2010

Proposal for a Food Systems Spire of Excellence at the University of Vermont

Vernon P. Grubinger, et al.
vernon.grubinger@uvm.edu

Proposal for

A FOOD SYSTEMS SPIRE OF EXCELLENCE AT THE UNIVERSITY OF VERMONT

February 19, 2010

Submitted by:

Prof. Vern Grubinger, Extension (Chair)
Prof. Linda Berlin, Extension
Prof. Elizabeth Berman, Libraries
Prof. Cynthia Belliveau, Continuing Education
Prof. Naomi Fukagawa, College of Medicine
Prof. Jane Kolodinsky, College of Agriculture & Life Sciences
Prof. Deborah Neher, College of Agriculture & Life Sciences
Prof. Bob Parsons, College of Agriculture & Life Sciences
Prof. Amy Trubek, College of Agriculture and Life Sciences
Prof. Kimberly Wallin, Rubenstein School of Environment & Natural Resources

Executive Summary. The field of food systems focuses on connections among food production, promotion of human health and well-being, and maintenance of the environment. Modern food systems provide unparalleled productivity but are accompanied by unacceptable levels of diet-related health problems, food-borne disease, hunger and agricultural pollution. Meanwhile solutions are critical within the next 40 years to discern how to provide more food without intensifying environmental damage and concurrently coping with climate change. The University of Vermont is uniquely positioned to address these concerns by generating knowledge through transdisciplinary teaching, research and outreach. Already, more than 100 faculty and 400 community partners are engaging with models and methods that show promise for revitalizing agriculture while improving people's diet, protecting environmental quality, and creating economic opportunity. The following four integrative domains of transdisciplinary research are proposed to more comprehensively pursue the goal of healthier food systems: 1) food, culture and health; 2) energy and food; 3) policy, ecology and land use; and 4) regional food chains.

A number of existing public and private resources will be leveraged in support of a food systems spire to: 1) immediately hire a Director and then purse philanthropy for an Endowed Chair in Regional Food Systems; 2) create four to eight faculty positions to address critical transdisciplinary food systems questions; 3) offer annual food systems research planning grants for faculty; 4) host biennial national symposia on food systems research and outreach; 5) establish a regional food systems advisory council to guide and review progress; and 6) launch a campus-wide initiative that links transdisciplinary food systems research with student engagement in all domains of campus life from dining halls to teaching gardens to capstone seminars. A transdisciplinary spire of excellence emphasizing regionally-scaled food systems will position the University of Vermont as a premier 21st century land-grant university.

Background and Rationale. The field of food systems is a compelling interdisciplinary domain of study because it elucidates connections among vital interests of humanity by creating nourishment, pursuing health and well-being, and maintaining the environment. In addition, contemporary food systems pose a remarkable paradox that is the basis for serious societal concerns: unparalleled productivity accompanied by unacceptable levels of diet-related health problems, food-borne disease, hunger and agricultural pollution. The University of Vermont (UVM) is uniquely positioned to address these concerns by generating knowledge through transdisciplinary teaching, research and outreach conducted by faculty who participate in a food systems spire of excellence. The program will build on the trend in higher education towards more engaged scholarship and the transformational impact that engaged scholarship can have on students. This spire will be organized around the definition of food systems as *an interconnected web of activities, resources and people that extends across all domains involved in providing human nourishment and sustaining health, including production, processing, packaging, distribution, marketing, consumption and disposal of food. The organization of food systems reflects and responds to social, cultural, political, economic, health and environmental conditions and can be identified at multiple scales, from a household kitchen to a city, county, state or nation* (Figure 1).

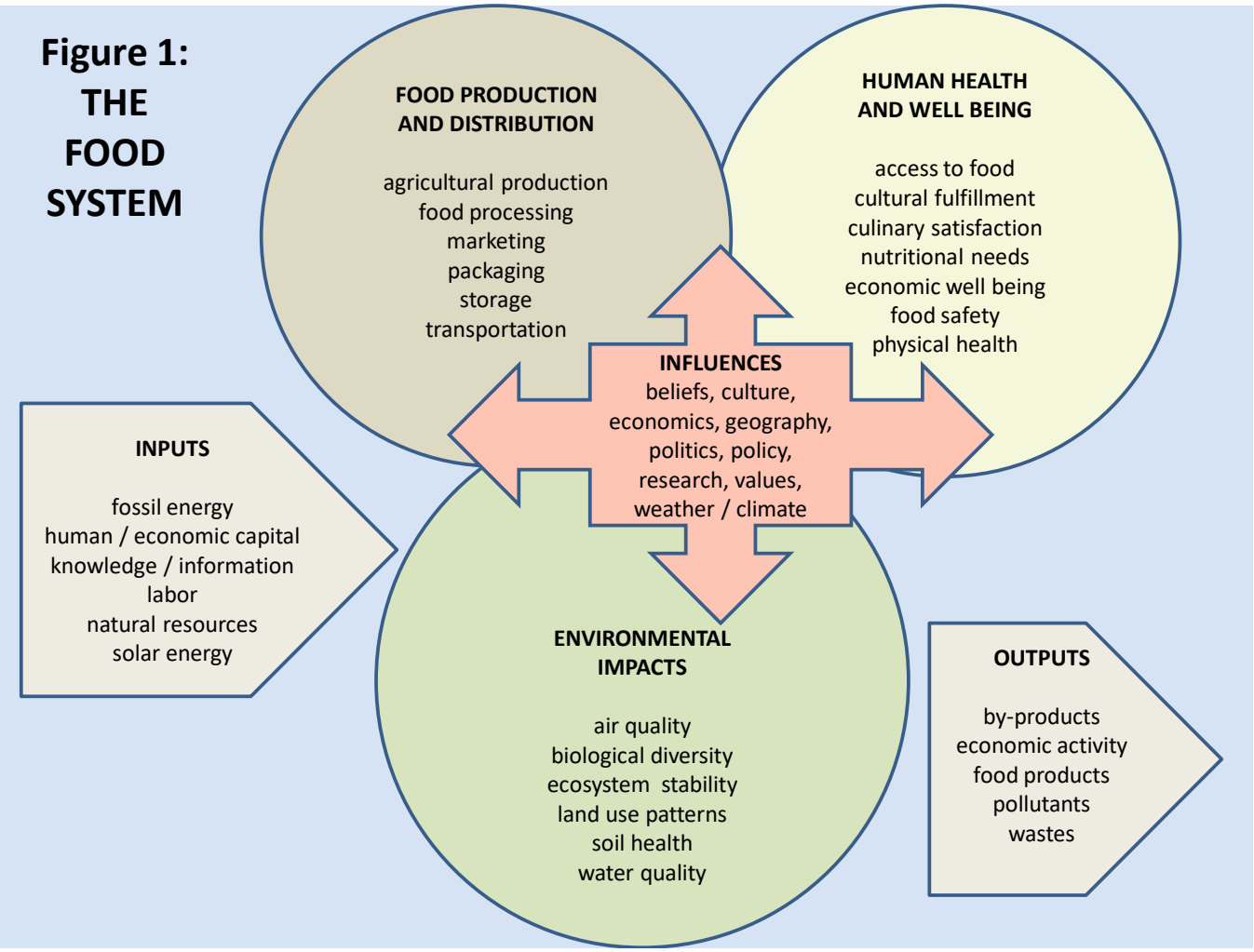
Increasing evidence shows that some of our most pressing public health problems—diet and diet-related illnesses—may be a consequence of our contemporary food systems, and the following statistics underscore the enormity of these problems in this country (although they exist outside this country as well):

