Coordinated Teaching, Research and Outreach Programs at the University of Vermont Horticulture Research Center:

A Proposal to Improve Student Experiential Learning in Applied Farm Management

Terence Bradshaw
Assistant Director, UVM Horticulture Research Center
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Portions of this proposal include material developed for academic credit for two courses, CDAE 395 Economics of Food Systems, and PSS 298: Curriculum Development for Diversified Agriculture, completed Spring 2013.
Executive Summary

As numbers of startup farms increase in Vermont and across the U.S., and established operations scale up or shift production and marketing efforts to support local demand for farm produce, challenges have been identified for small farm operators that potentially threaten their business viability. New farm operators that sell direct to consumer markets are more likely to be college educated than established, larger-scale farmers, so effective experiential farm training programs at colleges and universities pose opportunities to provide training that will improve their overall success. In this paper, characteristics of successful student farm programs are identified, and farmer training opportunities at the University of Vermont (UVM) examined to identify improvements that will enhance student satisfaction and increase graduates’ success with farm operations. In a survey of graduates from the UVM Plant and Soil Science (PSS) department and participants in the Common Ground Student run farm, several improvements in instructional programming and student farm operation were suggested. Respondents indicated a desire for increased on-farm experiential learning opportunities that relate classroom learning to real farm practices. Increased instruction in farm planning and business management was requested, and improved management of the Common Ground farm suggested through appointing a staff-level farm manager that would coordinate specialty crop production activities that would support formal teaching programs. The UVM Continuing Education Farmer Training Program (FTP), a non-credit certificate program that teaches skills for diversified farm management and has operated since 2011, is identified as a successful program whose concepts may be adopted by undergraduate programs to improve teaching of farm management skills.

This plan proposes a reorganization of the UVM Horticulture Research Center (HRC) to develop an interdisciplinary, diversified teaching farm that will support instruction in farm management from Continuing Education and Plant and Soil Science while linking farm production into the greater UVM Food System by:

- Hiring a Production Manager under the cooperative direction of the HRC and FTP and funded by HRC, FTP, and PSS, who will implement a comprehensive management plan for all specialty crop production plots used in teaching programs.
- Developing an interdisciplinary farm brand under which all produce sales at the HRC will be coordinated to provide experiential opportunities in farm production, processing, and marketing; improve produce consistency and quality; and increase marketing of produce within the UVM community, while capturing produce revenue to support farm management.
- Refining present PSS courses and increasing summer course opportunities and collaborations with other departments to increase experiential learning opportunities for undergraduate students.
- Coordinating production and teaching functions between CALS departments and the FTP to reduce duplication and increase collaboration between similar programs offered to undergraduate and non-credit students.
- Marketing this comprehensive, interdisciplinary farm program in the early fall prior to the growing season to UVM undergraduates, students from other colleges and universities, non-credit farmer trainees, Vermont farmers and food system practitioners, and high school science teachers to increase student diversity and maintain robust enrollment.
Introduction: Challenges Facing Beginning Diversified Farmers

Increased interest in local and diversified food production and its role in the greater food system in Vermont and nationwide demands that colleges and universities that train future farmers respond to student feedback and changes in production and consumption patterns. Curriculum development for comprehensive undergraduate, graduate, Extension, and certificate course programming in sustainable food production and farm management at the University of Vermont (UVM) cannot be conducted in a vacuum, but rather must be based on current research and conditions within the local food system, while also training students who will farm in other regions to adapt their knowledge to varying conditions. Recent changes in local, state, and federal agricultural and education policy have increased support for relocalized food production and increased farm diversification. Local food programs at federal and state levels and grassroots efforts combine to increase demand for products and experiences provided by small, diversified farmers across the country. For example, direct-to-consumer farm sales in the U.S. increased by 118% and the number of farmers’ markets increased 91% from 1997 to 2007 [1]. Federal initiatives, including USDA’s Farmers Market Promotion Program, Senior Farmers Market Nutrition Program, Rural Business Enterprise Grant Program, and others, collected under the Know Your Farmers, Know Your Food Initiative, provide support services for diversified farmers and service providers that often participate in alternative food production and distribution systems [2]. Other programs target research and promotions of Specialty Crops, which include fruits, vegetables, nursery and other horticultural crops that, prior to the passage of the 2008 Farm Bill, had little support in USDA programs compared to traditional field crops including corn, wheat, and soybeans [3]. The end result of these programs is a marked increase in support for diversified farms that produce multiple horticultural, agronomic, and/or livestock crops and sell to local markets. Many established farms and new farm startups are taking advantage of the increased demand for local produce. In Vermont, total food systems employment, including farm jobs, is increasing, with 649 new jobs and 298 new food systems businesses established from 2007 to 2012 [4]. Many new operations are small, diversified farms, which produce multiple products and supply diverse markets including wholesale, and increasingly, retail, farmers market, community supported agriculture (CSA), and other direct-to-consumer markets. These farms find increasing support for their development through directed agricultural policies that encourage market and product diversification and entry of new farmers into the agricultural sector [5].

In a review of local food systems and their associated farms [1], a number of characteristics of local food suppliers was described. Most farms were small, with less than $50,000 in gross sales; tended to grow vegetables, fruit, and other produce; were located near metropolitan counties; and had significant entrepreneurial activity such as diversified marketing strategies, value-added processing, and sales of non-food products or services. Diversified farmers are educated: in a national study of farmers that market through Community Supported Agriculture (CSA) systems, 95% of those farmers held a college
degree, were on average ten years younger than farmers in the overall USDA census, and tended to be split between male and female operators, where less than 10% of farmers in the USDA census were female [6]. Another USDA report on local food suppliers found that farms that market directly to consumers generated low gross sales, with farms that sell exclusively direct-to-customer having mean gross farm sales of only $6,844. Farms that increased their markets to include other venues generally increased their gross revenue from farm activities, but maximum mean direct sales per farm was only $28,651 for farms that sold in three or more markets in addition to direct sales [1]. A 2006 survey of participants in farmers’ markets nationwide found that average annual gross sales per vendor was $7,108 [7]. For farms that participated in CSA sales, 40% had gross farm income below $20,000, and median gross farm income was below $30,000 in the Lass et. al. study. In a USDA study of beginning farmers, new farmers (defined as those operators who have been in business for less than ten years) were more likely than their counterparts who have been in business longer to hold college degrees, but they were less likely to have previous farming experience, with only 6% reporting previous experience in farming [8].

Even with support programs available that encourage new farm startups, significant barriers of entry exist for beginning farm operators. High startup costs, especially for land but also for equipment, infrastructure, and working capital, are cited as a common problem for beginning farmers [8]. Infrastructure costs in particular are high for small farms, since many farm structures including refrigeration and packing/processing facilities are designed for larger operations that can use costly machinery more efficiently [9]. Small farms also face difficulties in developing production capacity sufficient to supply local market demands, and thus may have difficulty with establishing sales outlets for their products [10, 11]. Because new farmers generally seek to differentiate their products from commodity crops, they tend to face higher per-unit costs when conducting business [12]. These costs include increased per-unit planting, seasonal management, harvest, processing, shipment, and sales costs that are lower for larger operations with increased economies of scale and better integration into existing supply chains. Lastly, regulations on food production, in particular food safety standards that will only be increasing with institutionalization of Good Agricultural Practices (GAPs) and GAPs-like programs and recent passage of the Food Safety Modernization Act (FSMA) place significant costs on small farmers that are disproportionate to their large farm counterparts [13]. This scenario makes entry into farming for small, beginning operators difficult, with less than half of startups surviving after five years, and only 15% staying in business beyond fifteen years [8, 14].

Beginning diversified farmers require sufficient training programs to ensure they develop adequate skills to be competitive despite the hurdles they face. Farmers are not simply planters and harvesters of crops based on explicit knowledge that can be applied to any farm situation from a textbook. Increasingly, farm operators are managers of complex biological, economic, and social systems with multiple adaptive facets that must be understood and managed to be successful. In order to best manage these systems, farmers require comprehensive training programs, especially for beginning farmers who often have
no background in agriculture. Universities can play an important part in providing training programs for beginning farmers, especially since most new farmers are college-educated and thus are available to complete applied farm and business management coursework, and their associations with universities is a form of networking that can keep them in the knowledge loop via Extension and other outreach programs after graduation [15]. Training programs must however be comprehensive to ensure that all aspects of the farm business are covered. An occupational profile of operators of diversified, small-scale sustainable farms developed by the New England Small Farms Institute highlights several skills necessary for operation of a successful farm [16]. These skills include:

- whole-farm concept planning and ecological understanding; production planning; market analysis;
- understanding of local (and state and national) regulations;
- business setup including financial and management team establishment;
- task and timeline development;
- farm labor management;
- equipment maintenance, operation, and adaptation to the business;
- infrastructure building and maintenance;
- knowledge of specific, biology-based crop needs, including pest management and horticultural requirements;
- understanding of livestock production systems, if applicable;
- harvest and post-harvest management;
- post-harvest processing, including value-added processing, if applicable;
- crop marketing and sales; and
- whole farm review and adaptation.

This is not a list of skills that can be offered with a short course, but rather requires coordinated and planned programming to ensure that comprehensive skills are conveyed to students and farmers to improve their success.

**Student Farm Programs**

Experiential farm curricula are popular at colleges and universities throughout the U.S., and each program contains important elements often common to others, that should be considered in the development of an on-farm curriculum at UVM. Private, agriculture-oriented programs at “work colleges” including Berea College in Kentucky and Sterling College in Vermont have operated farm-based educational programs since the middle of the 20th century, and since the 19th century in the case of Berea [17]. Among seven such institutions in the country, work colleges require student work as part of their integrated curriculum. These colleges have a strong focus on hands-on, applied learning and service projects, and often have an agricultural focus. They are generally not as geared toward traditional academic research nor broad-based liberal studies as colleges and universities, and typically have low and selective enrollment. These programs can be very important components of greater agricultural education systems. However, Sterling College which serves as an important training and food systems advocacy center in Vermont, has greater influence than its small student body would suggest. Sterling’s curriculum could be described as holistic, comprehensive, and

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1Much of this section was informed by Laura Sayre’s, ‘Fields of Learning: The Student Farm Movement in North America’, (Lexington, KY: University Press of Kentucky, 2011).
idealistic—its focus on small, diversified production systems may limit application to larger farm operations yet its comprehensiveness ensures that graduates from the program understand the full skill and knowledge set required to operate food systems businesses [18]. Student farms can also be found at private liberal arts and even Ivy League colleges, with notable programs at Hampshire (Amherst, MA), Prescott (AZ), Dartmouth (Hanover, NH), and Middlebury Colleges that cater specifically to sustainable agriculture programs, student clubs, or other extracurricular initiatives.

Land Grant Universities (LGUs) may have the greatest potential to serve as learning centers for students studying applied sustainable agriculture and farm management. The breadth of LGUs’ course offerings and the number and diversity of students and faculty that participate in their programs create a critical mass for course development that can cover multiple, interdisciplinary aspects of farm and food systems while maintaining program focus. The land-grant tradition of providing teaching, research, and community outreach programs with strong agricultural emphasis gives LGUs a unique perspective in academia, because they link academic concepts with real practices performed in communities; one could say they have “one hand in the clouds and one hand in the soil.” Thus, LGUs attract rural students from agricultural backgrounds, as well as increasing numbers of urban and suburban students for whom farming is a completely new activity, yet who make up the majority of participants in student farm and other agricultural programs at many colleges and universities [19]. Several well-established model experiential agriculture training programs exist at universities with significant specialty crop and other diversified agriculture industries that can serve as models for Vermont.

