The University of Vermont

ANNUAL REPORT 2016

University of Vermont Extension
&
Vermont Agricultural Experiment Station

Vermont AGRICULTURAL EXPERIMENT STATION

The University of Vermont EXTENSION

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IN THIS ISSUE

ADVISORY BOARDS

ON THE COVER

The Proctor Maple Research Center and UVM Extension Maple Program support maple producers by providing outreach education and research-based solutions in agriculture, forest management, plumbing, weather forecasting, food production and small business management for maintaining sustainable operations with above-average yields of high quality syrup.

CREDITS

Contributors & Photographers: Stephanie Albaugh, Terry Bradshaw, Chris Callahan, Mark Cannella, Jeff Carter, Jennifer Colby, David Conner, Cindy Corkins, Heather Darby, Gary Deziel, Stephanie Dion, Debbie Fajans, Sabrina Greenwood, Vern Grubinger, Sarah Braun Hamilton, Dan Hudson, Mark Isselhardt, Jeanne Keefe, Sarah Kleinman, Doug Lantagne, Dan Lerner, Rebecca Maden, Martha Manning, Jane Nevins, Jane O'Neill, Omar Oyarzabal, Bob Parsons, Mary Peabody, Ellen Rowe, Erin Shea, Robin Smith, Wendy Sorrell, Sarah Tichonuk, Joel Tilley, Marcus Tracy, Lauren Traister, Diane Trono, Tom Vogelmann, Qingbin Wang, Kirsten Workman, Cathy Yandow.

DEAN'S MESSAGE

UVM Extension and the Vermont Agricultural Experiment Station (VTAES) are dedicated to working with citizens, communities and organizations throughout the state to meet the changing needs of Vermonters. We continually strive to integrate higher education, research and outreach to protect and enhance a quality of life characterized by a healthy natural environment, vibrant economy, a strong sense of community, resilient youth, and a deeply engrained connection to agriculture.

Strengthening economic development is among our critical priorities, and we support many industries that produce signature Vermont products such as maple, apples, milk, artisan cheese, hard cider, wine, artisan beer and ice cream, to name a few. Several of these are spotlighted in the following pages of this Annual Report.

This year marked the reintegration of UVM Extension into the College of Agriculture and Life Sciences (CALS). Following the decision made by Dean Doug Lantagne to step down from UVM Extension, UVM administration made a thoughtful decision to combine CALS and UVM Extension into one administrative unit. This decision was followed shortly thereafter with an announcement that Chuck Ross will serve as the new Director of UVM Extension.

As we welcome Chuck, we also thank Doug for his outstanding leadership of UVM Extension for more than 13 years. He built the foundation for today's UVM Extension, hiring a cadre of talented professionals, promoting partnerships and shaping the mission of UVM Extension to meet the needs of Vermont in the 21st century. We owe Doug a debt of gratitude, and UVM Extension is well-positioned to continue its forward momentum under Chuck's new leadership.

Chuck comes to us from the Vermont Agency of Agriculture, Food and Markets where he served as Secretary since 2011. He has a strong knowledge of Vermont agriculture, deep working relationships with Vermont stakeholders and agencies, and has worked successfully with the Vermont legislature and Congressional delegation to fund critical initiatives. Chuck has a strong track record in promoting collaborations between different state and government agencies, and he led and implemented a strategic planning process at the agency that created a foundation for its success. This effort was made to facilitate closer working relationships, strengthen economic development and education, and to unify outstanding research throughout Vermont education and outreach — actions that will benefit UVM Extension and VTAES as we work together to improve the lives of Vermonters.

As we work together in a common mission of service and outreach, we celebrate this very exciting time for UVM Extension, the College, and the citizens of this state. As always, we welcome your comments, perspectives and feedback as we move forward with new energy and purpose.