- 67 percent of adults age 20 and above are overweight, 34 percent are obese (CDC 2008).
- 17 million households have difficulty obtaining enough food at some time during the year (ERS 2009).
- Food-borne illness affects an estimated 76 million people each year (CDC 2005).

Meanwhile, the agricultural landscape in the U.S. is under threat, seriously challenging the sustainable production of food. Consider the following situation:

- 42 million acres of farmland have been lost since 1987.

- 2.6 percent of all farms now account for 59 percent of the nation's gross agricultural sales (USDA 2009). Such consolidation creates vulnerabilities associated with reliance on fossil energy for transportation and storage, and can amplify food safety threats by aggregating risk.
- Agriculture is responsible for pollution of 48 percent of river miles, 41 percent of lake acres, and 18 percent of estuarine waters found to be water-quality impaired (EPA 2002).



The Vision: *A food systems spire of excellence at UVM will develop solutions to pressing problems in food systems through world-class transdisciplinary research, teaching and outreach dedicated to improving economic, ecological and human well-being.*

Food systems of regional scale are receiving attention for their potential to address urgent societal needs, enhanced climate change mitigation, energy efficiency, economic security, human health and

ecological resilience. Yet evidence for the positive impacts of more regionalized food systems remains limited (Cowell & Jones 2008) with little rigorous scientific analysis in universities and peer-reviewed literature. Grassroots movements and nonprofit organizations have been leaders in existing innovation and, thus, expertise remains predominantly at the community level. Therefore, new frameworks are needed to integrate community and university knowledge using science-based inquiry to test, examine, and evaluate regional food systems' viability and sustainability.

The objectives of examining regional-scale food systems are to 1) generate models, critical analysis, and interpretation; 2) increase capacity for collaborative research that integrates scientific knowledge between academics and communities; and 3) create a cadre of graduates with the knowledge and skills to address food systems challenges. In the most recent Farm Bill, Congress defined locally-produced agricultural food products as those that are raised, produced and distributed within a locality or region and transported less than 400 miles from their origin. This geographic context suggests a vision for food systems wherein goods and services can be moved within a day's time, minimizing storage, handling, and energy usage; wherein mutually beneficial relationships among food system entities can be better developed due to proximity; and wherein consistent political, social, and regulatory support can be established because of a limited number of jurisdictions. Therefore, we posit that regionally-scaled questions will best facilitate problem-solving around obesity, food safety, and sufficient access to food, environmental protection and farm viability with modifications based on the natural and social contexts of a given location (Godfrey et al. 2010).

Vermont: Already a Food Systems Laboratory. The state of Vermont is an ideal site for an engaged exploration of healthy regional food systems due to its history of challenging "business as usual" assumptions of large-scale, global commodity food production and consumption. With its varied topography, harsh climate and limited infrastructure, Vermont has relied on entrepreneurship to maintain a vital agriculture in synergy with citizens who value food and farming beyond economic terms (Vermont Rural

Development Council 2009). Vermonters, as well as tourists to the state, support the working landscape. As a result, food is a significant economic engine in Vermont where 20 percent of private jobs and 31 percent of private business establishments involve the production, processing, distribution, sales or infrastructure of food (Vermont Sustainable Jobs Fund 2009).Vermont leads the nation in per-capita direct-market sales from farms to consumers, and percentage of farmland under organic management. Nearly 8 percent of the state's land is protected for agricultural use by land trust conservation easements. Vermont's innovation, in the face of problems that are widely shared beyond its borders, makes it a rich site for research and development of sustainable models with relevance across the country and the globe.

UVM is Well-Positioned to be a national leader on the complexities of food systems with a regional scale for the following reasons:

- UVM is a land-grant university in the Northeast where massive urban and suburban areas (New York City and Boston) are within 300 miles of large rural areas (northern New England and upstate NY).
- UVM's agricultural efforts are tailored to the community at a grassroots level; research and funding are not driven by a few commodity interests but by the state's diversified needs.
- UVM is engaged in nationally acclaimed entrepreneurship in food and farming, artisan cheese research, farm-to-school food programs, and renewable energy development on farms.
- Food systems research, teaching and outreach integrate seamlessly into the university's strategic commitments to environment and health.
- Undergraduate and graduate students at UVM embrace food systems through service-learning projects, a Community Supported Agriculture program based at UVM's horticultural research farm an undergraduate minor, on-going collaboration with New York University to broaden student experience with both rural and urban food systems, and the development of an interdisciplinary master's program.

UVM has significant existing resources to support a food systems spire:

- $25 million in external 'food system' funding (19% of UVM's $133 million total in 2009).
- 442 relevant courses across 44 departments.
- 420 acres of farms and forests equipped with research facilities.
- A processing facility focused on new dairy product development.
- A health care system and medical/nursing/allied health schools engaged in the integration of nutrition with the treatment and prevention of disease in both research and practice.
- Off-campus extension demonstrations of new biofuel and animal feed crops that integrate energy and food production at a scale that is applicable to the Northeast.

UVM is poised to secure its place as a national and international leader in food systems inquiry, education, and outreach by building on existing efforts. Many of our faculty use transdisciplinary approaches organized around problems, blending research methodologies and collaborating with community stakeholders such as farmers, teachers and physicians to conduct groundbreaking research and to involve students in systems approaches to problem-solving (see Appendix A).

The UVM Food Systems Spire will be Unique. Few institutions can lay claim to the deep and broad commitment to food systems research and engagement occurring at the University of Vermont. Currently, a handful of departments at other universities offer sustainable food systems programs, including University of California-Santa Cruz Center for Agroecology and Sustainable Food Systems, and Tufts University Agriculture, Food and Environment M.S. and Ph.D. programs in the School of Nutrition Science and Policy. Smaller food systems programs exist at Cornell University, Michigan State University, Iowa State University, New York University, University of California-Davis, and the University of Wisconsin; others are emerging. Many of these programs appear to be discrete efforts without integrated institution-wide engagement. In contrast, UVM will develop food systems as a transdisciplinary focus that transcends all schools and colleges. This unique position will attract outstanding scientists and students to UVM.