The University of California at Santa Cruz (UCSC) is a state university (but not an LGU) with significant investment in its student farm program. The roots of the program began in the 1960s, but the Agroecology Program, which would foster the growth and development of the student farm, was established in 1981 by Dr. Stephen Gliessman [20]. This program conducts research and education programs in sustainable, and to a large extent organic, production systems, in contrast to programs at other UC campuses that are oriented more toward supporting conventional, large-scale specialty crop horticulture that is an important component of California’s agricultural sector. Funding for the program was tenuous initially, and relied on grants to staff the experiential farm. In 1985, the UC Office of the President provided stable funding for the program and its facilities through a line-item in the overall UC budget. This secure funding is relatively rare among student farms, and budgetary concerns are a common theme for most programs. UCSC operates several levels of training, including summer session courses for undergraduates, Extension programming for farmers, and a six-month apprenticeship program where students are involved full-time in farm operations and receive comprehensive interdisciplinary training on Agroecology and farm management issues. The program has been successful, and is held as a model for similar programs at Michigan State University and UVM, among others.

Another UC program, based at the LGU Davis campus, incorporates an experiential student farm into the greater land-grant mission of research, extension, and teaching
The UC Davis (UCD) Student Experiential Farm (SEF) was established with initial funding from the College of Agriculture and Environmental Sciences, which has continued to support the program with staffing, equipment, and land access, although students have been primary supporters of and volunteers for the farm. The farm includes diverse crops and research plots, and hosts diverse programming activities including graduate and faculty research, farmer extension programs, and undergraduate classes. Student researchers serve as farm technicians, and thus contribute to the overall management of the facility and its operation. However, they are not given carte blanche access to the facility, as all projects are required to have a faculty sponsor which ensures that projects are curriculum-appropriate and well-managed. SEF students have sometimes struggled with conflict between student-driven learning and traditional, instructor-led teaching methods that some felt allowed too little autonomy in their experiences. To address this, students are grouped to facilitate mentoring of less-experienced students by those who have been in the program longer, and instruction is carefully balanced between traditional classroom-based and management-down teaching and student experimentation via field labs that provide them with opportunities for trial and error in a relatively low-risk setting.

Formal educational programming was not a component of the SEF at its outset, but as UCD developed its Agriculture and Sustainable Environment major in the 1990s, more formal coursework was integrated into the farm operations. In 2004, a comprehensive curriculum development effort was implemented, which included, among other initiatives, a national study of academics involved with agriculture-based education at U.S. colleges and universities [22]. The results of the survey conclude that sustainable agriculture programming should include:

1. A mix of disciplinary and interdisciplinary instruction that integrates practical farming skills in the context of social, environmental, and economic frameworks;
2. Training in problem solving, logic, and analysis, and the means to work and communicate with stakeholders to find solutions to complicated problems; and
3. Significant and diverse on-and off-campus experiences to introduce students to real-world practices in the field of sustainable agriculture [21].

The curriculum developed from this planning includes a set of core courses that provide training in environmental, economic, and social considerations in production-oriented agriculture. Students have opportunities to pursue specialized tracks in the middle-upper class years, and the program is completed with a capstone sequence that involves active farm and other project participation designed to develop analysis and problem-solving skills. The SEF is a core component of the program, with many courses or labs taught and internship and project opportunities available to majors on the farm.

Michigan State University’s Student Organic Farm (MSU SOF) exhibits many characteristics that make it a model farm for curriculum and farm management development at UVM [23]. In 2001, a competitively-funded research project assessing the performance of high tunnels (unheated greenhouse structures) for production of specialty crops was initiated at the MSU Horticulture Teaching and Research Center. As those structures were developed, the site’s suitability for the SOF program
became apparent due to its proximity to the MSU campus, availability of equipment and infrastructure, and potential staff availability. This initial tie-in with formal MSU research programs has continued to the present day, and forms an important link between student farming opportunities and the research, extension, and teaching mission of the LGU. The SOF core program is a year-round, CSA-model production farm utilizing high tunnels to extend the crop production season and to better integrate crop production with the academic year. As the SOF program formalized, the programs’ director, Dr. John Biernbaum, realized that startup funding would be required to fund farm staff and operations, and in 2003, a USDA Higher Education Challenge Grant was secured that provided $100,000 for two years that helped the program to become established. Initially, the farm manager was a graduate student, but it was soon realized that the demands of the student and the farm were not compatible in the long-term, so a new model of management was sought, and a full-time staff farm manager was hired to provide continuity and overall farm management including farm planning, plan implementation, and produce contracts and sales. In 2006, the SOF developed a full-time, nine-month, non-credit bearing certificate course for farm trainees that focuses on intensive specialty crop production for local markets. This Organic Farmers Training Program (OFTP) is self-funded by student tuition to cover staff and instructor expenses, which is adequate as long as the farm operations are self-sustaining through produce sales (Appendix 1, sample MSUE SOF budget). In addition to this program, the SOF is used in topic-specific undergraduate and graduate coursework throughout the year, as well as in Extension programming.

Elements from the featured student farms can be applied in constructing an integrated curriculum and student experiential farm from the components that presently exist at UVM, particularly from within the Horticulture Research Center (HRC), Plant and Soil Science (PSS) undergraduate courses, Continuing Education’s Farmer Training Program (FTP), and Common Ground (CG) student club.

**Current Experiential Farm Opportunities and Applied Undergraduate Food Production Programs at UVM**

**Plant and Soil Science: Ecological Agriculture**

The UVM PSS Department has traditionally specialized in an applied, farm-based curriculum for students who pursue careers in sustainable agriculture at the University, and has included faculty specialists in vegetable and fruit production and agricultural pest management. PSS undergraduates up to twenty years ago participated in a single required curriculum for the major, and selected one of four areas of concentration (Agroecology / Sustainable Agriculture, Landscape Design, Horticulture, and Environmental Soil Science) that largely guided department elective coursework beyond the core curriculum. Coursework generally was science-based, with no social science or business management coursework required beyond the core college coursework. Still, many options for food-crop horticultural studies were available to students, including courses such as: Principles of Plant Science; Entomology and Pest Management; Small Fruit Crops; Vegetable
Fruit Crops; Vegetable Root Crops; Greenhouse Operations and Management; Commercial Plant Propagation; Forage Crop Management; Agroecology; Composting Ecology and Management; Permaculture; Mineral Nutrition of Plants; and Tree Fruit Culture [24]. The Ecological Agriculture major supplanted the PSS major in 2004 for students who wished to pursue studies in sustainable agriculture at the university (students interested in ornamental horticulture are offered the Sustainable Landscape Horticulture major). Coursework for this program added social and/or economic teaching to the curriculum, with one of the three courses: Principles of Community Development; Introduction to Community Entrepreneurship; or Principals of Management and Organization Behavior required in addition to Agriculture and Food Policy and Introduction to Ecological Agriculture. By 2007, Principles of Plant Science, a core course that provided an in-depth overview of the science behind agronomic and horticultural crop production was dropped from the curriculum and no longer offered by the department. Replacement courses in the core PSS curriculum included two semesters of biology and one semester of ecology, in order to remove redundancies among courses, streamline the curriculum, and provide students with a broader biological science background. PSS has not had food crop-based professors of horticulture in the department after the departures of Dr. Elena Garcia, tree fruit specialist, in 2005, and Dr. Buddy Tignor, vegetable crops specialist, in 2006.

A 2008 reorganization plan for the UVM Farms recommended several steps toward improved plant science courses available at the University (Appendix 2, 2008 UVM Farms Reorganization Plan). These recommendations included a suite of additional new courses, certificate programs and internships that would be offered in the summer months to UVM students, students at other Universities throughout New England, K-12 teachers, and the non-degree student community-at-large. PSS began development of its Summer Institute, a two-year cycle of courses based at the HRC or Miller Dairy farms, which was initiated in the summer of 2009. Course enrollment has been variable; in particular, required courses that may not be offered before some students’ graduation year tend to have good participation [25]. Two non-requirement courses (that do fulfill program elective requirements) that have had good enrollments were production-oriented tree fruit and viticulture classes, which had not been offered by PSS in several years and are no longer included in the course listings. This highlights the importance of providing applied, science-based coursework on crop production topics, so that students understand the fundamental practices used to produce food in an ecological context- in fact, students continue to request that these and similar courses be offered in the program. Many courses had low enrollments and some were cancelled due to a lack of students. This can be attributed to several reasons, including an inability of traditional undergraduate students to use financial aid funds for summer courses and poor course marketing in certain years when scheduling and pricing information were not ready until the March prior to the summer semester. Furthermore, in some years too many similar, non-coordinated courses were offered and cross-listed with PSS (e.g. the ‘Farmward Bound’ series in 2010) that could have diluted the potential pool of students that the PSS courses were marketed toward.
One course in particular, Organic Farm Practicum, was envisioned during the 2008 Reorganization Plan sessions as a capstone course that would integrate student experiential farming with their academic program has had difficulty with enrollment. An arrangement to offer course credit in the fall for coursework completed in the summer, ostensibly to allow students to apply their regular tuition dollars and financial aid to pay for the course, backfired when students would drop the course well into the summer with no recourse, since they had not yet actually signed up for it and thus did not need to follow add/drop rules. This arrangement was facilitated by the decision of the instructor to allow Common Ground Student-Run Farm (CG, described below) to operate autonomously of the course, even though the 2008 plan clearly outlined the intention to bring the club into a formal academic program as part of the reasoning for hiring the instructor and as a primary component of the Summer Institute concept. Thus, CG students, who receive a stipend with funding from the UVM Student Government Association for their summer work, had little incentive to pay for credits when they were able to participate in the farm in exchange for a paycheck (given that most CG farm workers are non-PSS majors, the availability of elective PSS credits which may not be useful for their major program is not a sufficient incentive to enroll in the course).

Furthermore, by ceding management responsibility of farm operations to CG at a point when UVM College of Agriculture and Life Sciences (CALS) and PSS were seeking to pull it under an academic faculty’s leadership, created a point of contention for several years between the CG club and the courses built up to support it. In addition to increased summer programming, required coursework on Organic Farm Planning was added to the curriculum and taught in the spring semester of each year. Initially this course was intended to guide development of the annual CG farm plan submitted to HRC management as a condition of their operation but that plan has not been generated by this class and submitted as of yet. In addition, the course was charged with developing recordkeeping systems that would facilitate Organic Certification of the CG plots, which only require submission of those records to be included in the annually submitted HRC application to receive Organic certification, but those records have never been submitted. The course instructor has suggested that the expectation to both operate a commercial farm and teach courses that support it without dedicated staffing was not realistic in light of her assigned workload and research scholarship required to attain tenure.

**Common Ground Student Run Farm**

Founded in 1994 by PSS undergraduate students as an independent study project, CG has operated for nearly twenty years on up to three acres of land at the HRC as an experiential learning opportunity for students interested in sustainable agriculture and small-scale farming. The program is entirely student-run, but has collaborated closely with PSS since its inception to serve as a place where students could practice their classroom learning in a low-risk environment. CG operates a diverse mixed vegetable farm and markets its produce via CSA shares, on-campus farmstand sales, and donations to the food shelf. CG has operated as a student government association (SGA) club since 1998. SGA club status provides annual funding of approximately $10,000 annually, that supports farm operations and summer stipends for farm workers (SGA has a policy of disallowing payment of wages or stipends to
club members, but CG has an explicit exemption to that rule). As a club, CG is required to have an advisor of the students’ choice who may not perform a management function, and who has no decision making power within the organization [26]. CG advisors have been faculty or staff from PSS, and that role has been supported from ‘Service’ requirements which provided faculty minimal compensation for their time.

