need a robust dataset both in terms of number of drains sampled and a high frequency of sampling across a range of flow conditions. Because of this frequency, this sampling will likely be most successful if farmers are doing it themselves. Research protocols that have been used successfully elsewhere in Vermont and in other states to suggest a protocol for the McKenzie Brook Watershed. Pending permission from landowners and weather conditions, you can also sample from tile drains along with the other sampling detailed below.
- Water sampling and flow measurements. Weather permitting, you will have the opportunity to learn about water sampling protocols from our partners and then conduct sampling at the state's established sites in order to continue to add to the water quality database. Water chemistry data ideally can be paired with flow information to weight the concentrations, so you will also take flow measurements using college-owned meters. The state is also in the early stages of a process to install some stream gauging stations for more continuous flow records and you may have the chance to learn about this process if the timing allows.

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2015 State of the Lake Report from the Lake Champlain Basin Program
South Lake Champlain Tactical Basin Plan
Champlain Valley Farmer Coalition
Lake Champlain TMDL Agricultural Lands Management Fact Sheet
Spring 2016 ES 401 Report: Water Quality and Tile Drainage in Addison County

Project #2 – Biomethane Digesters

Project Partners:

- David Dunn, Green Mountain Power Energy Innovation Center and "Cow Power" Leader

Resource Contacts:

- JJ Vandette, Ag Planning Manager with Efficiency Vermont and Chair of Vermont Farm to Plate Energy Cross-Cutting Team; Julie Moore, Water Resources Group Leader at Stone Environmental Consulting; Dairy Farmers Bill Rowell & Marie Audet

As per Vermont's 2016 Comprehensive Energy Plan, the state has set the long-term goal of obtaining 90% of the state's total energy needs from renewable sources by 2050, and has a statutory goal of 25% renewable energy by 2025. Part of achieving this will also include reducing overall energy consumption, with benchmarks for 15% reductions by 2025 and more than 33% reductions by 2050.

Farm Waste Digesters or Biomethane Digesters that capture and harness methane from manure (and sometimes also food scraps and food by-products) are one of several tools in the toolkit for renewable energy generation in Vermont. Vermont farms have emerged as leaders in the field of farm methane digester development—as of July 2015, there were 17 systems operating in the state, with an installed capacity of about 5.6 MW. The Comprehensive Energy Plan estimates that there is the potential for tripling this current capacity.

A challenge to digester expansion is that while the majority of Vermont farms (82%) have less than 200 cows, the majority of digesters are on farms with more than 1000 cows. Even farms with 200 or more cows cited initial capital cost, possible maintenance costs, and having to pull farm labor away from other pressing tasks as challenges to digester adoption.

There are multiple co-benefits farmers could receive by using anaerobic digesters. Animal bedding (a costly input for dairy farms) is a digester by-product, produced when large solids are separated out during anaerobic digestion. Another opportunity associated with digester expansion is the co-benefit of removing phosphorus from the system through integrated nutrient recovery systems, thereby adding in water quality benefits. Further, since phosphorus is a commodity that is bought and sold in other parts of the country, the financial benefits from phosphorus extraction could help offset the costs of installing and operating a digester. A variety of innovative public/private partnerships have emerged to explore nutrient recovery systems, most notably a project our Green Mountain Power (GMP) partners are involved with in St. Alban's Bay (another priority watershed as noted in Project #1).

Our partners have identified a range of policy and funding questions associated with the challenges of digester expansion and the opportunity posed by nutrient recovery and these are detailed below. Through a combination of conversations with your partners and your team's interest you will select your areas of focus.

Policy Question #1:

- Identify key policy "leverage points" with an integrated systems analysis. Biomethane digesters ostensibly address multiple intersecting environmental issues/opportunities, e.g. GHG emissions from fossil fuel-based energy, water quality issues, air quality concerns, imbalance of areas with nutrient surpluses and areas of nutrient deficits, etc. With the right policy design and support, digester models and public/private partnerships could help address this suite of problems.
    - Are there models elsewhere for "whole community" or "whole system" projects?