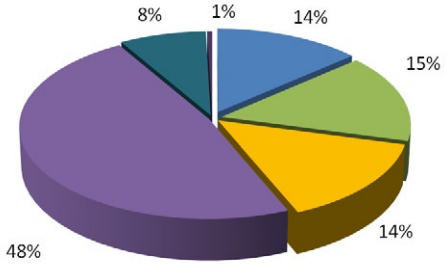
Thomas C. Vogelmann

Dean, College of
Agriculture and Life Sciences,
and UVM Extension

BUDGETED DOLLARS BY NATIONAL GOAL AREA FY 2016

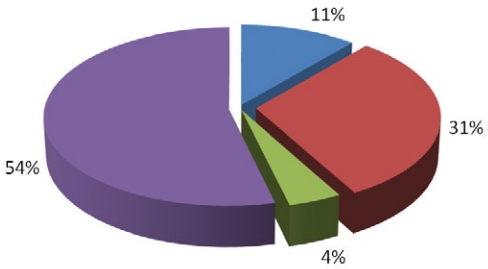
Our work is fundamentally a partnership with our federal funder, USDA-NIFA (United States Department of Agriculture National Institutes of Food and Agriculture). Effort is applied in a number of national goal priority areas as illustrated in the charts below.

Vermont Agricultural Experiment Station



- Reducing Childhood Obesity $1,158,645
- Studying Climate Change $1,320,990
- Enhancing Food Safety $1,234,205
- Strengthening Global Food Security $4,068,936
- Advancing Sustainable Energy $684,422
- Managing Urban Nonpoint Source Pollution $38,938

UVM Extension



- Reducing Childhood Obesity $1,329,890
- Studying Climate Change $476,121
- Strengthening Global Food Security $6,199,025
- Increasing Community Development $3,528,118

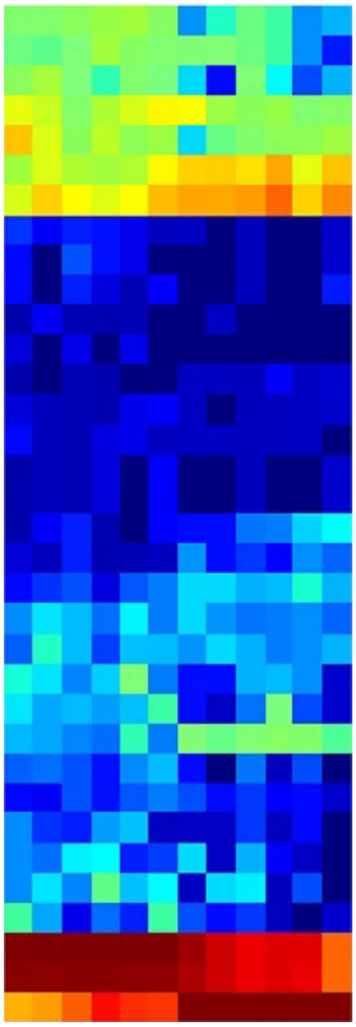
Sabrina Greenwood (below), an animal and nutrition scientist, examines the feasibility of altering a cow's diet creating a unique and healthful milk product that can be sold to consumers.

CREATING A HEALTHIER MILK PRODUCT

Milk is not only an important source of nutrients for the growing population, but proteins and peptides produced from the dairy cow are now known to actively influence human health. Farm animal milk and all of its byproducts like cheese and yogurt are an important part of human diets.

Proteins are key molecules of milk components, and **Dr. Sabrina Greenwood** examines the feasibility of altering bovine milk proteins through change of the dairy cow's diet. Her research emphasizes the use of alternative forages and byproducts as nutritional strategies to manipulate dairy outputs.

Proteomics is the study of proteins of which there are hundreds in cow's milk. The objective of Dr. Greenwood's research is to create a healthier product by manipulating the cow's diet, ultimately changing the milk proteome.



This heat map (right) shows the quantities of 34 different proteins (one in each row) found in milk from six Jersey cows and six Holsteins (one milk sample in each column). Cows were fed a total mix ration (TMR), a typical dairy herd diet. This baseline data will inform future research on how changes in bovine diet will affect the distribution of these proteins.

These results were generated from a liquid chromatography tandem-mass spectrometer (LC-MS/MS) at the Vermont Genetics Network Proteomics Facility at UVM.

This natural method of changing the milk profile can be used by producers and commercial entities as an on-farm strategy to create a unique and healthful milk product for consumers. This will provide significant contributions to the nation's economy, and increase dairy competitiveness in the human health sector through enhanced nutritional quality of milk and its byproducts.