While the relative autonomy of CG has provided its students with an important experiential learning opportunity, the program has not been free of problems. Lack of year-to-year carryover of management and personnel has resulted poor recordkeeping, inadequate crop planning and rotations, poor retention of CSA members, and seasonal teams making the same horticultural mistakes as their predecessors in many years. Because the CG officers turn over in winter, and start new in the spring semester, they must develop their crop plan, order seeds and other supplies, start greenhouse transplants, and make the marketing plan during an otherwise busy semester, yet the bulk of planting gets delayed as end-of-semester coursework, exams, and housing limitations prevent many student from working until late-May or even early June. Poor planning and lack of education on farm equipment implementation have prevented the crews from using time- and labor-saving machinery available to them at the HRC such as cultivating tractors and mulch layers, so the CG workers have often fought difficult weed problems and often lost the battle in the process. The PSS summer course, Organic Farm Practicum, was offered beginning 2009, to provide an educational framework for students involved in CG or who showed interest in sustainable agriculture and applied farm management, but CG students were never required to enroll in the course nor have many done so voluntarily. This, coupled with financing and difficulties that prevented course enrollment from being satisfactory, led to the cancellation of the course for 2013, so CG will return to having no academic component or support.

A CG student from 2012 summarized some of the issues with the program and its lack of integration into any UVM curriculum in an essay for the summer ENVS 295 course, Ecology of Food Systems:

“The Organic Farm Practicum over the summer, [is] meant to be an experiential course in tandem with CG, [but] student enrollment is low, attendance even lower, and enthusiasm even below that...CG spends 200% more money than it brings in annually-it is not a profitable business, and will remain that way, barring major changes in the program. I often find myself wondering, why does SGA give us so much money every year? Surely, it is not to provide a few dozen homes with fresh produce; there are plenty of opportunities for that in the Burlington area. CG’s reason for existence is the educational experience it offers; never again in my life will I be able to run a farm, make all the decisions, and get paid relatively well, without any liability. CG is an amazing learning opportunity, thanks largely to the autonomy the students are given... The cultural functions of CG are its saving grace, and I find this embarrassing. UVM gives CG thousands of dollars each year, for the education of five or six
There is no doubt the experience attained by this handful is incredibly valuable, yet I can’t help but think that more students can and should be reached with that money. (Our CSA members don’t seem too interested in the “community” aspect, but that may largely fluctuate between years as well. There is a high turnover rate, and not much is contributed culturally through this venue)…Of course, one mustn’t forget to pick one’s head up. There are larger changes going on within the University that will significantly affect CG. With the new Food Systems [Spire of Excellence], renewed attention...is being given to the HRC, [with a new facility]…planned for the property, and the University has begun to [develop undergraduate curricula at the HRC into an] “On-Farm Summer Institute.”

Feedback from Former Plant and Soil Science/Common Ground Students

Survey Methods

In the course of this curriculum evaluation, former PSS and CG students were polled to assess their experience with each respective program, and its applicability to their post-college careers. A thirty-question survey (some questions contained multiple parts, and several were open-ended comment-style questions) was developed in Survey Monkey (http://www.surveymonkey.com/MySurvey_EditorFull.aspx?sm=xxyticRoa6GMfBB1ZxozOoZw7yV%2burtApnf9WxFcxYbc%3d) and the link distributed to 159 PSS graduates and graduates who participated in CG from 1995 to 2012. Surveyed alumni contact information was located through social media, personal contacts of the author, and the UVM Alumni Foundation. Thirty-nine responses were received in the short (one-week) window that the survey was open, although not all respondents answered every question so n will not always = 39. Graduates were asked to rate their experience with PSS undergraduate curriculum, PSS summer curriculum, and CG program and its impact on their learning of several components of diversified farming, including overall satisfaction with the program, production skills (basic plant science; vegetable, and fruit production; pest identification and management), and planning and marketing (developing crop and whole farm management plans; implementing farm plans; business and finance management; and customer and community relations). Respondents were asked to rate each component on a 1-5 scale where 1 = not at all valuable, 2 = somewhat valuable, 3 = neutral, 4 = very valuable, and 5 = extremely valuable. Survey participants were then asked if they had completed any business or financing coursework while at UVM, and whether such coursework was required by their program or suggested by their advisor. Finally, open-ended comments were sought on the perceived strengths and weaknesses of the PSS curriculum, courses that were particularly useful, and suggested changes to curriculum and summer programming.

Survey Results

Respondents were diverse, with graduation year ranging from 1995-2012; 62% were PSS or Ecological Agriculture majors, with 16% Sustainable Landscape Horticulture, 14% Environmental Studies, just under 3% Environmental Science, and 5% other majors; 43% participated in CG, and of those, 63% were former CG farm managers. Fifty-four percent of respondents had farmed professionally since
graduation, for an average of 5.6 years, with most (90%) having worked on mixed vegetable farms but tree fruit, small fruit, vineyard, dairy, meat, grain, and value-added processing businesses were also included. Average farm size was 85 acres, but several large (550, 1000, 1500) acreage farms skewed that value; the mode was 2 acres. Gross sales ranged from $5000 to $500,000, although responses were limited for that question (n=11). Respondents sold produce through diverse means, including CSA and retail, direct store delivery, and farmer’s markets, farmer stands, and, to a lesser extent, pick-your own.

Information received in this survey will be valuable for extensive analysis of the PSS curriculum and CG club activities. However, the results for this curriculum development paper are limited to a cross-tabulation of responses by graduation year. Since the intent of this paper is to identify issues with present PSS summer programming and to offer suggested curriculum changes, the dataset was divided into two groups by graduation year: 1995-2008, and 2009-2013. The summer semester of 2008 was chosen because this marked the initial implementation of the PSS Summer Institute program, and because it provided for a reasonable sample balance of 15 respondents in the latter group versus 24 in the earlier-graduating group. Overall, PSS curriculum and CG activities were not highly rated by respondents (Table 1), and most program components declined in value for the post-2008 graduates. For the PSS undergraduate curriculum, only knowledge of basic plant science, pest identification, and integrated pest management (IPM) implementation were rated ‘very valuable’ or higher. Knowledge of vegetable and fruit crop production and the overall rating of the PSS program were rated as slightly better than neutral, and all declined from the earlier to the later graduating groups. Respondents’ ratings of their CG experience on the same components showed similar results, although the CG experience was rated as ‘very valuable’ overall for knowledge of vegetable production, but pest management components were less valuable than in the PSS curriculum. Few differences between the two groups were statistically significant, although most values declined from the former to the latter groups of graduates. This indicates that PSS curriculum
and CG programming has generally not been satisfactory, and the changes with the initiation of the PSS Summer Institute in 2008 did not improve graduate satisfaction.

Comments from respondents in open-ended questions indicate a strong desire for more business management and planning instruction; formal integration of coursework with experiential learning; and applied farm management instruction including equipment operation and animal husbandry:

“I would encourage the Department to improve the out of classroom experience, that’s what brings all the classwork together in an applied way.”

“More hands on experiences.”

“Specific classes focused on marketing, how to do risk management for a farm, I think it would be very useful to give people a better framework as to what the risks are and how to mitigate them before making any kind of farm plan.”

“I think students would learn more from the organic farm planning course if it was offered in the fall semester so there is ample time to develop the business and crop plans in the off season so the course and the practicum are more in line with when a farmer would actually be doing that planning. Also I think a more agriculturally experienced professor is needed.”

“I think we needed way more hands-on field experience with courses like plant physiology and plant pathology to understand plant diseases, functions, on a deeper, more practical level. I think most students who want to be a part of PSS do [not] want to work in a lab under a microscope, so the lab experience should be more comprehensive and bigger picture based. Find plants in their natural environments that are showing signs of various nutrient deficiencies, diseases, etc. The 2nd soils class needed to be way more centered on actually seeing in plants how the soil is lacking N, P, K, etc; identifying that, problem solving that. Instead of just being lectured to on what the signs are. Things like that need to be seen beyond the chalk board. In general, anything to do with plants needs to be as hands on as possible and outside as often as possible. I would also encourage independent projects for credit for students that are plant/farm/garden based, with the option to forgo another class so they could truly dedicate the time and get hands on experience.”

**Continuing Education Farmer Training Program**

In 2011, an intensive, full-time, six-month certificate program for aspiring farmers and food systems advocates that provides a hands-on, skill-based education in sustainable agriculture was initiated, with the bulk of its production acreage at the UVM HRC. Beginning with 12 students in its first year, the FTP has enrolled 24 students for the 2013 season, and maintains a waiting list of potential students who wish to enroll in the program. Students attend from throughout the region, country, and internationally, in 2013 there are 13 U.S. states represented, with 2 Canadians and 3 Vermont students who pay the $6200 program fee for the season. FTP uses areas farms and
farmers as classrooms and instructors, but the majority of their time is spent at the HRC, where they initially farmed 1 acre, and now are maintaining over 3 acres in vegetable production for their teaching uses. The program is comprehensive: students learn the entire production cycle from soil preparation to marketing the final crop, with instruction on equipment operation, farm building construction, animal husbandry, tree fruit, and post-harvest processing included within the general programming on running a mixed diversified vegetable farm. By all accounts, the program has been a success, and is a model for how student farms can be operated given limited but adequate resources.

FTP is operated within the College of Continuing Education, and was established with loaned startup funds from the Dean. The program has no full-time, salaried staff, but a Program Director and Program Coordinator/Farm Manager on hourly wages each work more than full-time during the growing season. In addition, one or two Assistant Educators are hired during the growing season. FTP has been under pressure to make the Director and Program Coordinator/Farm Manager positions salaried, but present cash flow from tuition funds are not sufficient to cover salary and benefits for those positions. Presently the program conducts all of its own management activities in the teaching plots at the HRC, and pays user fees for equipment and infrastructure as well. While this does allow for autonomy and integration of management and teaching functions, it is also an expensive component of the program. Produce sales are small but important to the program, with roughly $20,000 in sales in 2012. FTP sells much of their produce to Sodexo, UVM’s food service provider, and operates a small 10-person CSA to Continuing Education staff members. This helps to reduce or deflect criticism that the program is unfairly competing with local growers by maintain a closed-loop cycle of food production and sales within the greater UVM community. It also provides students important learning opportunities with producing relatively large orders, compared to smaller CSA markets and farmstands, under contract requirements and with an integrated food safety component. This marketing focus could serve a redeveloped curriculum well in the future by providing an opportunity to integrate production, marketing, business management, and food safety into an interdisciplinary curriculum.

UVM Horticulture Research Center

The UVM HRC serves as the primary field laboratory for professors in Plant and Soil Science and, to a lesser degree, Plant Biology. Purchased by the University in 1952 and located about four miles south of campus, the farm has historically supported horticultural research on fruit and ornamental crops. Currently, the facility supports fruit research projects as well as agronomic and limited ornamental trials; teaching or experiential vegetable farms on the CG and FTP plots; and public workshops, activities, and legacy plant collections managed in cooperation with the non-profit Friends of the Horticulture Farm (FHF). Facilities at the farm are functional but dated, and present uses, including summer coursework up to the levels provided through 2012, find the classroom and other facilities maxed out during the growing season, yet underutilized from November through April. Equipment available to researchers and other users consists of a diverse selection of tractors and implements.
that meet most users’ needs well. The farm is located on very sandy Windsor Adams soil, and irrigation facilities provide water to potentially about 1/3 of the farm. Expansion of programs at the HRC will require: 1) upgraded facilities, including classroom, laboratory, and food storage, processing, and sales areas; 2) increased staffing to facilitate program needs, and 3) development of an overarching management plan to coordinate conflicting, complementary, and supplemental uses of the facility.