    - Can policies incentivize / prioritize (w/ funding or other) projects that can produce "multiple goods"?
    - How to ensure no "cross-system" boundary leakage – i.e. that a solution to one problem causes trouble in another environmental or social sector.
- How might one decrease costs or increase incentives? Digester projects with all of these innovations end up being much more expensive than more traditional renewable energy models like wind or solar, which raises questions of how costs are passed on to Vermonters (e.g. via utility bills or other ways):
    - Are there models for looking at costs from a community or regional investment perspective?
        - Meeting Vermont's TMDL / Phosphorus-reduction goals will be a cost to Vermonters in one way or the other
        - Phosphorus-reduction via digesters is substantially less expensive than reducing phosphorus from stormwater runoff or waste water treatment plants
            - What information and key stakeholder feedback is needed to design a policy for inter-sector trading related to phosphorus-reduction across all sectors?
                - A cost-benefit analysis would need to identify the lowest-cost approach to meeting overall phosphorus-reducing goals
            - What can we learn from models from similar inter-sector trading elsewhere (e.g. inter-sector trading in with carbon, RECs, etc.)?

Policy Question #2:

- Digesters enable you to manage manure in a way that can make a difference with regards to water quality via technological add-ons. The range of questions associated with this are:
    - Who pays for the technology and how can one assess the value of nutrient reduction?
    - How should one measure and monitor phosphorus removal to ensure it is happening, and who pays for this effort? What models, benchmarks, and proven methodologies exist elsewhere?
    - How do command and control vs. cap and trade or other market-based models compare for phosphorus reduction?
        - Research what models exist elsewhere
        - Benefits to farmers for increasing value of phosphorus beyond commodity market value

Funding / Policy Question #3:

- Historically, what suite of incentives and financing options were available to VT farmers that made installing digesters feasible for farms of a certain scale?
- Which of these options are still on the table if any (state, regional, and federal initiatives)?
- What policy or other mechanisms are needed to bring defunct funding options back?
- What policy or other mechanisms are needed to make digesters feasible for smaller scale farms?
- Different options are open to different types of project stakeholders – what mechanisms would need to be in place to puzzle together options available to different project partners as part of a coalition?
- Based on models from elsewhere, what other policy options might be feasible in Vermont?

Question #4:

- What are business models that work, particularly for farmer-owned as opposed to utility or third-part owned.
- What digester "outputs" allow these models to be successful – e.g. fuel, heat, pipeline injection?

Other:

- Systems thinking models – e.g. pelletize phosphorus and send back to grain farmers who are supplying VT farmers with feed
- Problem of legacy phosphorus in soils
    - Would there be enough publicly available data to map soil test results from existing nutrient management plans (NMPs)?
        - This could be pared with priority watershed maps and substation capacity issues to further inform digester siting?
        - Could help identify areas of phosphorus surplus vs. deficit for exporting captured phosphorus
        - Sets up mapping process to be able to plug in new data from all the NMPs that will be newly required under Act 64.
- Notion of adoption curves / behavior change
    - Our partners are interested in understanding what influences behavior change pertaining to technology adoption. Specifically, what are adoption curves for digesters themselves?
- The concern that using digesters can mean that organic material is not being reapplied to fields warrants a comprehensive look at how a digester fits into farm nutrient planning (not just "nutrients" but also organic matter and carbon), perhaps modeled on farms where digesters are already present.

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Project #3 – Migrant Justice Fair Food Programs

Project Partner:

- Marita Canedo, Migrant Justice

Resource Contacts:

- Susannah McCandless, Global Diversity Foundation and UVM Extension's Farmworker Resources

Many farms, especially dairy farms and larger-scale fruit and vegetable farms, depend on guest and migrant workers from Mexico, other Latin American countries, and the Caribbean. Between 2000 and 2010, Vermont's Latino population grew 24 times faster than its overall population, and the two largest dairy producing counties, Addison and Franklin, tallied 73 and 111 percent increases respectively. Approximately 1,500-2,000 undocumented migrant farm workers are employed at Vermont's dairy farms.

Both farmers and undocumented workers they hire face significant risks because of federal as well as state policies and practices pertaining to immigration, and worker status. Comprehensive immigration reform on a national level has been stalled for many years, though seasonal and temporary workers may be hired through the H-2A program. Because the H-2A visa program allows for the hiring of only seasonal or temporary laborers, it does not help farms that require dependable year-round labor, such as Vermont's dairy and livestock farms.