Samantha Driscoll (above) gets hands-on experience with the UVM dairy herd. She and other undergraduate students assist with research into how a cow's diet affects the distribution of the more than 900 distinct proteins in the milk it produces.

SUPPORTING AGRICULTURAL LABOR & MANAGEMENT

Farm business success relies, in part, on the quality and quantity of products. But a supported workforce, led by managers who have the appropriate soft and technical skills, is equally valuable. These and other social and economic issues are exactly what UVM Extension programs help farmers navigate.

Vermont Migrant Education Program Empowers Families

Employees are a critical component of farm success and migrant workers provide an important seasonal and temporary workforce for Vermont agricultural producers. But frequent moves can be isolating for families, often disconnecting them from necessary public services and impacting the ability of migrant youth to successfully transition into postsecondary education or employment. The **Vermont Migrant Education Program** (MEP), led by Director **Erin Shea**, helps families overcome these barriers by providing free educational services to children of farmworkers and young adults under 22.

Through a new contract with the Vermont Agency of Education, UVM Extension is now the sole, statewide source for all supplemental educational programming, enrolling and serving 340 eligible migrant students this year.

Driving the Future of Workforce Management

With all farm workers in mind, the **Farm Labor Decision Making Project** directed by Community Economic Development Specialist **Mary Peabody** is improving labor management practices for small and medium-sized farms in Vermont. With funding from the Agriculture and Food Research Initiative, UVM Extension is calling on farmers experienced in labor management. Data from interviews, focus groups and surveys will help create online tools farmers can use to aid in labor-related decision making. When complete, a "decision-support dashboard" will give farmers access to a labor readiness assessment, job description generator and cost calculator. Together, these research-based tools will help farmers make the appropriate decisions for their farms and employees, allowing them to successfully grow their operations.

(below) A small, yet impactful part of MEP's offerings are site-based English courses. Four sites around the state each delivered 48 hours of education to a total of 56 migrant students; 100% reported an increase in their language proficiency.

Agricultural Business Programs Boost Manager Satisfaction

Beyond daily management of the business and employees, farm owners must consider the future of the farm and its ability to generate a household income. With manager satisfaction playing a key role in business sustainability, it is vital that farmers have access to the tools they need to move their Vermont farm in the right direction. Directed by Farm Business Management Specialist **Mark Cannella**, the **UVM Extension Agricultural Business Program** provides individualized business coaching, business plan preparation support and financial analysis. In 2016, more than 50 farm owners completed business planning and analysis projects with the program. Survey results indicated a dramatic increase in the number of respondents who were satisfied with their ability to manage the farm. With a clear plan for the future, farmers will improve both business and outcomes.

50+ farm managers
completed business planning and analysis projects with UVM Extension

	BEFORE	AFTER
satisfied with their overall ability to manage the business	32%	68%
clearly understand the direction to take their business	14%	82%
satisfied with their ability to generate household income from the business	18%	45%

VERMONT APPLE & GRAPE INDUSTRY: HELPING FARMERS ACHIEVE SUCCESS

Apples are the second-most valuable specialty crop in Vermont after maple with $12 million in annual farm gate sales. Most Vermont apples are sold as fresh market fruit, but Vermont hard cider makers have recently seen substantial growth, and growers are responding by looking to shift production to cider apples to meet cidery demand. Winegrape production has also increased in Vermont and grapes are now grown on over 160 acres with wine sales at $5 million annually. Both Vermont hard cider and wine are gaining national recognition for their superior quality.

Dr. Terry Bradshaw's research studies the challenges of growing these specialty crops and provides support through workshops, site visits and electronic communications to assist apple and grape growers with pest and other risk management. His research looks at the evaluation of economics of cider and apple production in Vermont, and the unique characteristics of specialty cider cultivars grown in the state. With grapes, Dr. Bradshaw focuses on the challenges of winegrape production with Vermont's cold winter, short growing season and pest complex.