Presently the HRC, as well as the UVM (Miller) Dairy Farm, are slated for facility improvements that would support expansion of teaching, research, and community outreach programming. The improvements are in the architect rendering and conceptual phase at this point, and fundraising efforts are underway to implement the first steps of the plan. Staffing at the HRC is short. One, CALS-funded, half-time Assistant Director is the only salaried personnel at the facility. Another part-time hourly worker, a former full-time farm employee with over 30 years’ experience in farm operations and equipment operation and maintenance, spends about 0.6 FTE at the farm. Other staffing is rounded out by hired hourly student workers, primarily in summer, who collectively make up about 1.0 FTE but concentrated within that time frame. The HRC maintains a facility such that its educational and research users may conduct their own programs; the HRC does not provide programming of its own. The HRC does manage the apple orchards to facilitate research and extension programming in exchange for fruit that are sold to support the farm. All other users must manage their own program needs, and are only supported by HRC staff where facilities, land, or equipment use must be coordinated.

Planned Renovations at the University of Vermont Horticulture Research and Education Center

The UVM Farms reutilization project proposes a name change (Horticultural Research and Education Center (HREC)) to reflect increased educational use of the facility. Upgrades with new state of the art facilities, an essential step to implement CALS’ strategic planning initiatives for the next decade, are already in place. This capital improvement will:
• Support an overarching farm program that supports undergraduate, graduate, and certificate students;
• Result in higher quality student experience and increased experiential learning opportunities;
• Facilitate increased research activities and extramural funding;
• Provide the needed physical infrastructure to align our facilities with new initiatives in food systems;
• Enable research and teaching partnerships with VT’s agricultural and environmental sectors that will contribute to the state’s economic well-being.

This project will be broken down into phases as funding becomes available. The proposed first phase of the project entails building facilities essential for our outstanding undergraduate curriculum and our research. This will involve construction of the produce receiving and ‘field’ preparation building including: separate public and field entrances and loading dock; integrated produce washing and sorting station; multiple, independent coolers with separate environmental controls, forklift access and integrated shelving/racks; seed oil press, flour mill, seed cleaner; six triple-wash stations; and produce sales /CSA pickup area.

Future phases will include a new Visitor/Conference Center, renovations to the current Blasberg Building, a new well, a new pond, some site work to mitigate water run-off, and renovations/maintenance to our existing barns and sheds. One goal is to make the Farms energy neutral, using technologies that could serve as a model for farms in the state. We currently have a student clean energy project in progress on site that uses our large animal compost products to heat a greenhouse with the goal of growing vegetables year round in Vermont. In addition students from the College of Engineering are completing senior projects looking at other innovative ways for reducing/generating energy. The plan for Phase 1 is to break ground as soon as enough money for this project has been realized.

### Action Plan for Effective Experiential Farm Management and Teaching Curricula at UVM

#### Principles of Experiential Farm Program Instruction

Interest in farming and food systems in Vermont and across the nation are at an all-time high. Initiatives within the federal government, state Agency of Agriculture, and non-profit support organizations are increasing focus on sustainable food systems as a means of providing social, economic, and environmental benefits to society. At UVM, the Food Systems Spire of Excellence was launched in 2010 to coordinate teaching, research, and community outreach activities that support sustainable research on food production, processing, distribution, and consumption. Annual research and teaching symposia are conducted where food systems practitioners highlight their programs among like-minded faculty. Practical, plant-based undergraduate instruction in food production on diversified farms has traditionally been the province of the Plant and Soil Science Department, which launched a B.S. degree program in Ecological Agriculture in 2004. A loosely affiliated non-
academic SGA club, Common Ground, provides experiential opportunities to students who wish to practice farming in a low-risk setting; this is conducted with minimal oversight at the UVM Horticulture Research Center. Surveys of past graduates in PSS and/or who participated in CG indicate a low level of satisfaction with the experience provided through either program, and changes in PSS curriculum and CG management beginning in 2008 did not improve and sometimes reduced student satisfaction with the programs. At the same time, a non-affiliated, non-credit certificate program in diverse farm management also based at the HRC and available through the College of Continuing Education has been successful in its initial two years of operation, although it faces budgetary challenges to ensure future success. Improvements in or integration of experiential and academic offerings must balance and coordinate the needs of these programs to be successful.

Past studies have highlighted the shortcomings of traditional LGU teaching programs in providing comprehensive educational opportunities to prepare students for the careers they will face. The Boyer commission [27] noted an imbalance between research and teaching activities at LGUs; a predominance on rote classroom teaching at the expense of experiential learning; overspecialization within departments and a lack of cooperation between divergent departments to provide a broad-based comprehensive learning perspective. Another 2011 Ohio State University survey of student farm managers from colleges and universities across the U.S. found that faculty and staff involvement was critical in the success of the operation, with a mean of four faculty and three staff involved with farms [28]. Additionally, most farms offered volunteer, related coursework, community activities, and internships, but fewer were associated with an academic major or certificate program. Presently, the Common Ground plots, associated with PSS coursework but not integrated onto the Ecological Agriculture major, serve in this ad-hoc capacity. However, the potential to provide experiential training that is integrated into the PSS program presents a valuable opportunity for faculty and students in the department. Not only can the farm meet the expressed needs of past, and therefore future, PSS students, but it also can be used as a recruiting tool- over 80% of respondents in the Ohio State survey agreed that the student farm attracted students to their institution.

The transdisciplinary nature of food systems study requires cooperation and collaboration among disciplines as well; in fact, this is the directive of the UVM Food Systems Spire of Excellence. In a nationwide survey of academics from multiple social science, humanities, and natural science programs at Universities, several important concepts were identified as important in teaching sustainable agriculture programs, including: integrated farm and classroom experiences; on-farm internships; opportunities to apply classroom theory into practice; and identifying relations among agriculture, environment, and community [22]. That same survey identified important curriculum knowledge components such as: ecological processes in agricultural systems; environmental impacts of agriculture; nutrient cycling; relationship between agriculture, environment, and community; and social and economic impacts of agriculture. In this context, it is also important to include a solid biological framework for the core concepts in agriculture, including plant science, pest
biology, crop production requirements, soil and water relations, and, increasingly, animal husbandry. Those courses have been identified as important by past PSS students in their evaluation of their undergraduate experience (T. Bradshaw, unpublished data, 2013). Other specific coursework identified as essential and lacking in the PSS Ecological Agriculture program includes farm planning, business management, and finance. Other research highlights the need to develop and deliver instruction in transdisciplinary, multimedia, and experiential to maximize the student learning experience [29].

In a review of curricula at organic farming programs at LGUs nationwide, Ngouajio et. al [30] found several common components within successful programs. These include:

- A strong program identity that can be used to ‘brand’ the program;
- A core facility, usually a student-based farm located on a research station or other campus property;
- A teaching component that provides a solid academic foundation in the natural and social sciences and economics of farming;
- An experiential component that provides students with the opportunity to practice classroom concepts in a real-world setting; and
- A marketing component that allows students to learn critical business and customer management skills essential for farm operation.

Fortunately, these components presently exist to some degree at UVM, through components of the PSS Ecological Agriculture program, CG, FTP, and the HRC. However, these programs require integration and coordination of their strengths to minimize their weaknesses and to develop an integrated program with maximum educational impact. The following proposed changes in facilities, programming and curricula are based on core principles that must be emphasized in each program component:

- CALS support for the HRC, and its integrated teaching farm plots, is provided to advance the missions of CALS and the University by supporting faculty-directed academic programs, funded research projects, and outreach programs;
- Course materials on applied farm management must be scientifically accurate, and the core biological concepts must be delivered to students;
- Sustainability of farming systems is paramount to their continued operation, so economic, environmental, and social indicators of sustainability must be emphasized;
- Core teaching programs in PSS, Continuing Education, and other curricula developed in this model shall be oriented toward training the next generation of commercial food and fiber producers- hobbyists and homesteaders are welcome to participate, but the orientation of coursework will be to support farmers who may earn a living from their pursuits;
• Students should have opportunities to experience diverse farm practices that are used in Vermont, the region, the nation, and the world, and should understand why those systems are used by farmers in practice;
• Courses should be developed such that they support one another, e.g. a pest management course may utilize planting systems used in a tree fruits course, or plant propagation may support a farm plan development course in helping to establish transplants, and;
• Faculty research projects should be integrated into curricula to provide students with research protocol experience and to highlight developing knowledge in agricultural production.

Catamount Farm: A transdisciplinary research and education center

The core pieces required for effective delivery of experiential, transdisciplinary farm education programs are, for the most part, present within the University: the HRC, PSS Ecological Agriculture major, FTP and CG programs serve as facility, educational, experiential, and marketing programs, respectively. However, these components are poorly integrated, which presents missed opportunities for comprehensive programming on food production at the University. Food Systems are transdisciplinary in nature, yet these programs operate independently within their departmental or program boundaries. In order to facilitate coordination of functions and to maximize applied farm education and research activities, a new initiative, Catamount Farm at the UVM Horticulture and Research Center (Catamount Farm), is proposed. This facility will be managed collaboratively through Continuing Education (via FTP) and the HREC and will report directly to the College of Agriculture and Life Sciences. The mission of Catamount Farm is to provide an exceptional research and demonstration facility to support applied, diversified agriculture education programs at the University of Vermont that support the Food Systems of the University, the surrounding area, and the state. This new program will:

• Facilitate interdepartmental and cross-college coordination of programs relating to diversified, sustainable farm education and research;
• Coordinate management of produce including vegetables, fruit, and herbs at the farm to reduce inefficiencies between related but uncoordinated programs, to provide year-to-year continuity of staff, and maintain long-term records of farm inputs, outputs, and activities;
• Provide a branded identity under which high-quality food production education programs can be marketed, and;
• Create a single entity for produce from experiential farm and research projects to be sold to CSA shareholders, the greater UVM community, and institutional buyers.

The Catamount Farm Facility

The primary production fields for the farm will include the plots historically assigned to FTP and CG for vegetable production, which encompass roughly six acres and are located at the northwest and north-central portions of the HREC. These field will be managed together to coordinate production functions between programs and colleges and allow for intensive soil improvement through cover crop rotations that will build soil quality, which is critical given the sandy, low-organic matter soil at the farm.
It is expected that at least 1/3 of the plots will be dedicated to managed, soil-building cover crops at any given time, and at some times of the year up to 1/2 of the acreage will be in fallow crop rotations. This arrangement breaks from current management, where FTP and CG maintain separate plots with significant duplication and variability in crop quality and soil improvement. In each season, plots will be allocated to cruciferous, cucurbit, solanaceous, root vegetable, and leafy green production in order to maximize field efficiency and coordinate production with marketing and teaching needs. In addition, one plot of less than one acre per season will be available to program-enrolled students to provide space for experimental plantings and experiential learning. These plots will be coordinated with the Production Manager to ensure that they are maintained to a horticulturally-acceptable standard and that soil-building practices are used within the plots.

Orchard and vineyard plots are perennial plantings that support significant research projects within PSS. These plantings will be managed by the HREC Director in coordination with PSS research and outreach personnel, and the Production Manager. Where appropriate, orchard and vineyard activities will be included in PSS and FTP educational programming. Other plots of interest to students or researchers, e.g. small grains or forage plantings, will be included in educational programming in consultation with their sponsoring research faculty.

Greenhouse use, including use the high tunnel, will be coordinated with the UVM Greenhouse group. Fees for greenhouse maintenance and support will be divided between the HREC (75%) and FTP and PSS teaching programs (12.5% each).

In consideration of revenue generated through produce and other crop sales, the HREC will assume costs for seed, supplies, greenhouse rental, infrastructure, and equipment use in support of the annual Farm Plan. Educational uses of equipment and other facilities specifically in relation to program curricula will be charged normal published rates to their respective programs.