A Robust Community of External Partners and Programs. Vermont has over 400 diverse agencies, commodity associations and non-profit organizations working to provide innovative solutions to food systems issues (Vermont Sustainable Jobs Fund 2009). Activities include improving school food (Food Education Every Day), promoting new products (Vermont Cheese Council), supporting purchase of locally produced food (Vermont Fresh Network), a legislatively established think tank called the Vermont Sustainable Agriculture Council, and UVM faculty and program staff responding and engaging with community partners.

In 2009, the Vermont legislature authorized $100,000 to develop a10-year strategic plan for agriculture—an effort titled 'Farm to Plate'—focused on identification of obstacles and opportunities for local and regional production, processing, distribution and consumption. Over 800 Vermonters have engaged in public planning meetings, and 50 UVM faculty and staff are providing support to the process. The results of this effort will provide specific guidance to the work of the food systems spire.

A Vision for Cutting-Edge Food Systems Research at University of Vermont. A century ago, the discipline of ecology was born of recognition that the study of organisms in their environment involved a complex system of interactions, and that human intervention in such systems based on reductionist thinking yielded unintended negative consequences (McIntosh 1985). Today, the study of how humans in their environment obtain nourishment requires a similar holistic analysis to consider everything from microbes found in compost facilities to global trade agreements. Currently, a paucity of research links the theories and applications necessary to fully address our food systems challenges because interdisciplinary investigations of food from 'farm to plate' have only emerged within the past 20 years. The food systems spire will embrace a continuum of research efforts from basic natural and physical sciences to translational 'real world' studies. For example, faculty at UVM engaged in basic soil science research on the role of soil microorganisms in synchronizing the availability of soil nutrients with plant needs (e.g., Dr. Neher) will generate data that can be used by faculty focused on enhancing agricultural production while reducing

negative environmental impact (Drs. Drizo & Berkett) which can also be studied from a socio-economic perspective (Drs. Kolodinsky & Parsons). Simultaneously, data can be integrated with research such as: 1) health outcomes of school-age children whose schools are engaged in the Farm-to-School initiative (Drs. Berlin & Harvey-Berino); 2) investigations into the history of land use and school nutrition policy (Drs. Koliba, Johnson &Trubek); and 3) implications for farmer viability and climate change (Drs. Kolodinsky & Wright).

A transdisciplinary spire of excellence emphasizing regionally-scaled food systems will position University of Vermont as the first land-grant university to adopt a 21st century version of Thomas Jefferson's vision of agrarian virtue and democracy; marrying his ideal with innovative and relevant scientific research. Four integrative domains of research that are central to societal concerns about the state of food systems, with potential to attract significant external funding, recruit outstanding students, and generate new knowledge and raise UVM's profile. They are 1) food, culture and health; 2) energy and food; 3) policy, ecology and land use; and 4) regional food chains. These domains reflect current research strengths within the University but also have great potential for creating new synergies with other faculty. An example of extending faculty and student engagement with food systems would attract nationally distinguished scholars who energize research, teaching and outreach. Priority would be given to scholars who could facilitate broad and deep considerations to inform transdisciplinary research frameworks.

1) *Food, Culture and Health.* This integrative area will naturally combine the intellectual endeavors of faculty across the university, including anthropologists, nutritionists, psychologists, physicians, political scientists and economists. A challenge in imagining the future of the food system lies in the fact that food choices are made every day by individuals, but these choices are invariably constrained in some manner. Individual dietary decisions are influenced by cultural and historical practices, psychological and biological factors, influences of mass media and advertising, physical and economic access to food and other domains that cross multiple disciplines. For example, America has a public health crisis related to overweight/obesity

and associated chronic diseases; most alarming is the epidemic in children, a priority of the Obama administration. Adults (parents, caregivers, teachers, health care providers, and others who work with and care for children and families) act as role models and share a responsibility to help the next generation prevent obesity and promote health. UVM scholars will study the impact of a present intervention strategy, Farm-to-School program, that incorporates nutrition education, gardening experiences, and exposure to local food in cafeterias on eating habits or food choices (e.g., Drs. Berlin, Colley, & Kolodinsky) and health outcomes such as body mass index and blood pressure (Drs. Harvey-Berino, Fukugawa, & Johnson). In addition, an interdisciplinary team of faculty will consider connections among cultural values, public policy, food distribution and consumption patterns. Models will be developed for successful programs applicable to multiple locations at various scales for populations of varying race, class and ethnicities (Drs. Bose, Trubek, & Gilley). Health behavior, cultural, economic and environmental theory inform investigations of current trends in Vermont, the Northeast and the nation to link a transformative systems model of school food programs to promote better health outcomes for children. The results of this work will directly support achievement of Vermont's strategic health goals (Vermont Dept. of Health 2007).

2) *Energy and Food*. Regional-scaled models for food systems are increasingly identified as possible solutions for two pressing 21st century problems: food security and climate change. Farms must feed future generations, even as fossil energy diminishes and the global population increases. Reducing energy use in agriculture will help maintain food security while mitigating environmental impacts associated with fossil fuel-based transportation and fertilizer production (Godfray et al. 2001). An international group of scientists addressing food security and agriculture in a recent *Science* magazine editorial recommended "building local educational, technical, and research capacity, food processing capability, storage capacity, ….as well as rural transportation and water and communications infrastructure" (Federoff et.al. 2010). A deeper understanding of the energy and carbon flows associated with varying levels of inputs and outputs of food systems is needed to develop more efficient and sustainable practices and technologies. Teams of UVM scholars will

investigate 1) the productive capacity of regional food systems (e.g., Drs. Darby & Grubinger); 2) factors affecting establishment of these systems (Drs. Wallin & Berkett); 3) their contribution to ecological, economic and social sustainability (Drs. Mendez, Constanza & Erickson); 4) synergies and trade-offs between food and energy systems (Drs. Bosworth &Wright); and 5) trends and drivers affecting local food economies (Drs. Kolodinsky, Liang, Parson & Peabody). These questions establish new domains of inquiry related to effective scales of production and resource use, new notions of ecological health, and a globalized nature of local economies. They stimulate new types of multi-scale and systems analysis wherein both local community and societal food and energy needs are considered and cross-scale impacts are analyzed (Barrett 2010).