Dr. Bradshaw provides much needed, grant-funded technical support for Vermont apple and grape producers. In 2016, Dr. Bradshaw began a comprehensive assessment of integrated pest management (IPM) implementation in Vermont orchards and vineyards to guide future programming efforts. He also began two projects to evaluate reduced-input apple production systems to meet the needs of the cider apple market. His research was presented at local, regional, and international meetings, including at the first International Symposium on Beverage Crops in Cairns, Australia.

$12 MILLION
in annual farm gate sales

Apples are the second-most valuable specialty crop in Vermont after maple syrup

Terry Bradshaw (above), a research scientist, knows the challenges farmers face. Dr. Bradshaw provides support through workshops, site visits and communications to assist apple and grape growers with pest and risk management.

ECONOMY

Image: iliveworkdream.com

ECONOMIC DEVELOPMENT IN FOOD & AGRICULTURE

Successful businesses help Vermont's economy and create jobs; UVM Extension supports them with expertise, technical assistance and innovative solutions.

Extending Growing Season & Marketing Period

Vermonters' consumption of fresh, local foods continues to grow, often outpacing supply. Extending the growing season with high tunnels and greenhouses is one way to meet this growing need, but expensive and fluctuating heating costs can strain farm finances. UVM Extension helped 25 farmers install biomass (plant-based fuel) heating systems in their greenhouses. By replacing nonrenewable oil or propane fuels, farmers saved (on average) $2,696 per system per year (paying back the full cost of a system in 4.8 years) and collectively avoided ~2.14 million pounds of carbon dioxide emissions (roughly equivalent to the annual emissions from 204 cars!).

Post-harvest crop storage is another necessity, keeping vegetables fresh for market. Yet each year crops are lost due to spoilage from inaccurate and fluctuating temperature and humidity settings. Ag Engineer **Chris Callahan** improved the design and management of storage facilities at nine commercial vegetable farms. With new environmental monitoring equipment, farmers are now alerted when conditions change, allowing for easy and prompt climate correction. Results over a two-year period were substantial: market value of crops stored in these facilities was $3.5 million, and new systems reduced historical losses from 15% to 5%.

40,269 kWh **$5,800**

average annual electricity savings per farm due to crop storage upgrades

Ensuring a Safe Food Supply

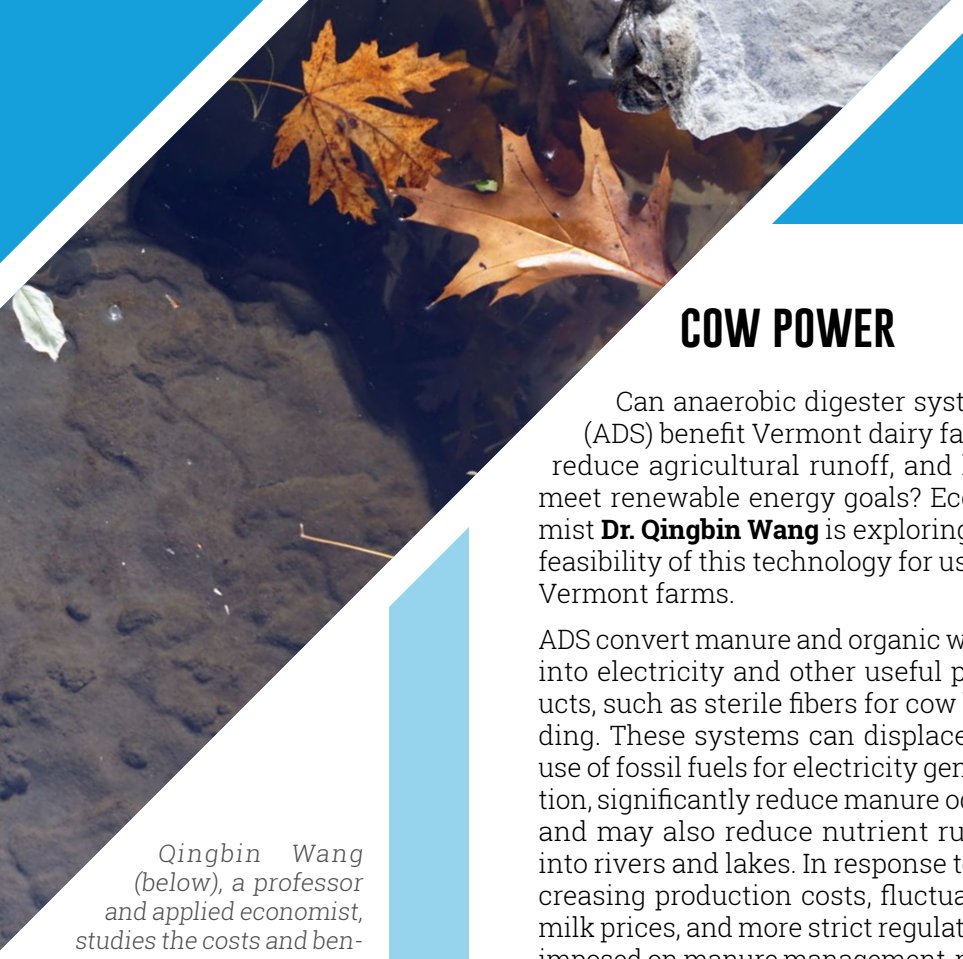
UVM Extension continues to help producers and processors improve food quality, meet Food Safety Modernization Act (FSMA) compliance, and scale up efficiency and profitability.