The present policy of managing the western 1/3 of the HREC according to certified organic practices will continue, and other plots may use organic and will be required to use sustainable practices. Rigorous recordkeeping of inputs and outputs in all plots will be required, and will be maintained by the Production Manager and HREC Director. Recordkeeping for certified-organic plots will follow requirements from Vermont Organic Farmers LLC in order to maintain organic certification of present plots and to expand certification to other qualifying plots if appropriate. Organic certification of plots outside of the present western 1/3 of the HREC is not expected due to buffer issues with the orchards and to maintain flexibility for current and future research and teaching projects that may use sustainable, but not organically-certified, production practices.

Proposed HREC Staffing Changes
This effort will require three staff positions at the HREC that would support it, including:

- HREC Director, 0.25 FTE. Responsible for providing directional oversight of the HREC facility including use planning and program implementation. Duties will include:
supervision of support staff and student employees; responses to faculty and public inquiries; farm produce sales; plot allocation and protocol planning with researchers and instructors; archiving of crop records; liaison with Friends of the Horticulture Farm; managerial oversight of HREC in conjunction with facility staff.

- Catamount Farm Production Manager, 1.0 FTE (0.4 HREC, 0.4 FTP, 0.2 PSS). This key position exists collaboratively between CALS and Continuing Education (via FTP), and includes many of the functions presently provided by the FTP Farm Manager. This person will be responsible for overall management of specialty crop production in support of educational programming. The Production Manager shall develop and implement an overall farm plan in support of: FTP and PSS undergraduate programs; CSA, farmstand, and institutional produce sales; and research needs of faculty in collaboration with the HREC Director. The Production Manager will also serve as an instructor for the FTP program and provide field laboratory support for PSS courses.

- HREC Operations Manager, 0.75 FTE. Responsible for day-to-day management of HREC operations, including: grounds, building, and infrastructure maintenance in collaboration with HREC Director; maintenance of agricultural equipment; safety and operator training of equipment and implements; plot tillage; winterization; facility security and animal control.

HREC staff will be required to collaborate with faculty and instructors from PSS and FTP to develop a farm plan that will meet the needs of the respective programs. A Catamount Farm advisory board with representatives from CALS, PSS faculty, FTP, and area farmers will convene at least once per year in winter to coordinate farm and programming needs.

Labor required to operate the farm will be performed by students, volunteers, and paid workers when necessary, in order to provide experiential learning opportunities and facilitate whole-farm instruction programs. Workers will come from three groups:

- FTP: As a full-time, six-month program, students enrolled in FTP spend the most time on the farm, and will be key in implementation of the farm plan. Farm activities are built into the FTP curriculum, so while overall management of the plots will fall under HREC responsibility, FTP students will be intimately involved with production decisions, and the reasoning behind production practices at all levels of the farm will be discussed in the curriculum. The HREC Director and Production Manager will be empowered and encouraged to incorporate student ideas into management decisions.

FTP is also expected to maintain instructional and support staffing as determined by program needs. This may include a Program Director (presently staffed by Susie Walsh Daloz), and one or two staff instructors, as outlined in Table 2. The FTP Director is assumed a 0.5 FTE position supported by tuition funds, with complementary funding provided by other Continuing Education programs.

- PSS Students: Because undergraduate courses will meet for shorter periods than FTP, and the coursework will focus on in-class as well as experiential learning at Catamount Farm as well as other area
farms, the day-to-day commitment of these students across the growing season will likely be less than that of the FTP students. Instructors of PSS courses will be encouraged to integrate student experiential learning at the Farm into their courses, and will coordinate with the Production Manager and HREC Director to include PSS students in their program.

- CG Club: CG volunteers and workers are invited to participate in the development and implementation of the farm plan under the direction of the Production Manager. CG workers may provide important functions to farm operations. For example, CG may assist in propagation and early season planting of transplants; crop planting and field maintenance; crop harvest; and support of CSA and other marketing initiatives. CG is invited to implement their purpose “to increase the avenues for hands-on education in sustainable agriculture for UVM students and to create positive links between UVM and Vermont communities through...donations to anti-hunger organizations (Common Ground Constitution, not presently published).”

The core production function of Catamount Farm will follow the FTP program goals, in consideration of the season-long curriculum the program involves. In the development of the annual farm plan, course needs for PSS curriculum will be included. Presentation of the farm plan will be made annually by March to PSS, FTP, and CALS representatives to ensure that program needs are met.

Marketing Produce from the Farm

A core function of the proposed reorganization of teaching farm plots at the HREC is to market all produce through a single channel. This will accomplish several goals: develop a sustainable funding stream for the program; coordinate production with sales; provide a consistent ‘brand’ for HREC-produced food; improve food quality and allow for implementation of food safety programming; improve retention of CSA members; and facilitate institutional sales to UVM food service and Fletcher Allen Health Care. This effort will also be integrated into teaching and research opportunities, for example, the establishment of a modern farmstand in the proposed food processing facility can be guided by design projects in an on-farm produce marketing course through the Department of Community Development and Applied Economics (CDAE), and development of a Good Agricultural Practices (GAP) food safety plan can be informed by courses in the Nutrition and Food Sciences department.

This effort requires consideration of several factors. First, the Catamount Farm program must be sensitive to potential concerns from area farmers that it will unfairly compete for food dollars in the local economy. This can be addressed by selling within the UVM community. CSA shares will therefore be marketed only to the UVM community; with over 13,000 students, 1500 faculty, 2300 staff, and numerous retirees and alumni, there is ample room to market the produce from the farm within the University. Farmstand sales will be held on-campus, and more importantly, at the HREC. Apple sales, which have been conducted from the HRC since the 1960s, have been very successful with this, with roughly 200 transactions every Friday during the harvest season. Those sales are timed so as to not affect local orchards- the HRC does not conduct pick-your-own sales, and does not open on...
weekends, which are the primary sales window for in-season, farm-purchased apples. The apple stand is also open for limited hours, from 10-4 on Fridays, yet has seen annual growth of 10-15% in revenue since 2005, with total sales approaching $30,000 in 2012. UVM apple customers are extremely loyal; most return every week, and many have been coming to the farm for decades. This model can be extended to include vegetables to build upon the brand loyalty of the HRC apples, while establishing a common marketing and quality standard for all produce from the farm.

The Catamount Farm proposal assumes that 60 CSA shares will be made available annually. This is a conservative number given the potential productive acreage in the program, and in many years, CG has had over 60 shares from half the land. Share price is suggested at $500 for a full share, which is a premium price above the CSA share price for local farms, and reflects an increase in produce abundance and quality over the present CG farm, a commitment from shareholders to support educational programming at the farm, and a ‘non-competition premium’ to deflect criticism that the farm is unfairly competing with local growers who bear increased production and especially labor costs (yet do not have to support faculty salaries, research support, and outreach activities). Farmstand sales during apple sales are assumed at $600 weekly for 10 weeks. The plan also assumes $10,000 in institutional sales to UVM and/or Fletcher Allen food service. This is a critical component of the farm plan, and provides an opportunity to integrate the farm into the broader UVM Food System. Sodexho, UVM’s food service provider, signed the Real Food Challenge in 2012, pledging to increase purchases of local, organic, Fair Trade, or humanely produced food. A track record has been established; in 2008 CG began selling CSA shares to Sodexho, and FTP has included institutional sales as a core part of their curriculum and marketing strategy. There have been problems, for example, Sodexho has declined to continue purchase of CG shares because of a decline in produce quality, especially washing and produce consistency, and some animosity between CG and FTP developed as FTP increased institutional sales from their farm. This problem will be solved by coordinating production under one label, and ensuring that contracted sales are met through implementation of a sound production plan followed by consistent washing and grading steps. The pieces to the complete marketing program are in-place among the various programs based at the HRC; by combining and coordinating production and sales functions, their full potential may be realized.

Funding
An initial budget for the Catamount Farm proposal is included in Table 2. This budget is preliminary, but shows the potential for solvency of the Catamount Farm initiative, as well as for FTP and PSS teaching programs. Not every cost is included for each program, particularly for PSS faculty and for off-farm activities of FTP, but projected surpluses for each program may be applied to those costs. The budget also assumes a 70% tuition capture for summer undergraduate courses as part of a pilot summer semester program. The budget also assumes that the program is in its full maturity, with adequate student numbers and produce sales. Many parts of this plan are already in place however, so the program cannot be assumed to be at a true startup phase. However, startup funding will be required to develop farm infrastructure,
personnel, and marketing initiatives. CALS, HREC, PSS, and FTP faculty and staff should consider applying funding from teaching or other budgets to fund the program. In addition, grant funding should be pursued to cover startup costs. A letter of intent was submitted to the Vermont Agency of Agriculture Specialty Crops Block Grants Program with the grant due June 5, 2013 to cover 25% of the Production Manager for two years. Another potentially valuable and pertinent funding program is the USDA Higher Education Challenge Grant, which will likely have a request for proposals open in fall 2013 with funding available for the 2014 season.

Continuing Education Farmer Training Program

This proposal recognizes the strengths of the UVM FTP program, and seeks to reward those who fostered its success. At the same time, it recognizes the growing pains felt by the program, and identifies ways to improve the sustainability of it, as well as PSS and HRC programs that are also involved with experiential student farm programming. We propose that FTP maintain its summer program at the present student numbers or as necessary based on funding needs. This proposal does involve a significant change to the program however, in that it would take daily management of crop production from the Program Coordinator/Farm Manager, and place that responsibility under the Production Manager, who would report to the HREC Director. The integrated teaching and production function of this program is recognized, and the Production Manager would continue to be expected to provide instruction to FTP students as a primary component of the position, this is recognized by proposing that the position be split between HREC (0.4 FTE), FTP (0.2 FTE), and PSS (0.2 FTE), the latter of which would receive laboratory support for its summer coursework from the maintenance of the production plots at the farm. In summary, this proposal removes ‘ownership’ and management responsibilities for teaching-related produce plots from individual programs, and replaces all production (roughly 6 acres of vegetables, plus access to 8 acres of fruit) with a single management team that is to some degree funded by each program, and thus is responsible to all of them. The needs of FTP can be assured to be met by: maintaining partial funding and therefore partial direction of the Production Manager with FTP funds; adopting a Catamount Farm advisory board that oversees the crop plan and its implementation, and; directing within the Production Manager position description that instruction of FTP students is expected.

PSS Curriculum

“The Department of Plant and Soil Science aims to expand, integrate, and extend the knowledge of plant/soil ecosystems in the production of plants, the creation of a living landscape and the sustenance of environmental quality...The Ecological Agriculture major focuses on:

- Applying ecological concepts to environmentally friendly food production;
- Learn how to produce food in a sustainable and ecologically-sound manner;
- Gain a solid foundation in the natural sciences and practical experience through our organic farm practicum, internships, and field trips;

Nationally there is a growing need for professionals who understand and apply effective principles to agriculture. The Ecological
Agriculture major integrates course work in ecology, plant science, soil science, entomology, economics, and policy with an experiential learning internship to create educated professionals.” From UVM Plant and Soil Science Department and Ecological Agriculture Mission Statements, (http://www.uvm.edu/~pss).

The existing curriculum requirements for the PSS Ecological Agriculture major (http://www.uvm.edu/~pss/documents/EcAGCheckListandRequirements.pdf) includes comprehensive classroom-based coursework on plant science; disease, insect, and weed pest management; ecology; chemistry; soil science; statistics; and social sciences. In addition, an internship is required for the major, and participation in the summer Organic Farm Practicum (PSS 209) fulfills that requirement, although few PSS students have enrolled in it in recent years. Specific production courses on vegetable, fruit, forage and turf, and other topics are required, but not taught every year, nor is each area necessarily offered as a regular listed course. In recent years, for example, tree fruit and viticulture have been offered as special topics summer courses, but they are not listed in the PSS course catalog, and therefore student who wish to study those production systems may not be aware of the offerings when selecting the major. In addition, no courses are required in farm finance, marketing, and small business management beyond the entrepreneurship course offered through CDAE.