3) *Policy, Ecology and Land Use.* The farm landscape includes cropland as well as forest, wetland and grassland that provide ecosystem services such as carbon sequestration, groundwater recharge and wildlife habitat. The long-term value of this multi-functionality is often compromised by short-term land use decisions. A collaborative team of UVM scholars will examine connections among agricultural policy (Dr. Koliba), land use patterns (Drs. Troy, Dupigny-Giroux & Mendez) and their relationship to food production (Drs. Smith, Bosworth & Darby), water quality and biological diversity in the landscape (Dr. Neher, Watzin & Wallin). They will document and connect these assets to socioeconomic processes that undergird rural economic development. Domains of investigation include intermingling of croplands and urban and suburban development, size and homogeneity of land use patches within the agricultural landscape, and identification optimal sizes and clusters of food production, processing and distribution properties. Systems modeling and landscape design methods will be used to assess what is possible at a regional scale. Factors to be considered include land capability, energy and food costs, land tenure, policy incentives, infrastructure needs, capital investment opportunities and facilitating social structures.

4) *Regional Food Chains*. Collaborative teams of scholars at the University of Vermont are working with stakeholders to understand and facilitate shifts in supply chains necessary to create a regional food

systems model. Lack of profitability in larger commodity markets is difficult to surmount in the Northeast, yet booming direct producer-to-consumer retail markets for food cannot accommodate the volume of product desired by consumers in Vermont and throughout the region. This is due partially to broad citizen interest in re-localizing the food economy. In Vermont, food scientists, anthropologists, economists, land use planners, policy specialists, and engineers and agronomists at UVM are collaborating with local stakeholders such as Hardwick's Center for an Agricultural Economy, the Vermont Cheese Council and the Vermont Agency of Agriculture, Food and Markets to study the best methods of re-localizing the food system. For example, aggregating local milk for processing into a premium, branded wholesale product helps dairy farms overcome low commodity prices for milk if farmers have equity in the processing business, and if the product can be marketed effectively. Vegetable farmers organized into wholesale cooperatives sell locally-branded produce directly to schools, avoiding distributor fees and enhancing profits. Actualizing such a system requires an interdisciplinary team of faculty scholars on domains including a regional agrarian culinary history (e.g., Drs. Brown & Trubek), product development and production efficiency (Drs. Kindstedt & Guo), food pathogens and food safety (Drs. Donnelly, Hill & Smith), alternative regulatory and policy mechanisms (Drs. Bartlett & Koliba), processing and distribution channels (Dr. Barlow) to facilitate the emergence of new enterprises that exemplify viable regional food chains (Drs. Darby & Grubinger).

Extraordinary Recruitment Potential. The ultimate goal for graduate education is to create an interdisciplinary Ph.D. program in food systems with tracks in policy, public health and environment. Vermont's national reputation for innovation in food and agriculture has attracted numerous inquiries for graduate level opportunities in food systems from across the nation. World-class graduation education in food systems is being developed, supported by a recent USDA Challenge grant award to develop a new master's degree program in food systems. The grant provides resources and momentum for the creation of core courses and overall curriculum design based on a transdisciplinary, engaged pedagogy to educate students to be future food systems leaders and scholars. Students will receive significant training from

experienced faculty in practical skills such as facilitation, cross-cultural communication, research ethics, collaborative learning and adaptive management to enhance their job preparedness and competitiveness as scientists, project managers and policy makers. The intellectual foundation for the Ph.D. program was created through the process of submitting an Integrative Graduate Education and Research Traineeship (IGERT) proposal to National Science Foundation in fall 2009. The food systems Ph.D. program has been endorsed by the Colleges of Agriculture and Life Sciences (CALS) and the Rubenstein School of Environment and Natural Resources (RSENR); it integrates well with the complex systems spire, and existing campus programs including the Spatial Analysis Laboratory, the Transportation Center, Ecosystems Science Laboratory, the Gund Institute for Ecological Economics, the Center for Sustainable Agriculture, the Center for Rural Studies, the Vermont Food Systems Research Collaborative, the Vermont Water Resources and Lake Studies Center, and the Community-University Partnerships office.

Undergraduate and graduate curriculum offerings on food systems will be enhanced as new faculty infuse transdisciplinary knowledge in classrooms across all colleges and schools on the UVM campus. This concept was launched in August 2009 by the Honors College who hosted a food systems seminar, attracting participants from every college within the University. Melding the four integrative research domains into traditional semester offerings, intensive travel and summer courses (focused on urban and rural food systems), internships (with food businesses, non-profits and state agencies), and student research opportunities (on emerging new models for regional food systems) will enhance the appeal of UVM to students seeking multi-faceted educational experiences around complex societal issues. UVM's campus-based food systems—including methods of production, procurement, consumption, and waste management—will be used as a "living laboratory" for students. The spire will integrate the academic learning environments (the horticulture and dairy farm, the foods laboratory, the Office of Sustainability, Vtrim weight loss program) with students' everyday decisions about what to eat (high fat or low fat, sit down

or grab-and-go, anonymous or identifiable producers). This 'informed eating environment' will bring questions of scale, scope and sustainability to the forefront of the UVM student experience.

Achieving Success. The food systems spire balances the complex interdependencies in the connections among vital interests of humanity such as the creation of nourishment, the pursuit of health and well-being, and maintenance of the environment. To realize such an important and ambitious project and allow the food systems spire to reach its full potential at UVM we propose the following six actions, which will be supported in large measure by an aggressive effort to secure external funding, leveraged with appropriate allocations of internal resources.

1. *Clearly commit to a leadership role by immediately hiring a Director and then pursing philanthropy for an Endowed Chair in Regional Food Systems.*
2. *Create four to eight faculty positions to address critical transdisciplinary food systems questions.*
3. *Offer annual food systems research planning grants for faculty.*
4. *Host biennial national symposia on food systems research and outreach.*
5. *Establish a UVM Regional Food Systems Advisory Council to guide and review progress.*
6. *Launch a campus-wide initiative that links transdisciplinary food systems research with student engagement in all domains of campus life from dining halls to teaching gardens to capstone seminars.*

The Director will be responsible for administration, implementation and assessment of cross campus food systems activities and programs. New faculty positions will focus on the four integrative research domains presented above, which are central to the sustainability of regional food systems. The nationally-recognized scholar selected to be the Regional Food Systems Endowed Chair will be provide intellectual leadership to cement UVM's diverse food systems research into a unified effort. The Chair will facilitate communication and, thus, synergy among teams of faculty scholars addressing ambitious transdisciplinary projects. To catalyze such projects, we suggest providing at least four $25,000 integration grants in each of the spire's first three years and subsequently one per year. This will encourage team formation, project

planning and submission of external funding requests. Food systems faculty will organize symposia on a biennial basis to share research results with national and international colleagues to foment cross-disciplinary communication well beyond the campus and state borders, and to elevate UVM's leadership role in food systems research. A national food systems advisory council will be created, to meet semi-annually with the Food Systems Director and Endowed Chair, to assure that research proposals are optimally connected to external partners, and to promote stakeholder awareness of UVM's research efforts and results.