The three-year, $950,000 award from the U.S. Food and Drug Administration to create the 12-state Northeast Center to Advance Food Safety (NECAFS) consortium aims to improve understanding and practice of food safety among the region's small- and medium-sized produce growers and processors.

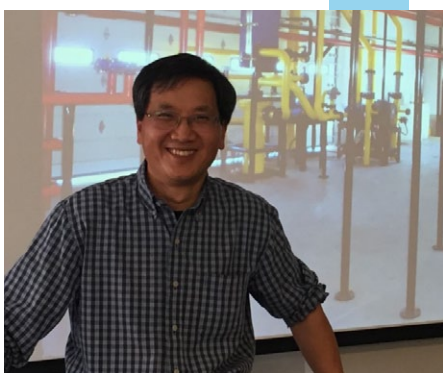
Providing Market-Specific, Industry-Level Guidance

Understanding finances associated with business start-up or expansion in a particular sector is important. With the right resources, producers are able to make informed decisions about the future of their businesses. UVM Extension Farm Business Specialist **Mark Cannella** took a deep dive into the financial performance of three industries in Vermont – maple, grapes and eggs. The resulting reports contain useful data and tools for current and potential producers: *Maple Benchmark Report, Vineyard Feasibility Study* and *Scaling Up Egg Production*.

A robust food safety program is key to the long-term viability of any food business. Omar Oyarzabal, food safety specialist, provides technical assistance to food facilities in Vermont—including a newly established sauce manufacturing plant—increasing their understanding of required FSMA changes, helping implement food safety plans, and ultimately improving their place in the industry.



Qingbin Wang (below), a professor and applied economist, studies the costs and benefits of on-farm anaerobic digester systems (ADS) that convert cow manure into electricity and other renewable energy products.



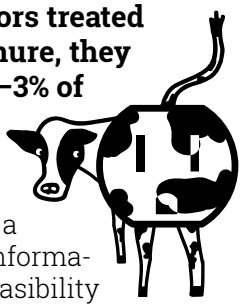
COW POWER

Can anaerobic digester systems (ADS) benefit Vermont dairy farms, reduce agricultural runoff, and help meet renewable energy goals? Economist **Dr. Qingbin Wang** is exploring the feasibility of this technology for use by Vermont farms.

ADS convert manure and organic waste into electricity and other useful products, such as sterile fibers for cow bedding. These systems can displace the use of fossil fuels for electricity generation, significantly reduce manure odors, and may also reduce nutrient runoff into rivers and lakes. In response to increasing production costs, fluctuating milk prices, and more strict regulations imposed on manure management, more than 250 American farms have installed these systems in an effort to diversify income and comply with regulations.