This project proposes the following changes be implemented in the PSS Ecological Agriculture curriculum that would address student concerns and improve interdisciplinary learning for future farm managers and entrepreneurs:
• In order to facilitate a unified experience for undergraduates, course instructors should coordinate instructional materials between courses. For example, Entomology courses should address common pests of crops grown at the farm, Plant Propagation should include commercial-scale transplant production that will be used in the implementation of the annual farm plan, and economic sustainability of farm operations.

• Alternative pedagogical strategies should be incorporated to increase experiential learning techniques, especially in production classes. Rote course material is important for students to learn, but topical readings should be assigned for completion outside of the classroom and activities that

![Figure 4: Management structure and instructional roles at the proposed Catamount Farm.](image-url)

each.

• Course instruction should cover topics for all types and scales of potential farming operations. Organic Farm Planning may be changed to Diversified Farm Planning, Vegetable Crops should include information on larger-scale production that may not necessarily be organic, but all strategies should be address social, environmental, teach interdisciplinary application of farming practices encouraged during class meetings. This is especially important for summer coursework, where students will be able to apply concepts from readings on the farm, rather than receive lectures on book material that can be covered when the weather is less conducive to field learning.
• Relist production courses within the PSS course offerings that have been inactive yet requested by students. These courses should, if possible, be taught during the growing season to allow students to receive hands-on training in farm operations for a specific crop.

• In order to provide assessment of the annual Catamount Farm plan and to prepare for spring planting, move the spring PSS 208 Organic Farm Planning course to fall and rename Diversified Farm Planning. This course would include a comprehensive review of the season’s production records and should develop an initial plan for the next year’s season at the farm.

• PSS 209, Diversified Farm Practicum, will be offered annually as a capstone course and marketed to Ecological Agriculture students with junior standing. The course will have prerequisites including PSS 021 Introduction to Ecological Agriculture, PSS 106 or 117 (Entomology or Plant Pathology), and at least one production course either taken concurrently or prior to enrollment. The course will provide hands-on, applied instruction in implementing a farm plan, and will focus on critical evaluation of crop production during the growing season to develop management skills that will allow for successful farm management (this course may be modeled after the UC Davis capstone experience described on page 9).

• Establish a one-credit, 200-level special topics course in spring of each year, Applied Plant Propagation, that will enroll a small number of students who have completed PSS 138 Commercial Plant Propagation who will implement the transplant production plan from the Catamount Farm plan to prepare for the next growing season.

• Develop one or two-credit short courses that may be taught at unconventional times (nights, weekends, between regular course schedules) and will cover specific farm topics, including: irrigation management, farm equipment operation, fruit tree pruning, etc.

• Allow one or two Animal Science (ASCI) courses to be applied to the program requirement. Consider offering a diversified farm-specific animal husbandry course that addresses issues with including animals in small farm operations.

• Require a multi-course series on small business management. This could include the CDAE 166, 167, and 168 suite: Introduction to Community Entrepreneurship, Financial Management for Community Entrepreneurs, and Marketing for Community Entrepreneurs. Alternative coursework in the School of Business Administration (BSAD) may be appropriate to meet this requirement, including BSAD 101 (Business Savvy), 137 & 138 (Entrepreneurial Leadership, Entrepreneurship: Business Planning).

• Partner with CDAE to develop and offer a summer Farm Marketing course that specifically covers business and marketing issues associated with Catamount and other similar diversified farms. Students in this course can assist in development, implementation, and assessment of Catamount Farm marketing plan.
• Collaborate with Continuing Education to include non-credit sections of courses marketed to farmers as certificate sections at a reduced cost. For example, a three-credit fruit production course, which would cost $1716 for credit in 2013-2014, could be offered without credit for under $1000 to farmers. This would increase participation by active and interested growers whose perspective would be valuable for all course enrollees. This would also increase total program revenue without competing for existing students from other programs.

• Develop a comprehensive summer course plan by September 15 of the prior year, complete with course and certificate enrollment costs, so that the program may be marketed over the winter to prospective students.

• Develop a comprehensive summer Farm Practicum certificate program including core PSS summer courses and contributions from FTP that can be marketed to high school science teachers for continuing education credits. This would likely be a two to three-week course sequence that could be timed around high school schedules.

• Appoint a PSS summer curriculum coordinator who will oversee development of the curriculum.

• Convene meetings of a summer program advisory board, to include participating faculty, HREC staff, Continuing Education staff, and representatives from FTP at least twice annually to coordinate program needs and provide guidance to the HREC Director and Production Manager to ensure that instructional needs may be met through the implementation of the farm plan.

A suggested 2014-2015 schedule for PSS and related courses is included in Table 3.
indeed common in many seasons, and problems such as poor weed, soil fertility, or financial management affect future groups of students. In the 2008 farms reorganization plan (Appendix 2), the intent was made clear to shift CALS support for the CG program toward a comprehensive, credit-bearing, academic program. In a PSS independent study course review of the 2008 season, then-manager Andrew Herrick recommended in his writeup that the program be shifted toward a faculty or staff-managed farm that could better serve the learning needs of students, and this was repeated in a review by a 2012 CG officer in an assignment for PSS 296: Ecology of Food Systems (T. Bradshaw, pers. comm.). Thus, this proposal is not suggested independent of student comments, but rather in response to them. In 2009, CALS support for CG plots located at the HRC was made contingent on their direct application to an academic program, and thus, PSS 209 Organic Farm Practicum was initiated, but for whatever reason, maintained separate from the CG farm and management of the farm remained with the students. Enrollment has been poor in PSS 209, and thus the academic tie has not been strong enough to justify continued support of the program in its present form. This proposal pulls management of all specialty crops teaching plots under the direction of the HREC for the express use by credit and non-credit bearing academic units.

Common Ground is invited to participate in this venture, and its students can potentially find greater value from participating in a more organized program. CG students often have not been PSS or Ecological Agricultural majors, and the club provides an important opportunity for non-majors who are interested in food production that may not necessarily have a science or production agriculture background. The mission of CG “to increase the avenues for hands-on education in sustainable agriculture for UVM students and to create positive links between UVM and Vermont communities through...donations to anti-hunger organizations (Common Ground Constitution, not presently published)” can be met without actively managing the farm itself, and in fact the student’s limited time resources may be better utilized by identifying specific farm program components that CG students may implement via the club:

- **Food shelf donations:** Catamount Farm, like many diversified vegetable farms, will likely produce an excess of certain products, and their coordinated harvest and delivery to food shelves and anti-hunger organizations will serve the missions of each organization well.
- **Transplant propagation:** the core group of FTP students who will perform much of the labor at the farm will not be present during propagation season, but CG undergraduates are available, and often looking for farm and garden activities during late winter and early spring when field planting is months away. CG could help the Production Manager to implement the transplant plan to ensure adequate availability of plants during the initial and later planting seasons.
- **Field work:** including planting, weed management, harvest, and preparation of produce for sales and delivery.

Core, day-to-day educational programming under this program will be reserved for tuition-paying students, but general farm support and incidental learning opportunities are available within the 15+ acres managed by the farm. Another important component that CG may continue its leadership role with is in student
advocacy and off-farm/on-campus workshop programming. In some years, CG students have sponsored a diverse array of speakers and meetings on agricultural and food systems-related topics; these can continue and in fact increase as efforts throughout UVM on Food Systems education increase across campus. CG may also cooperate with the Horticulture Club, Campus Kitchens, and other clubs to facilitate their activities and broaden their scope and reach.
Table 1: Survey responses from past PSS students and CG participants on perceived value of their undergraduate experience.

Survey respondents’ ratings of experience with CG program or PSS curriculum and its impact on learning of components of farm and agricultural business management by graduation year

<table>
<thead>
<tr>
<th>Component</th>
<th>PSS Curriculum</th>
<th></th>
<th></th>
<th>CG Program</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall preparation to work on/run a farm</td>
<td>3.7</td>
<td>3.2</td>
<td>0.08</td>
<td>3.9</td>
<td>3.6</td>
<td>0.26</td>
</tr>
<tr>
<td>Basic plant science</td>
<td>4.3</td>
<td>4.3</td>
<td>0.50</td>
<td>3.4</td>
<td>3.1</td>
<td>0.24</td>
</tr>
<tr>
<td>Preseason farm crop planning</td>
<td>3.4</td>
<td>2.8</td>
<td>0.06</td>
<td>4.0</td>
<td>3.3</td>
<td>0.11</td>
</tr>
<tr>
<td>Whole farm planning</td>
<td>3.3</td>
<td>3.1</td>
<td>0.30</td>
<td>3.7</td>
<td>3.5</td>
<td>0.33</td>
</tr>
<tr>
<td>Implementation of a crop plan</td>
<td>3.4</td>
<td>3.2</td>
<td>0.21</td>
<td>4.3</td>
<td>3.6</td>
<td>0.07</td>
</tr>
<tr>
<td>Vegetable crop production</td>
<td>3.4</td>
<td>3.4</td>
<td>0.45</td>
<td>4.3</td>
<td>4.1</td>
<td>0.32</td>
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<tr>
<td>Fruit crop production</td>
<td>3.3</td>
<td>3.2</td>
<td>0.36</td>
<td>3.2</td>
<td>2.8</td>
<td>0.21</td>
</tr>
<tr>
<td>Small grains production</td>
<td>2.4</td>
<td>2.5</td>
<td>0.32</td>
<td>2.2</td>
<td>2.3</td>
<td>0.41</td>
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<tr>
<td>Animal husbandry</td>
<td>2.2</td>
<td>2.5</td>
<td>0.20</td>
<td>2.2</td>
<td>2.5</td>
<td>0.30</td>
</tr>
<tr>
<td>Farm equipment selection and operation</td>
<td>2.3</td>
<td>2.6</td>
<td>0.21</td>
<td>2.8</td>
<td>3.4</td>
<td>0.07</td>
</tr>
<tr>
<td>Pest identification</td>
<td>4.3</td>
<td>4.1</td>
<td>0.23</td>
<td>3.8</td>
<td>3.4</td>
<td>0.17</td>
</tr>
<tr>
<td>Integrated pest management</td>
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<td>4.0</td>
<td>0.08</td>
<td>3.9</td>
<td>3.6</td>
<td>0.20</td>
</tr>
<tr>
<td>Farm business management</td>
<td>2.8</td>
<td>2.7</td>
<td>0.36</td>
<td>3.4</td>
<td>3.2</td>
<td>0.36</td>
</tr>
<tr>
<td>Farm finance</td>
<td>2.4</td>
<td>2.6</td>
<td>0.36</td>
<td>3.3</td>
<td>2.9</td>
<td>0.22</td>
</tr>
<tr>
<td>Farm product marketing</td>
<td>2.9</td>
<td>2.6</td>
<td>0.30</td>
<td>3.4</td>
<td>3.2</td>
<td>0.33</td>
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<tr>
<td>Customer relations</td>
<td>2.6</td>
<td>2.8</td>
<td>0.36</td>
<td>3.5</td>
<td>3.8</td>
<td>0.22</td>
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<td>Community relations</td>
<td>2.8</td>
<td>3.3</td>
<td>0.17</td>
<td>3.5</td>
<td>3.7</td>
<td>0.36</td>
</tr>
<tr>
<td>Ecology and ecosystem services</td>
<td>3.5</td>
<td>4.1</td>
<td>0.04</td>
<td>3.3</td>
<td>3.1</td>
<td>0.36</td>
</tr>
</tbody>
</table>