Comprehensively engaging students with issues and choices on a daily basis through the campus food system, as well as in educational programs, promises yield benefits to both academic performance and student health. Such engagement will serve as a powerful recruitment tool for students seeking immersion in a transformative and highly applicable educational experience.

By unequivocally stating its commitment to generating new knowledge about sustainable and viable regional food systems, UVM will be seen as a laboratory for the nation and the globe, inviting partnerships from many sectors, while positioning itself for renewed interest from governmental and philanthropic funders.

External Funding. The spire's work will align with the goals of several key federal funding agencies and philanthropic organizations, as well as the specific objectives of grant programs within those entities. The five priority science areas of the National Institute of Food and Agriculture (NIFA) are: 1) food security, 2) climate change, 3) sustainable energy, 4) childhood obesity and 5) food safety (USDA 2009). These clearly align with food systems solutions desired at UVM.

In February of 2010, NIFA's flagship competitive grants program, the Agriculture and Food Research Initiative (AFRI), is committing up to $800 million in funding for new grants that support interdisciplinary, multi-functional projects in the five priority areas to achieve significant and measurable outcomes (USDA 2010).

Other competitive grant programs administered by NIFA also have strong potential for supporting food systems work, including: Community Food Projects, the Specialty Crop Research Initiative and the Sustainable Agriculture Research and Education program. The "Know Your Farmers Know Your Food" initiative is a USDA-wide effort to create new economic opportunities by better connecting consumers with local producers, with a focus on integrating government programs in a food systems framework.

The NIH Roadmap for Medical Research identifies interdisciplinary research as an approach to transforming the way scientists work and how their work is reviewed and supported (NIH 2008). The National Center for Research Resources (NCRR) at the NIH will support research infrastructure, thematic research programs and clinical translational science centers; UVM presently has an application to support the latter in review. The NCRR Centers of Biomedical Research Excellence (COBRE) program has the objective of strengthening an institution's biomedical research infrastructure through the establishment of a thematic multidisciplinary center. A UVM Food Systems Research center would focus on the spectrum from food consumption patterns and behavior to nutrient-gene interactions that modulate the evolution of obesity and/or type 2 diabetes and related disease complications with the overall goal of improving public health.

Vermont foundations have a strong history of funding agriculture, environment and health-related projects. Several faculty, including the co-directors of Vermont Institute of Artisan Cheese at UVM (Drs. Donelly & Kinstedt), have repeatedly been awarded funding from Vermont foundations for food systems research and outreach. At the national level, UVM food systems work has previously garnered the support of the W.K. Kellogg Foundation, which recently announced a Food and Community program that will invest $32 million over three years to increase access to healthy food and physical activity.

Measuring Success. An annual measure of goals achieved will help guide and evaluate the spire's work both internally and externally. While somewhat speculative, we consider the following benchmarks for the spire's performance to be ambitious but achievable.

- *Year One:* Hire director. UVM faculty submits three transdisciplinary proposals to funding agencies for a total of $1 million. The Masters in Food Systems program is launched, recruiting five new students; two new Ph.D. students will also conduct food systems research. A philanthropic campaign is initiated to endow a Regional Food Systems Chair, securing pledges of $500,000.
- *Year Two:* A total of $5 million in grant proposals is submitted, engaging 25 faculty members. Fifteen faculty associate their publications with the spire. The Ph.D. program in Food Systems is launched. The Chair's endowment reaches $2 million in pledges and a search commences. An additional 10 graduate students engage in food systems research.
- *Year Three:* At least $2.5 million in external grant funding is secured. Three publications are produced that are based specifically on the first transdisciplinary grant earned. Endowed Chair is hired. More than 25 graduate students are engaged in food systems research.
- *Year Five:* Annual external funding reaches $40 million in food systems related research. Faculty in the spire generate 30 refereed journal publications. There is a cohort of 35 to 50 graduate students.

Conclusion. There are few societal challenges that provide greater justification for transdisciplinary research than those presented by our modern-day food systems. To date, we have addressed food systems problems in relative isolation, whether reducing obesity, protecting water quality or the need to develop more sustainable bio-fuels. Clearly these problems can best be solved by seeking solutions that address their multiple root causes, using new knowledge that explains complex relationships. UVM already provides leadership in this area, within the region but also within the nation and globe. A food systems spire of excellence at UVM focusing on the scope of regional food systems will allow Vermont's excellent land-grant university to extend such important work to a higher level by synergizing existing efforts, catalyzing bold thinking, and stimulating the acquisition of additional human and financial resources. The results will elevate recognition for the University of Vermont as a premier public land grant university, showcasing our deep commitment to generating relevant new knowledge for the public good.

References Cited.

Barrett CB. 2010. Measuring food insecurity. *Science* 327: 825-828.

CDC. 2005. *Foodborne illness*. Retrieved February 16, 2010 from Centers for Disease Control and Prevention: http://www.cdc.gov/ncidod/dbmd/diseaseinfo/foodborneinfections_g.htm#howmanycases

CDC. 2008. *Health, United States, 2008*. Retrieved February 16, 2010 from Centers for Disease Control: http://www.cdc.gov/nchs/hus.htm.

Cowell SJ & Jones DL. 2008. Testing the assertion that 'local food is best': the challenges of an evidence-based approach. *Trends in Food Science & Technology* 19: 265-274.

EPA. 2002. *National water quality inventory: 2000 report to Congress*. Retrieved February 16, 2010 from Environmental Protection Agency: http://www.ers.usda.gov/publications/arei/eib16/Chapter2/2.2/.

ERS. 2009. *Household food security in the United States, 2008*. Retrieved February 16, 2010 from Economic Research Servce, USDA: http://www.ers.usda.gov/features/householdfoodsecurity

Fedoroff NV, Battisti BS, Beachy RN et al. 2010. Radically rethinking agriculture for the 21st century. *Science* 327: 833-834.

Godfra HCJ, Beddington JR, Crute IR et al. 2010. Food security: the challenge of feeding 9 billion people. *Science* 327: 812-818.

MacIntosh R. 1985. *The background of ecology: concept and theory*. New York: Cambridge University Press.

NIH. 2008. *NIH roadmap for medical research, research teams of the future*. Retrieved February 16, 2010 from National Institutes of Health: http://nihroadmap.nih.gov/researchteams.

USDA. 2009. *2007 Census publications, volume 1, chapter 1, national level data*. Retrieved February 16, 2010 from USDA Census of Agriculture, National Statistics Service: http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_1_US/index.asp.

USDA. 2009. *NIFA fact sheet*. Retrieved February 16, 2010 from USDA: http://www.nifa.usda.gov/newsroom/factsheet.pdf.

USDA. 2010. *NIFA plans to release agriculture and food research initiative RFA in February*. Retrieved February 16, 2010 from USDA: http://www.nifa.usda.gov/newsroom/news/2010news/01062_afri.html.