As a dairy state with 18 installed digesters, Vermont has been a leader in the development of these on-farm systems and provides a unique environment for studying ADS feasibility. Dr. Wang's research team has collected primary data and analyzed the investment, energy outputs, as well as operational costs, revenue and return on investment. Their findings, published in the *Journal of Dairy Science* in 2011, suggest that ADS are economically feasible – for large dairy farms with more than 700 cows.

If anaerobic digestors treated all U.S. animal manure, they would supply 1.8%—3% of this country's annual electricity.



These findings point to a growing need for more information on the economic feasibility of ADS for small- and medium-sized dairy farms (SMDFs). These smaller operations usually have between 75 and 500 cows; and in fact, more than 95% of dairy operations in Vermont have fewer than 500 cows. Dr. Wang and his team have recently examined the economics of digesters on SMDFs and their findings suggest that it would be very challenging for farms of this size to achieve positive financial returns operating ADS.

Dr. Wang's team has also evaluated community-based systems developed in Europe and mini biodigesters developed in China. His team's feasibility study used geographical information systems (GIS) to evaluate optimal locations for community ADS that may be used by multiple dairy farms in Vermont. These findings were published in the journal *Energy Policy* in 2013.

Dr. Wang continues to collect primary data and conduct research to provide economic information and policy recommendations for helping more farms to use or consider ADS.

PROTECTING CLEAN WATER IN VERMONT & BEYOND

Guided by soil test recommendations and new cover cropping information from UVM Extension, farmers are optimizing cash crop production while improving long term soil health and protecting water quality in the Lake Champlain Basin and Connecticut River.

In 2016, 5,117 soil samples were sent for testing to UVM's Agricultural Testing Lab from farmers wanting to improve manure and fertilizer management. But understanding and implementing recommendations can be challenging, especially for larger farms with many fields that must now be managed to comply with Vermont's Required Agricultural Practices (RAPs).

The Vegetable Soil Fertility Project, a pilot program developed by newly hired Vegetable Nutrient Management Specialist **Becky Maden**, helps produce growers meet those challenges. Ten commercial farms participated and received soil test guidance, nutrient management planning and consultations. Nine farms modified their nutrient management practices based on UVM Extension recommendations, impacting a total of 246 acres. Six of those farms specifically reduced the amount of applied phosphorus, the major nutrient of concern for Lake Champlain. By implementing changes tailored to the needs of each field, farmers are positively impacting both their business and the waters around them.

> ***With the help of UVM Extension we've been able to fine-tune our fertilizer uses; it's both cost effective and improves our crops.***
>
> **-Gary Bombard, Co-owner, Sam Mazza's Farm**

While phosphorus from erosion and run-off jeopardizes Lake Champlain, it is not the only nutrient of concern; nitrogen raises similar red flags for the Connecticut River. UVM Extension, a recipient of $875,000 to lead the Long Island Sound Watershed Resource Conservation Partnership Program in Vermont and New Hampshire, is partnering with groups like the Connecticut River Farmer Watershed Alliance to improve water quality. Pasture Program Coordinator **Jenn Colby** and Agronomist **Dan Hudson** provide technical assistance to farmers who are actively modifying practices to reduce their impact, continuing to demonstrate their commitment to improving water quality on the eastern border.

All across the state, UVM Extension staff continue to assist farmers in making the right management choices for their lands. Agronomy Specialists **Heather Darby** and **Jeff Carter** and their staffs worked with farmers who implemented 284 individual conservation practices on more than 36,200 acres. As an example, cover crops are now growing between corn rows protecting otherwise bare soil from erosion. Manure and fertilizer applications are being applied at rates and times that reduce the chance they would be lost into nearby water. And farmers are following nutrient management plans they developed, optimizing crop yield, minimizing costs, and protecting soil and water.

Cover Cropping in Action

Jake Guest (right) examines his field pea cover crop at Killdeer Farm, located in the Connecticut River watershed.

Nutrient runoff can also be mitigated by growing cover crops such as ryegrass between rows of vegetables (below). Inter-seeded covers are also being tried in field corn.

FOOD SYSTEMS

WHAT DRIVES CONSUMER SPENDING ON VERMONT'S LOCAL FOODS?