Migrant Justice is a non-profit organization founded in 2009 to provide crucial support to Vermont's migrant workers. Their mission is, "to build the voice, capacity, and power of the farmworker community and engage community partners to organize for economic justice and human rights." Their farmworker members have prioritized focusing on the following fundamental human rights to: **1) Dignified Work and Quality Housing; 2) Freedom of Movement and Access to Transportation; 3) Freedom from Discrimination; 4) Access to Health Care.**

One of Migrant Justice's prominent campaigns to achieve the above goals is their *Milk with Dignity* (MWD) campaign. Launched in 2014, the campaign established a *Milk with Dignity Code of Conduct* and calls on major food corporations to take responsibility for farmworker rights abuses in their supply chains. Their initial work has been with Ben and Jerry's and they hope to continue their work with other entities.

Since these are ongoing campaign efforts, this project team will need to be flexible and respond to emerging needs and conversations with stakeholders as the term begins. That said, **potential** areas of work might include:

- Develop educational material for colleges and universities focused on the status of farmworker rights in Vermont's dairy industry.
    - Materials should be targeted at different disciplines and be interactive.
- Research other fair food programs nationally and internationally to identify successful strategies and approaches to support Migrant Justice's (MJ) efforts
    - Migrant Justice is in close contact with the leaders of and has learned a great deal from the Coalition of Immokalee Workers based in Florida, who have successfully launched a Fair Food Program that ensures humane wages and working conditions for the workers who pick fruit and vegetables on participating farms. What led to the Coalition's success? What strategies were used? What is translatable to the milk industry? What is not?
    - Where else in the U.S. and beyond (think globally) have farmworker movements succeeded in protecting wages as well as living and working conditions? What were the

key ingredients to their success? What lessons learned might be helpful in organizing for farmworker rights in Vermont?

- Analysis and mapping of Vermont's milk lifecycle. Who are the major end users and consumers of VT milk products?
    - This information could be designed for:
        - end-users (any milk consumer)
        - institutions (any for-profit or not-for-profit purchaser who makes both pragmatic and ethical decisions concerning their purchases)
            - consider developing one for colleges/universities specifically
        - migrant workers (in language)
        - or others.
- Conduct research on entities that MJ would like to engage with through the MWD campaign:
    - number of farms associated with these entities, the number of migrant workers they have & their average herd size
    - mapping of farm locations
    - current sustainability and labor practice commitments
    - possible interviews with other key users (companies, universities, organizations) of Vermont milk.

Sources

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Project #4 – On-Farm Interviews: Succession Plans and Beyond

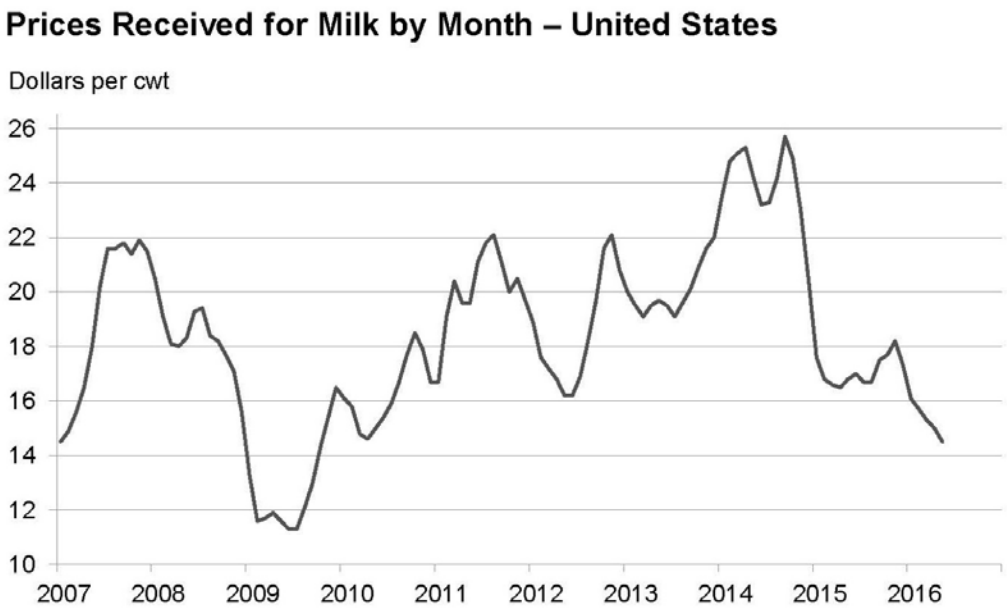
Project Partner:

- Ryan Patch, Senior Ag Development Coordinator, Vermont Agency of Agriculture, Food and Markets

Resource Contact:

- Annalise Carington '15, South Lake Conservation Planner, Vermont Association of Conservation Districts

Volatile conventional milk prices, concentration in the dairy industry, and rising farm input expenses (e.g. gasoline, diesel fuel, feed, and fertilizer expenses) are among the many factors that have impacted dairy's perceived and actual sustainability for decades. Many organizations and agencies across the state are working towards ensuring that Vermont's dairy industry is "viable and diversified."



Following an all-time high in September 2014, milk prices have dropped to their lowest point since 2009. While there are some price protection programs for Vermont Farmers, margins are still historically low and not all farms participate in these programs. 582 dairy farms (67%) enrolled in the program created by the 2014 Farm Bill and an additional 28 Vermont dairy farms took part in another program that offers protection based on the margin between the price of milk and national average feed costs.

These cost concerns are intimately linked to concerns about the costs of complying with the new required agricultural practices detailed in Project #1. Potential antidotes for cost concerns could include diversification and/or off-farm income generation, but how many dairy farmers are actively pursuing these avenue? An additional concern for dairy farms is that the average age of dairy farmers is mid- to late-50s and a majority of farms in the state do not have succession plans in place. Is there capacity for long-term planning with pressing day-to-day needs? How can farms "keep farming" by connecting retiring (through choice or need) farmers with young farmers looking to get started?

Our partner at the Agency of Agriculture, Food, and Markets is interested in capturing ideas, thoughts, and most importantly, ***strategies*** farmers use to deal with this suite of challenges through in-depth

interviews and possibly surveys concerning farm "survival strategies." Information gleaned through your interviews could be of great benefit to other farmers. What is working for one farm might work for other farms. Research in this realm can dig into the unique mosaic of strategies used by an individual farm as well as common strategies used across farms. Your interview findings will also greatly benefit the Agency of Agriculture–knowing how farmers conceptualize the challenges they are facing will allow the agency to tailor programs to support farmers in addressing these challenges.

Your research design should consider geographic scope, type of production, farm size, and a mix of organic and conventional dairy farms when seeking interviewees. An analysis of your learnings as well as narrative summaries of full interviews, vignettes and key quotes, and potentially also brief audio / video pieces would all be useful modes of presenting your findings.

Proposed Interview Topics

- Farm transitions – "generationality", long-term succession plans, off-farm supplemental income, diversification
- Acute concerns vs. long-term planning - Interviews could focus on hard times today as well as how farmers are thinking about getting through next 5 years
    - The daily pressures and workload of dairy farming in Vermont often makes it difficult to engage in long-term strategic planning to focus on either inter-generational transfer or the path to long-term profitability. Very often the daily pressures and emergencies— broken equipment, sick animals, etc.— make it difficult to ask these questions, but touching on these questions would be very useful.
    - To hear how conventional dairy farmers are conceptualizing the path forward in their own words might be useful to compare to organic dairy farmers who theoretically have a much more stable income owing to price stability of their commodity. Very often the state hears that conventional dairy farmers do not plan and rather respond to milk prices and make investments where they can. Hearing from farmers in their own words could help inform the programs and efforts your partner manages to ensure they best reach farmers directly in these tough times.
- Economic implications of Act 64 / RAPs
    - What types of incentives and support would be most helpful – e.g. upfront financial assistance to develop a nutrient management plan (NMP) is great but then how is long-term maintenance and updating of plan paid for?
        - Hearing from farmers directly about what strategies they feel would best support them is critical to successful implementation of the rules which many partners will be working on
        - The state feels there is enormous opportunity for the RAPs, and the supporting programing informed by Act 64, to help farmers expand and continue to utilize strategies which will not only improve water quality outcomes on their farms but also strengthen their bottom line—it would be especially useful to hear from farmers their own take on the RAPs and the ways in which they feel the Rules will impact their ability to operate profitability.
- Record-keeping strategies: This is done well for organic farming certification requirements – how can these effective strategies and approaches be shared with conventional farmers?
- Other creative ways farmers have made ends meet?

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