Vermont Council on Rural Development. 2009. *Imagining Vermont: value and vision for the future.* Retrieved February 16, 2010 from Final Report of the Council on the Future of Vermont.: http://futureofvermont.org/files/u1/Imagining_Vermont_Report1.pdf

Vermont Department of Health. 2007. *Blueprint for health: strategic plan*. Retrieved February 16, 2010 from report to the legislature: http://healthvermont.gov/admin/legislature/documents/Blueprint_leg_report.pdf.

Vermont Sustainable Jobs Fund. 2009. *Farm to plate initiative: a snapshot of Vermont's food system.* Retrieved February 16, 2010 from: http://www.vsjf.org/sustainable_agriculture/documents/VCDApresentation11.10.09-external.pdf.

White N. 2007. *Alternatives for on-farm energy enhancement in Vermont*. Burlington, VT: Vermont Sustainable Agriculture Council

Table 1. Actively participating core faculty and possible affiliated faculty contributing to food systems research at University of Vermont. Productivity is illustrated in two metrics: extramural grant funding since 2005 and publications. A sample bibliography of food systems peer-reviewed literature authored by UVM faculty is provided in the reference section; contributing faculty are denoted with a # (see Table 2).

Investigator, Rank, Department	Unit	Pubs (√)	2005-present Grants ($)	Investigator, Rank, Department	Unit	Pubs (√)	2005-present Grants ($)
1. Food, Culture and Health							
Abrams SE, Assoc Prof, Nursing	CNHS		0	Macias T, Assoc Prof, Sociology	CAS	#	0
Berlin L, Asst Prof, NFS, Ctr Sust Ag	EXT	#	384,369	Maltby H, Assoc Prof, Nursing	CNHS		20,000
Bingham P, Assoc Prof, Neurology	COM		1,751,215	Manning M, Outreach Prof	EXT		5,150
Bond L, Prof, Psyc	CAS	#	5,000	Matthews DE, Prof, Chair Chemistry	CAS	#	2,700,515
Delay E, Prof, Biology	CAS	#	744,144	Mincher D, Ext Assoc Prof	EXT		178,755
Fukagawa N, Prof, Geriontology	COM	#	1,902,110	Morris N, Assoc Prof, Nursing	CNHS		17,098
Galbraith R, Prof, Medicine	COM	#	10,362,769	Moulaert A, Res Assoc	CALS		300,000
Gilley B, Assoc Prof, Anthro	CAS		10,510	Mulvaney-Stanak L, Stud Life Prof	Other		21,804
Harvey-Berino J, Prof, Chair, NFS	CALS	#	4,313,507	Pratley R, Prof, Endocrinology	COM		2,664,405
Jetton T, Assoc Prof, Endocrinology	COM		5,230,051	Ryan S, Director, Ctr Disab &Comm	CESS		8,890,841
Johnson RK, Prof, NFS	CALS	#	335,912	Shaw J, Res Assoc Prof, Pediatrics	COM	#	23,924,688
Kleinman S, 4-H Coordinator	EXT		281,586	Stapleton R, Asst Prof, Pulmonary	COM		203,930
Kolodinsky J, Prof, Chair, CDAE	CALS	#	1,723,352	Trubek A, Asst Prof, NFS	CALS		206,104
Lewis M, Asst Prof, Pathology	COM		2,222,087	Wang QB, Assoc Prof, CDAE	CALS		0
Littenberg B, Prof, Internal Medicine	COM	#	3,029,635	Wood M, Prof, Hematology/Oncology	COM		1,412,179
				Group 1 Total			**$72,841,716**
2. Energy and Food							
Aultman-Hall L, Director	Trans	#	11,719,291	Darby HB, Asst Ext Prof	EXT/PSS	#	3,089,299
Baker D, Asst Prof, CDAE	CALS		24,725	Erickson JD, Assoc Prof, Gund	RSENR	#	73,248
Barlow J, Res Asst Prof, AS	CALS	#	412,984	Rizzo, D, Assoc Prof, Civil & Enviro	CEMS	#	3,748,933
Bosworth S, Assoc Ext Prof, PSS	CALS		192,193	Wright A-D, Prof, AS	CALS	#	4,700,000
				Group 2 Total			**$23,960,673**
3. Policy, Ecology and Land-Use							
Ali S, Assoc Prof	RSENR	#	95,500	LeVitre R, Assoc Dean	EXT		1,268,927
Barrington D, Prof, Plant Bio	CALS		140,672	Magdoff F, Emeritus Prof, PSS	CALS	#	32,375
Bartlett R, Prof, Pol Sci	CAS	#	0	Manning RE, Prof	RSENR		1,356,634

Berkett L, Ext Prof, PSS	CALS		1,841,863	Marsden JE, Prof	RSENR		1,556,208
Bierman P, Prof, Geol	CAS		1,914,164	McEvoy T, Ext Prof	RSENR/EXT		104,800
Bose P, Asst Prof, Geog	CAS		10,000	McMaster W, Ext Assoc Prof	EXT		74,234
Ceroni M, Res Asst Prof, Plant Bio	CALS		105,000	Mendez VE, Asst Prof, PSS	CALS	#	665,489
Costanza R, Prof, Gund	RSENR	#	2,358,073	Molofsky J, Prof, Plant Bio	CALS		412,372
Danks C, Asst Prof	RSENR		125,967	Neher D, Prof, Chair, PSS	CALS	#	1,603,990
Dupigny-Giroux L, Assoc Prof, Geog	CAS		1,329,411	Parker B, Prof, PSS	CALS		2,215,277
Drizo A, Res Assoc Prof, PSS	CALS		1,710,599	Perkins TD, Res Assoc Prof, Plant Bio	CALS		1,890,823
Eppstein M, Assoc Prof, Comp Sci	CEMS		532,400	Rogers G, Ext Prof	EXT		252,178
Gilker R, Outreach Prof, Ctr Sust Ag	EXT		342,713	Ross D, Res Assoc Prof, PSS	CALS		774,781
Gotelli N, Prof, Biology	CAS	#	161,144	Rowe E, Ext Assoc Prof	EXT		301,202
Greene E, Ext Prof, AS	CALS		17,000	Smith J, Assoc Ext Prof, AS	CALS	#	267,102
Grubinger V, Ext Prof	EXT	#	16,266,670	Starrett M, Assoc Prof, PSS	CALS		16,568
Harris J, Assoc Prof, Plant Biol	CALS		829,750	Strong AM, Assoc Prof	RSENR	#	804,172
Hazelrigg A, Ext Lecturer, PSS	CALS		713,163	Todd J, Res Prof	RSENR	#	636,011
Holtzman B, Outreach Prof	EXT		1,500	Troy A, Assoc Prof	RSENR		1,541,976
Homziak J, Ext Asst Prof	EXT/RSENR		3,160,834	Villa F, Res Prof, Plant Bio	CALS	#	1,558,976
Kaza S, Prof & Dir, Env Prog	RSENR	#	0	Wallin K, Res Asst Prof	RSENR		723,048
Koliba C, Assoc Prof, CDAE	CALS		210,181	Wang D, Assoc Prof	RSENR		1,550,505
Kuentzel W, Assoc Prof	RSENR		120,158	Watzin M, Prof, Dean	RSENR		4,059,349
Law MT, Asst Prof, Econ	CAS	#	0	Wollenberg E, Res Assoc Prof	RSENR		960,426
				Group 3 Total			**$56,614,185**
4. Regional Food Chains							
Brown D, Assoc Prof, History	CAS		0	Liang K, Assoc Prof, CDAE	CALS		162,097
Donnelly CW, Prof, NFS	CALS	#	1,507,245	Parsons R, Ext Assoc Prof	CDAE	#	5,034,685
Hill J, Asst Prof, Eng	CEMS	#	1,731,805	Peabody M, Ext Assoc Prof	EXT		1,367,092
Kindstedt P, Prof, NFS	CALS	#	85,583	Pintauro S, Assoc Prof, CDAE	CALS		3,350,955
Kirkpatrick B, Assoc Prof, Infect Dis	COM		4,952,389	Pritchard T, Sr Lecturer, NFS	CALS	#	4,003
Kolan M, Lecturer	RSENR		0	Wang QB, Assoc Prof, CDAE	CALS	#	0
				Group 4 Total			**$18,195,854**