*Ratings collected on a 1-5 scale where 1=not at all valuable, 2= somewhat valuable, 3= neutral, 4= very valuable, and 5= extremely valuable. Total respondent n=39, but not all respondents answered all questions. P-values based on a t-test between graduation year categories.*
### Table 2: Initial Budget for Catamount Farm and Associated Programs at Maturity

#### Income

<table>
<thead>
<tr>
<th>Description</th>
<th>HRC</th>
<th>PSS</th>
<th>FTP</th>
</tr>
</thead>
<tbody>
<tr>
<td>AES</td>
<td>$50,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment use fees</td>
<td></td>
<td>$3,000</td>
<td></td>
</tr>
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</table>

#### Produce and Sales:

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Unit $</th>
<th>Total $</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA shares (20 wk @ $25/wk)</td>
<td>60</td>
<td>500</td>
<td>$30,000</td>
</tr>
<tr>
<td>Farmstand @ HRC ($600 * 10 wks)</td>
<td>10</td>
<td>600</td>
<td>$6,000</td>
</tr>
<tr>
<td>Campus contract sales</td>
<td></td>
<td></td>
<td>$10,000</td>
</tr>
<tr>
<td>Apple sales, retail</td>
<td>12</td>
<td>2500</td>
<td>$30,000</td>
</tr>
<tr>
<td>Apple sales, wholesale</td>
<td></td>
<td></td>
<td>$5,000</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td><strong>$81,000</strong></td>
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</table>

#### Tuition

<table>
<thead>
<tr>
<th>Description</th>
<th>HREC</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTP Students</td>
<td>24, 6200, $148,800</td>
</tr>
<tr>
<td>Summer undergrad</td>
<td></td>
</tr>
<tr>
<td>Tuition capture %</td>
<td></td>
</tr>
<tr>
<td>Farm Practicum- undergrad</td>
<td>8, 1000, 3, 50, $1,200, $16,800</td>
</tr>
<tr>
<td>Farm Practicum- certificate</td>
<td>4, 1200, 1, 50, $200, $3,360</td>
</tr>
<tr>
<td>Production Course 1- undergrad</td>
<td>8, 1000, 3, 50, $1,200, $16,800</td>
</tr>
<tr>
<td>Production Course 1- certificate</td>
<td>4, 1200, 1, 50, $200, $3,360</td>
</tr>
<tr>
<td>Production Course 2- undergrad</td>
<td>8, 1000, 3, 50, $1,200, $16,800</td>
</tr>
<tr>
<td>Production Course 2- certificate</td>
<td>4, 1200, 1, 50, $200, $3,360</td>
</tr>
<tr>
<td>Farm marketing- undergrad (CDAE)</td>
<td>8, 1000, 3, 50, $1,200, $16,800</td>
</tr>
<tr>
<td>Farm marketing- certificate (CDAE)</td>
<td>4, 1200, 1, 50, $200, $3,360</td>
</tr>
<tr>
<td>Applied pest mgmt- undergrad</td>
<td>8, 1000, 3, 50, $1,200, $16,800</td>
</tr>
<tr>
<td>Applied pest mgmt- certificate</td>
<td>4, 1200, 1, 50, $200, $3,360</td>
</tr>
<tr>
<td>Soil &amp; plant nutrition mgmt- undergrad</td>
<td>8, 1000, 3, 50, $1,200, $16,800</td>
</tr>
<tr>
<td>Soil &amp; plant nutrition mgmt- certificate</td>
<td>4, 1200, 1, 50, $200, $3,360</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td>$8,400</td>
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**Total Income**

<table>
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<tr>
<th>Description</th>
<th>HRC</th>
<th>PSS</th>
<th>FTP</th>
</tr>
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<tbody>
<tr>
<td><strong>Total Income</strong></td>
<td>$142,400</td>
<td>$120,960</td>
<td>$148,800</td>
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#### Expenses

**Personnel**

<table>
<thead>
<tr>
<th>Description</th>
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</tr>
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<tbody>
<tr>
<td>HRC Director</td>
<td>$19,525</td>
<td>$3,905</td>
<td>$3,905</td>
</tr>
<tr>
<td>Production mgr</td>
<td>$20,448</td>
<td>$10,224</td>
<td>$20,448</td>
</tr>
<tr>
<td>Operations mgr</td>
<td>$38,340</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hourly students (2 @ 400 hrs *$10)</td>
<td>$8,720</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CG Students (3@ 400 hrs @$10)</td>
<td>-</td>
<td>$19,520</td>
<td>-</td>
</tr>
<tr>
<td>PSS Coordinator/Summer Instructor</td>
<td>-</td>
<td>$19,525</td>
<td>-</td>
</tr>
<tr>
<td>FTP Director</td>
<td>-</td>
<td>-</td>
<td>$28,400</td>
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<tr>
<td>FTP Instructor 1 ($20/hr * 40 hr * 28 wks)</td>
<td>-</td>
<td>-</td>
<td>$24,416</td>
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<tr>
<td>FTP Instructor 2 ($15/hr * 40 hr * 28 wks)</td>
<td>-</td>
<td>-</td>
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<td><strong>Subtotal</strong></td>
<td>$87,033</td>
<td>$33,654</td>
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#### Farm operations

<table>
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<th>Description</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
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<tr>
<td>Fertilizer</td>
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<td></td>
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<tr>
<td>Supplies</td>
<td>$1,500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pest management</td>
<td>$5,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel</td>
<td>$5,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment maintenance</td>
<td>$5,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greenhouse fees (75% HRC, 12.5% each PSS and FTP)</td>
<td>$5,524</td>
<td>$921</td>
<td>$921</td>
</tr>
<tr>
<td>Equipment- capital investment</td>
<td>$5,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment use fees (instructional)</td>
<td>1,500</td>
<td>1,500</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$42,024</td>
<td>2,421</td>
<td>2,421</td>
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</table>

**Total Expenses**

<table>
<thead>
<tr>
<th>Description</th>
<th>HRC</th>
<th>PSS</th>
<th>FTP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Expenses</strong></td>
<td>$129,057</td>
<td>$36,075</td>
<td>$97,902</td>
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**Net**

<table>
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<th>Description</th>
<th>HRC</th>
<th>PSS</th>
<th>FTP</th>
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<tr>
<td><strong>Net</strong></td>
<td>$13,343</td>
<td>$84,885</td>
<td>$50,898</td>
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32
<table>
<thead>
<tr>
<th>Table 3: Proposed PSS Course Offerings, Fall 2013 – Summer 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall 2013</strong></td>
</tr>
<tr>
<td>PSS 003 Coffee Ecologies &amp; Livelihoods</td>
</tr>
<tr>
<td>PSS 010 Home &amp; Garden Horticulture</td>
</tr>
<tr>
<td>PSS 015 Home &amp; Garden Horticulture Lab</td>
</tr>
<tr>
<td>PSS 096 Drawing &amp; <strong>Painting Botanicals</strong></td>
</tr>
<tr>
<td>PSS 106 Entomology &amp; <strong>Pest Management</strong></td>
</tr>
<tr>
<td>PSS 112 Weed Ecology</td>
</tr>
<tr>
<td>PSS 117 Plant Pathology</td>
</tr>
<tr>
<td>PSS 121 Indoor Plants</td>
</tr>
<tr>
<td>PSS 123 Garden Flowers</td>
</tr>
<tr>
<td>PSS 125 Woody Landscape Plants</td>
</tr>
<tr>
<td>PSS 137 Landscape <strong>Design Fundamentals</strong></td>
</tr>
<tr>
<td>PSS 143 Forage &amp; Pasture Management</td>
</tr>
<tr>
<td>PSS 156 Permaculture</td>
</tr>
<tr>
<td>PSS 158 Internship: EcAg/Landscape Hort.</td>
</tr>
<tr>
<td>PSS 161 Fundamentals of Soil Science</td>
</tr>
<tr>
<td>PSS 196 Permaculture Practicum</td>
</tr>
<tr>
<td>PSS 209 Organic Farm Practicum</td>
</tr>
<tr>
<td><strong>PSS 393/394 Seminar Series</strong></td>
</tr>
<tr>
<td>PSS 301 Plant Science Colloquim</td>
</tr>
</tbody>
</table>

**PSS 208 Diversified Farm Planning**

**Table 3: Proposed PSS Course Offerings, Fall 2013 – Summer 2015 (Cont.)**

<table>
<thead>
<tr>
<th><strong>Fall 2014</strong></th>
<th><strong>Spring 2015</strong></th>
<th><strong>Summer 2015</strong></th>
</tr>
</thead>
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33
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSS 003</td>
<td>Coffee Ecologies &amp; Livelihoods</td>
</tr>
<tr>
<td>PSS 010</td>
<td>Home &amp; Garden Horticulture Lab</td>
</tr>
<tr>
<td>PSS 015</td>
<td>Home &amp; Garden Horticulture</td>
</tr>
<tr>
<td>PSS 021</td>
<td>Introduction to Ecological Agriculture</td>
</tr>
<tr>
<td>PSS 096</td>
<td>Drawing &amp; Painting Botanicals</td>
</tr>
<tr>
<td>PSS 106</td>
<td>Entomology &amp; Pest Management</td>
</tr>
<tr>
<td>PSS 121</td>
<td>Indoor Plants</td>
</tr>
<tr>
<td>PSS 123</td>
<td>Garden Flowers</td>
</tr>
<tr>
<td>PSS 125</td>
<td>Woody Landscape Plants</td>
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<td>PSS 137</td>
<td>Landscape Design Fundamentals</td>
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<tr>
<td>PSS 145</td>
<td>Turfgrass Management</td>
</tr>
<tr>
<td>PSS 156</td>
<td>Permaculture</td>
</tr>
<tr>
<td>PSS 158</td>
<td>Internship: EcAg/Landscape Hort.</td>
</tr>
<tr>
<td>PSS 161</td>
<td>Fundamentals of Soil Science</td>
</tr>
<tr>
<td>PSS 196</td>
<td>Permaculture Practicum</td>
</tr>
<tr>
<td>PSS 208</td>
<td>Diversified Farm Planning</td>
</tr>
<tr>
<td>PSS 209</td>
<td>Organic Farm Practicum</td>
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<tr>
<td>PSS 212</td>
<td>Advanced Agroecology</td>
</tr>
<tr>
<td>PSS 393/394</td>
<td>Seminar Series</td>
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<tr>
<td>PSS 301</td>
<td>Plant Science Colloquium</td>
</tr>
<tr>
<td>PSS 028</td>
<td>A Bug’s Life</td>
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<tr>
<td>PSS 095</td>
<td>Tropical Farming &amp; Gardening</td>
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<tr>
<td>PSS 096</td>
<td>Drawing &amp; Painting Botanicals</td>
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<td>PSS 121</td>
<td>Indoor Plants</td>
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<tr>
<td>PSS 123</td>
<td>Garden Flowers</td>
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<tr>
<td>PSS 124</td>
<td>Agroecology of Vegetable Crops</td>
</tr>
<tr>
<td>PSS 138</td>
<td>Commercial Plant Propagation</td>
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<tr>
<td>PSS 156</td>
<td>Permaculture</td>
</tr>
<tr>
<td>PSS 158</td>
<td>Internship: EcAg/Landscape Hort.</td>
</tr>
<tr>
<td>PSS 162</td>
<td>Soil Fertility and Conservation</td>
</tr>
<tr>
<td>PSS 196</td>
<td>Permaculture Practicum</td>
</tr>
<tr>
<td>PSS 198</td>
<td>Perennial Garden Design</td>
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<tr>
<td>PSS 209</td>
<td>Diversified Farm Management</td>
</tr>
<tr>
<td>PSS 195</td>
<td>Steel in the Field (2 cr)</td>
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<tr>
<td>PSS 196</td>
<td>Irrigation in Horticultural Crops (2 cr)</td>
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<tr>
<td>CDAE/PSS 195</td>
<td>On-Farm Marketing</td>
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<tr>
<td>PSS 295</td>
<td>On-Farm Pest Management</td>
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<td>PSS 162</td>
<td>Soil Fertility and Conservation</td>
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<tr>
<td>PSS 195</td>
<td>Nutrient Runoff</td>
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<tr>
<td>PSS 296</td>
<td>Ecology of Food Systems</td>
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<tr>
<td>PSS 195 ST: Perennial Fruit Pruning (1 cr)</td>
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<tr>
<td>PSS 195 ST: Vegetable Transplant Production</td>
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</table>