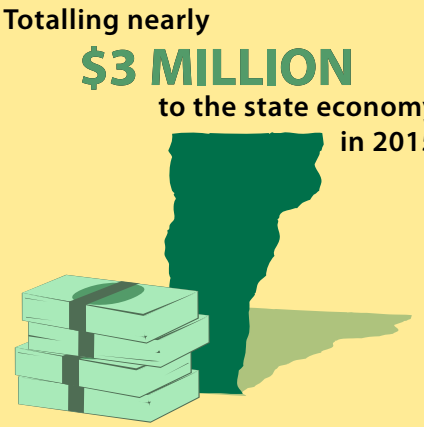
Dr. David Conner's research suggests great opportunity and potential for Vermont's food systems to contribute to a broad array of community development goals; in particular, economics and public health. His recent study measuring local food consumption in Vermont notes that state residents have increased their consumption of locally grown foods in recent years.

Every dollar spent on local foods creates additional income through an economic multiplier effect, and supports Vermont taxpayers and the working landscape. This economic multiplier was highlighted in a study at the University of Vermont Medical Center's (UVMMC) local food procurement program. Conner, Research Specialist **Florence Becot** of the UVM Center for Rural Studies, and UVMMC Nutrition Services Director **Diane Imrie** collaborated on a study showing that every dollar spent locally by UVMMC generates another 76 cents in the state economy and overall, their local purchases contribute almost $3 million to the state economy.

Local food systems may also have public health and nutritional benefits to Vermont communities. Dr. Conner teamed up with Assistant Professor of Education **Dr. Bernice Garnett** to look at drivers of fruit and vegetable intake. Using Vermonter Poll data, they found that participation in local food systems (especially through direct markets) was associated with increased consumption of fruits and vegetables.

In addition, Dr. Conner works with **Dr. Terry Bradshaw**, Director of the UVM Horticulture Farm, to study local foods like Vermont apples. Both researchers evaluate opportunities for local apple growers and cideries. In particular, Dr. Conner is looking into contracts or strategic partnerships that bring both sides of the cider making process together to create a marketable product.

Dr. Conner continues to study Vermont food systems as he and his staff measure the frequency of shopping and dietary motivations in the state's population, and how this correlates to demographic variables. His research shows that Vermont sales of locally grown foods have increased: this boosts the Vermont economy, is good for public health, has social benefits, and helps Vermont's working landscapes.



David Conner, an agricultural economist, examines local and regional food systems by studying Vermont markets, management institutions and their partnerships.

YOUTH & FAMILY

BUILDING A STEM FUTURE

UVM Extension 4-H programs are built on the premise that children learn best through hands-on activities. These experiences help young people build a foundation in **Science, Technology, Engineering, and Math (STEM)**, ultimately preparing them for the science- and technology-oriented world of work.

In 2016, 1,798 students in 66 Vermont classrooms incubated fertile chicken eggs, watching them hatch into fully-developed chicks in the **4-H Embryology Program** coordinated by 4-H Educator **Martha Manning**. Beginning in 2015, classes had the option of donating the chicks to a local food shelf. Nineteen birds were raised and turned into 182 pot pies for community food pantries, creating additional opportunities for students to engage in science while giving back to their communities.

Classroom-based 4-H programming continues across all STEM fields. The **4-H Tech Wizards Program** (funded by the Office of Juvenile Justice and Delinquency Prevention), led by Community and Leadership Development Specialist **Ellen Rowe** and Youth and Family Specialist **Debbie Fajans**, provides skill-building and mentoring for underserved youth through subjects like forestry and photography. Of the 148 students who successfully completed projects this year, 67 attended Kurn Hattin Homes, a residential school for at-risk children in Westminster.

Each student there invested 326 hours in learning, 72 in service, and 120 hours with an adult mentor. More than 60% of students demonstrated improvements in goal setting, communication or critical thinking; key components of STEM mastery.

STEM careers come in all shapes and sizes, as 34 teens discovered on the **4-H Tri-State Agriculture Tour** organized by 4-H Livestock Educator **Wendy Sorrell**. The three-day trip visited farms, production facilities and research sites for first-hand exploration of careers in food systems. Participants learned about value-added products, community supported agriculture, soil management and more; challenging assumptions of what a career in food systems means. Now, 97% of the students share a new belief that science will be an important part of their future. Two tours have been offered to date, thanks to funding from Yankee Farm Credit.