Table 2. Representative Bibliography of University of Vermont Faculty Publications on Food Systems

Ali S et al. 2007. Experts address the question: In your view, do agricultural subsidies in developed countries benefit or harm the majority of the poor in developing countries? *Natural Resources Forum* 31(4): 318-321.

Aultman-Hall L et al. 2006. Network Robustness Index: A new method for identifying critical links and evaluating the performance of transportation networks. *Journal of Transportation Geography* 14(3): 215-227.

Barlow JW et al. 2003. A comparison of antimicrobial susceptibility patterns for Staphylococcus aureus in organic and conventional dairy herds. *Microbial Drug Resistance-Mechanisms Epidemiology and Disease* 9, Suppl. 1: S39-S45.

Bartlett R & Gupte M. 2007. Necessary preconditions for deliberative environmental democracy? Challenging the modernity bias of current theory. *Global Environmental Politics* 7(3):94.

Berlin L et al. Purchasing foods produced on organic, small and local farms: A mixed method analysis of New England consumers. *Renewable Agriculture and Food Systems* 24(4): 267-275.

Costanza R, Erickson DL et al. 2006. Linking ecology and economics for ecosystem management. *Bioscience* 56(2): 121-133.

Costanza R, Ali S, Bond L, Rizvi S, Rizzo DM et al. 2007. Quality of life: An approach integrating opportunities, human needs, and subjective well-being. *Ecological Economics* 61(2-3): 267-276.

Costanza R et al. 2009. The value of producing food, energy, and ecosystem services within an agro-ecosystem. *AMBIO* 38(4): 186-193.

Darby HM et al. 2006. Compost and manure mediated impacts on soilborne pathogens and soil quality. *Soil Science Society of America Journal* 70(2): 347-358.

Darby HM, Berkett LP et al. 2008. Evaluation of alternative fungicides for organic apple production in Vermont. *Phytopathology* 98(6): S42.

Delay ER et al. 2006. Sucrose and monosodium glutamate taste thresholds and discrimination ability of T1R3 knockout mice. *Chemical Senses* 31(4): 351-357.

Donnelly CW. 2009. Detection, isolation, and incidence of Listeria spp. in small-scale artisan cheese processing facilities: A methods comparison. *Journal of Food Protection* 72(12): 2499-2507.

Drizo A et al. 2006. Flow patterns of dairy wastewater constructed wetlands in a cold climate. *Water Research* 40(17): 3209-3218.

Erickson JD et al. 2006. Technological learning and renewable energy costs: implications for US renewable energy policy. *Energy Policy* 34(13): 1645-1658.

Fukagawa NK. 2006. Sparing of methionine requirements: Evaluation of human data takes sulfur amino acids beyond protein. *Journal of Nutrition* 136(6): 1676S-1681S.

Fukagawa NK & Galbraith RA. 2004. Advancing age and other factors influencing the balance between amino acid requirements and toxicity. *Journal of Nutrition* 134(6): 1569S-1574S.

Galbraith RA et al. 2006. Possible role of creatine concentrations in the brain in regulating appetite and weight. *Brain Research* 1101: 85-91.

Gotelli N & Ellison AM. 2006. Food-web models predict species abundances in response to habitat change. *PLoS Biology* 4(10): 1869-1873.

Grubinger VP. 1992. Organic vegetable production and how it relates to LISA. *Hortscience* 27(7): 759-760.

Grubinger VP. 1999. Sustainable Vegetable Production from Start-up to Market. Ithaca, NY: Natural Resource, Agriculture, and Engineering Service.

Harvey-Berino J et al. 2005. The impact of calcium and dairy product consumption on weight loss. *Obesity Research* 13(10): 1720-1726.
Harvey-Berino J et al. 2007. Weight loss on the web: A pilot study comparing a structured behavioral intervention to a commercial program. *Obesity* 15(1): 155-164.
Hill JE & Cade-Menun BJ. 2009. Phosphorus-31 nuclear magnetic resonance spectroscopy transect study of poultry operations on the Delmarva Peninsula. *Journal of Environmental Quality* 38(1): 130-138.
Johnson RK et al. 2004. Children and adolescents' choices of foods and beverages high in added sugars are associated with intakes of key nutrients and food groups. *Journal of Adolescent Health* 34(1): 56-63.
Johnson RK et al. 2007. Associations between patterns of beverage consumption and nutrient intakes and BMI in the US. *FAEB Journal* 21(6): A1062.
Kaza S. 2005. Western Buddhist motivations for vegetarianism. *Worldviews, Environment, Culture, Religion* 9(3): 385-411.
Kindstedt P et al. 2006. Production meets processing: A vital link for high quality dairy foods. *Journal of Animal Science* 84, Suppl. 1: 279.
Koliba CJ et al. 2005. Place-based education in the standards-based reform era - Conflict or complement? *American Journal of Education* 112(1): 44-65.
Koliba CJ & Lathrop J. 2007. Inquiry as intervention - Employing action research to surface intersubjective theories-in-use and support an organization's capacity to learn. *Administration & Society* 39(1): 51-76.
Kolodinsky J, Harvey-Berino J et al. 2006. Consumers may not use or understand calorie labeling in restaurants. *Journal of the American Dietetic Association* 106(6): 917-920.
Kolodinsky J, Harvey-Berino J, Berlin L, Johnson RK & Reynolds T. 2007. Knowledge of current dietary guidelines and food choice by college students: Better eaters have higher knowledge of dietary guidance. *Journal of the American Dietetic Association* 107(8): 1409-1413.
Kolodinsky J, Hyman J et al. 2009. Household food and beverage purchasing. *Journal of the American Dietetic Association* 109(6): 982-983.
Kolodinsky J & Reynolds T. 2009. Segmentation of overweight Americans and opportunities for social marketing. *Journal of Behavioral Nutrition and Physical Activity* 6(13):
Law MT et al. 2008. Earmarked: The political economy of agricultural research appropriations. *Review of Agricultural Economics* 30(2): 194-213.
Littenberg B et al. 2005. Health literacy of community dwelling adults living with diabetes and congestive heart failure. *Journal of Cardiac Failure* 11(6): 373.
Macias T. 2008. Working toward a just, equitable, and local food system: the social impact of community-based agriculture. *Social Science Quarterly* 89(5): 1086-1101.
Magdoff F. 2001. Concept, components, and strategies of soil health in agroecosystems. *Journal of Nematology* 33(4): 169-172.
Matthews DE et al. 2009. Vitamin B-6 restriction tends to reduce the red blood cell glutathione synthesis rate without affecting red blood cell or plasma glutathione concentrations in healthy men and women. *American Journal of Clinical Nutrition* 90(2): 336-343.
Mendez VE et al. 2009. Cooperative management and its effects on shade tree diversity, soil properties and ecosystem services of coffee plantations in western El Salvador. *Agroforestry Systems* 76(1): 111-126.
Neher DA et al. 2005. Ecosystem type affects interpretation of soil nematode community measures. *Applied Soil Ecology* 30(1): 47-64.

Parsons RL, Kolodinsky J et al. 2007. A cost and returns evaluation of alternative dairy products to determine capital investment and operational feasibility of a small-scale dairy processing facility. *Journal of Dairy Science* 90(5): 2506-2516.
Pritchard T et al. 2007. Development of a Web-based, multimedia computer application for teaching food safety to middle school children. *FASEB Journal* 21(5): A212.
Rizzo DM, Hayden NJ & Rossman AJ. 2006. Low-temperature soil heating using renewable energy. *Journal of Environmental Engineering* 132(5):537-544.
Shaw J et al. 2007. Inspiring healthy adolescent choices: A rationale for and guide to strength promotion in primary care. *Journal of Adolescent Health* 41(6): 525-535.
Smith JM, Parsons RL et al. 2008. Love thy neighbor - But does that include a six hundred eighty-four cow dairy operation? A survey of community perceptions. *Journal of Dairy Science* 91(4): 1673-1685.
Smith JM et al. 2009. Dynamics of endemic infectious diseases of animal and human importance on three dairy herds in the northeastern United States. *Journal of Dairy Science* 92(4): 1811-1825.
Strong AM et al. 2008. Regional population viability of grassland songbirds: Effects of agricultural management. *Biological Conservation* 141(12): 3139-3151.
Todd J et al. 2003. Ecological design applied. *Ecological Engineering* 20(5): 421-440.
Trubek AB & Bowen S. 2008. Creating the taste of place in the United States: can we learn from the French? *GeoJournal* 73(1): 23-30.
Villa F et al. 2009. Modeling with knowledge: A review of emerging semantic approaches to environmental modeling. *Environmental Modeling & Software* 24(5): 577-587.
Wang QB & Timmons D. 2010. Direct food sales in the United States: evidence from state and county-level data. *Journal of Sustainable Agriculture* 34(2): 229-240.
Wright A-DG et al. 2009. Methanogen diversity in the rumen of lactating dairy cattle is not significantly influenced by long-term monensin supplementation. Applied and Environmental Microbiology 75(2): 374-380.

APPENDIX A: Present Transdisciplinary Food Systems Research and Outreach Projects

- Dept. of Animal Science faculty lead research and outreach that integrate biosecurity, epidemiology, emergency management and public policy aimed at food supply protection.
- UVM Extension is engaged in a $1 million project to improve organic wheat production, processing and culinary attributes through agronomic, marketing and baking quality investigations.
- The School of Natural Resources collaborates with an eco-industrial park to link businesses so that excess energy from one is used to heat greenhouse food crops while waste from another fertilizes those crops.
- Dept. of Nutrition and Food Sciences faculty are looking at the intersection of sensory science, food culture and rural economic development to understand the past, present and future of place-based foods.
- The Dept. of Medicine is analyzing the effects of environment and geography on obesity and energy balance, while improving diabetes management statewide through an automated health care reminder system.
  • The Dept. of Plant and Soil Science hosts a project on coffee growing and rural livelihoods that considers the problems of creating economically and environmentally sustainable practices in El Salvadoran communities.
- The Dept. of Community Development and Applied Economics faculty study consumer food behavior and economic implications for new markets, including organic dairy, institutional markets and community supported agriculture.
- The Food System Research Collaborative in the Center for Rural Studies provides coordination for on- and off-campus research projects focused on consumer and institutional issues that affect demand for local food.
- The Center for Nutrition and Health Food Systems at Fletcher Allen Hospital provides a virtual community to connect food professionals throughout New England who are working to promote healthier eating habits.
- Clinical research on obesity at UVM has generated Vtrim, an online behavioral weight loss program accessed by physicians and individuals across the country.
- The Center for Sustainable Agriculture links extension, teaching and research with state agencies and producer groups to optimize grass-fed livestock production, local food systems and support for new farmers.
- CREAM (Cooperative for Real Education in Agriculture Management) has allowed more than 300 students to combine classroom and experiential learning as they manage a 32-cow dairy herd business.
- UVM Continuing Education helped create the Food Systems Leadership Institute. More than 100 leaders in higher education, government, and industry participated in this three-week leadership development training.
- The UVM Libraries are developing a website portal for disseminating research on food systems at a national and international level through the National Digital Library for Agriculture and AGRICOLA.
- The College of Agriculture and Life Sciences has matriculated over 400 students in the past five years with an undergraduate major in entrepreneurship that focuses on start-up food systems businesses, or an undergraduate minor in food systems.
- The School of Business faculty offer expertise in food branding, retailing, and market research.

- The Northeast Sustainable Agriculture Research and Education program of USDA is hosted by UVM, annually awarding nearly $4 million in food systems grants to researchers, educators and farmers.
- Sodexho, UVM's food service provider, collaborates with student groups to increase availability and awareness of local food in UVM food outlets, including developing a premium on milk that is returned to local dairy farmers.
- The UVM Transportation Center is examining the impact of different scales of production, distribution systems and individual household access to food, as well as the impact of biofuels on the environment and health.