Helping children discover the real-world applications of STEM is exactly what the **Teens Reaching Youth (TRY) for the Environment**, a program led by 4-H Teen and Leadership Specialist **Lauren Traister**, does. Seventy-five teens from eight counties were trained to teach six-lesson courses about critical environmental issues to younger students. While younger students learned about renewable energy, waste management or food systems, teens recognized the long-term impact of their work. As one youth reflected: "I think our teaching went from renewable energy all the way to important skills that the kids need with them throughout their lives."

Today's youth are tomorrow's leaders and problem-solvers. Developing and learning to use life skills prepares them for success in STEM fields and beyond.

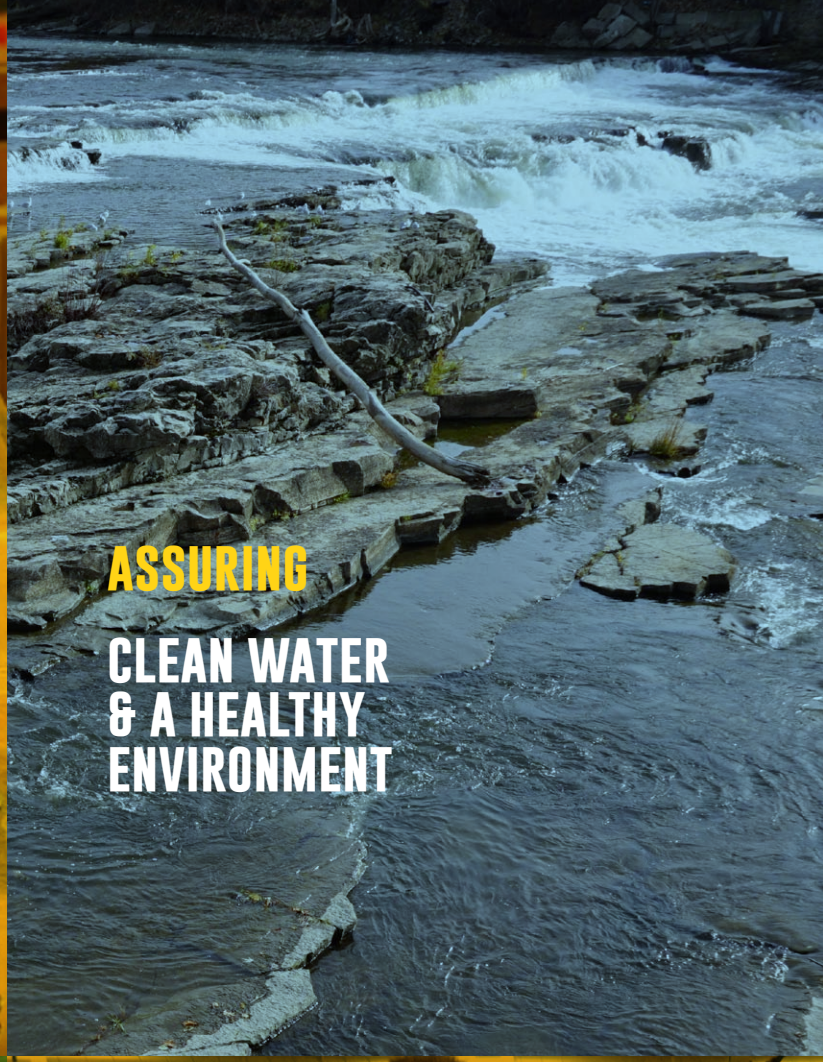
Youth participants in 4-H Tech Wizards increase problem-solving and goal-setting skills and abilities. A 4-H Tech Wizard (left) at Kurn Hattin Homes builds a solar powered helicopter—hands-on learning that leads to greater confidence and bigger challenges.

Teens Reaching Youth for the Environment

75 teens volunteered
1,500 hours to teach
728 students about:

- renewable energy
- waste management
- food systems

100%
of students increased their knowledge of STEM



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