Course name change and move to fall semester
Courses not presently posted on PSS website [http://www.uvm.edu/~pss/?Page=coursematrix.html&SM=course_menu.html]
Literature Cited


### Appendix 1. Sample Michigan State University Student Organic Farm Budget


<table>
<thead>
<tr>
<th>Income</th>
<th>Expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carryover $15,700</td>
<td>Personnel:</td>
</tr>
<tr>
<td>Produce and Sales:</td>
<td>Farm manager, $40,000 @ 40% fringe $56,000</td>
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<tr>
<td>60 membership, 48 wk. CSA $86,400</td>
<td>Outreach specialist, $50,000 @ 45% fringe $72,500</td>
</tr>
<tr>
<td>40 membership, 24 week CS $28,800</td>
<td>Training specialist, $50,000 @ 45% fringe $72,500</td>
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<tr>
<td>26 wk. farmstand $15,600</td>
<td>Second-year students, three @ $18,000 $54,000</td>
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<tr>
<td>Campus dining $6,000</td>
<td>Undergraduate labor $35,000</td>
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<tr>
<td>Subtotal $136,800</td>
<td>Subtotal $290,000</td>
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<tr>
<td>Outreach</td>
<td>Fees:</td>
</tr>
<tr>
<td>Grants $100,000</td>
<td>HTRC fee $5,000</td>
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<tr>
<td>Program fees $10,000</td>
<td>HTRC Office support $1,750</td>
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<tr>
<td>Subtotal $110,000</td>
<td>1% tax on income $3,750</td>
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<tr>
<td>Training program</td>
<td>Subtotal $10,500</td>
</tr>
<tr>
<td>15 students @ $7500</td>
<td>Other:</td>
</tr>
<tr>
<td>Subtotal $112,500</td>
<td>Farm materials and supplies $15,000</td>
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<tr>
<td></td>
<td>Infrastructure/equipment $5,000</td>
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<tr>
<td></td>
<td>Outreach materials and supplies $10,000</td>
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<tr>
<td></td>
<td>Outreach travel $17,500</td>
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<tr>
<td></td>
<td>Training materials and supplies $10,000</td>
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<td>Training travel $2,000</td>
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<td></td>
<td>Web page, marketing $5,000</td>
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<tr>
<td></td>
<td>Carryover $10,000</td>
</tr>
<tr>
<td></td>
<td>Subtotal $74,500</td>
</tr>
</tbody>
</table>

**Total Income $375,000**  **Total expenses $375,000**
Appendix 2. UVM Farms 2008 Reorganization Plan

The following plan was presented to the CALS Board of Advisors in April 2008. Since then some action items have been addressed, but many remain outstanding, and the present proposal addresses them in the context of the HRC.

UVM Farms Reorganization Plan (Version 4.5)

1.0 Executive Summary

The College of Agriculture and Life Sciences (CALS) proposes to reorganize its farm operations to align maximally with the mission, values and identity of the College and the University. We will fulfill our role as Vermont’s Land Grant University by providing a quality practical education for our students relevant to the 21st century, by conducting cutting-edge research that opens new horizons, and by working with the private sector to create opportunities that emulate economic and environmental sustainability. CALS can best serve these objectives by concentrating on the planes of intersection between our disciplinary strength areas: a scientific understanding of fundamental biological processes in plant, animal and microbial systems, a science-based assessment of biological processes at the ecological and environmental levels, cutting-edge approaches to develop healthy food products and to promote human nutrition and health, and a scholarly approach to community sustainability. The novel emergent value at the intersection of these disciplines is CALS’ ability to serve the needs of Vermont’s citizens through innovative applications that present economic opportunity for the agricultural sector and protect the environment.

We propose a multi-faceted plan for utilization of the UVM farms in accord with our strength areas, vision, values and opportunities. The tenets of the farms reorganization plan are to:

• Maximize opportunities for student instruction and involvement in activities that provide skills, knowledge and approaches our students will use throughout their lives. This will include a suite of farm-based courses to be offered in the summer months,

• Maximize competitiveness for extramurally-funded research that generates new knowledge related to healthy foods, agricultural profitability, community sustainability and environmental stewardship,

• Pursue research in animal health, reproduction, nutrition and transition cow management that provides strategies for Vermont’s farmers to realize greater productivity and economic success,

• Pursue value-added product and marketing strategies that provide economic opportunities for Vermont’s agricultural community,

• Commit to renewable energy systems that are environmentally and economically sound.

• Partner with Vermont’s private sector and state agencies in a variety of student-operated enterprises in areas such as compost production-marketing-and-sale, renewable energy generation-and-sale, farm operation-and-management, animal health management, value-
added product development-marketing-and-sales, and environmental stewardship through balance of farm nutrient export-and-import.

This plan will require significant investment to provide modern instructional and research farm facilities. We must also plan for the continual farm infrastructure upgrades. The immediate needs for investment are:

- A multistage digester to produce energy from animal, plant and food waste. This facility will also produce clean compost which can be a source of additional revenue and offset current costs. (Approximate cost $5.0 million)

- A new animal barn complex to house “500 mature cow equivalents” which is essential to expand competitively-awarded extramural research that addresses the key issues to maintain agricultural profitability in Vermont, to provide new student experiential learning opportunities, and to allow implementation of the multistage digester. (Approximate cost $5.5 million)

- On-farm classroom facilities at both the UVM Horticulture Farm and Miller Complex to serve the suite of additional course offerings. (Approximate cost $3.0 million)

- A pilot plant for dairy product development and testing (Approximate cost $1.5 million)

- “Proving ground” assessments of economically-effective solar and wind technologies in collaboration with private sector partners ($2.0 million)

Thus, we estimate the cost of these facility improvements at $17 million (in 2008 dollars), and accordingly, must compete for investment with other facilities on the UVM Capital Priorities List. We envision this project to be funded by a mix of sources:

- University bonding ($8 million) to be offset by current University expenditures for electricity, campus landscape inputs, and waste disposal (anticipated pay-back within 4 years),

- Philanthropy through development activities ($5 million),

- Leveraged investment by private sector partners and grants from state or federal agencies ($4 million).

We believe this project will have a highly-competitive Capital Project priority score based on:

a) centrality of its purpose to address the Institutional commitment to carbon neutrality and energy self-sufficiency,

b) opportunities to significantly enhance the student experience, and provide new course opportunities

c) importance of the effort for economic and environmental sustainability of the Vermont agricultural community,
d) anticipated funding from philanthropy, leveraged investment by private sector partners, and public funding sources.

e) potential to expand extramurally-funded research activities, both from NSF and USDA (for enhancing animal health, reproduction and economic success of dairy production) and particularly from “non-traditional” sources (DOE, DOT-Sun Grant) in cooperation with sister universities in the Northeast pursuing similar renewable energy opportunities (UMass, Cornell, Penn State, Rutgers, UNH).

It is essential to make the investment in UVM farm facilities in an immediate timeframe. The current system for UVM farm operations is not economically sustainable. The infrastructure has been neglected for over 20 years and is beyond the point where repair or renovation is a financially-responsible option. The current structure limits our opportunities for extramural research, student involvement, and private sector partnerships. Most importantly, the current operation limits our ability to align with our aspirations of environmental stewardship and developing economic opportunities for Vermont’s agricultural sector. We also note that the window of opportunity for such investment is open for a finite, narrow period of time if UVM is to be a relevant competitive contributor in this area.

2.0 Premise and Operating Parameters

CALS has been in the process of a year-long evaluation of our farm operations, facilities, services and utilization with the intent to better align our efforts to serve the research and instructional missions of the College and UVM. This process has included a review of operations, staffing and staff assignments, revenues and expenses (summer 2007); ad hoc conversations with primary users (August through September 2007); assessment by and recommendations of a committee composed of ASCI and PSS departmental representatives (October 5, 2007 through January 28, 2008); review and input from CALS departments (February to March 2008); and discussion among the CALS Leadership Team (March 2008). We now present this document as the synthesis of those efforts, to be further reviewed and refined by input from our CALS Board of Advisors, external stakeholders, sister units at UVM, and CALS Central Administration.

CALS leadership has concluded that a reorganization of its farm operations is essential. CALS allocates nearly a half-million dollars annually to the operation of the farms. Despite this sizable investment of limited College funds, it clear that the farm facilities and current farm operations do not adequately assist faculty efforts to conduct extramurally-funded research or to provide first-class experiential learning opportunities for our students.

- The farm infrastructure at the Miller Center (large animal research) and Horticulture Farm (Blasberg Building) has been neglected for more than 20 years with minimal infrastructure upkeep or improvements. As a result, the current facilities are inadequate for research and instruction in dairy and horticultural activities. Only the equine facilities have received attention thanks to the generous philanthropy of benefactors. It is essential that our plan for the UVM farms has the sense of purpose and value that benefactors are willing to assist, and supports research activities that enhance the profitability and competitiveness of Vermont’s agricultural sector.
The outlay of our farm facilities is ad hoc and inefficient for routine operations, student activities and research. Coupled with the advanced state of disrepair, these facilities limit opportunities for student involvement and competitive research. Our current activities do not align well with the scholarly strengths of our faculty, the aspirations of the University, or our ability to contribute to the viability of Vermont’s agricultural sector.

The current paradigm for operation of the UVM farms is not fiscally sustainable. CALS currently provides an annual investment of >$460k per year in base labor support from UVM and federal funding sources ($139K federal Hatch; $244 Ag Related Services; $86K UVM General Fund). Despite this annual investment, the farm account has overspent its revenue inputs by an additional $50,000 per year averaged over the past 5 years. These deficits limit the College’s ability to invest in research leverage, instructional lab infrastructure, faculty start-up packages or new programmatic initiatives. CALS faculty have indicated that the priority for allocation of Hatch and Ag Related Services funds should be in the following order: (1) graduate student assistantships, (2) the competitive Hatch seed-project pool, (3) farms infrastructure. With labor, feed, fuel, and other farm operational costs increasing at a rate greater than either Federal Hatch or State funding, the current deficit situation will only worsen with time. It is clear that these losses cannot continue and that a new paradigm for operation of the UVM farms must be pursued.

The CALS Leadership Team is committed to continued operation of the UVM farms. However, a base resource allocation on the order of $500,000 per year must be aligned with CALS strategic mission priorities, faculty strengths and institutional values. The farms must operate in a fiscally responsible way that demonstrate a “return on investment” which clearly serves the primary purpose of enabling our core mission priorities for research and instruction, and addresses our values of environmental stewardship, a healthy population, viability of Vermont’s agricultural sector and sustainability of our communities.

The January 28, 2008 committee report (included as Appendix I) provided recommendations on how to best restructure our farm operations to optimally meet their research and teaching needs. The Dean’s office specifically challenged that committee to visualize what the farm facilities would look like in 10 years, what activities they should support, and what professional services they would need. There were several key recommendations of this committee, including a need for:

- Greater utilization of the UVM farms for formal coursework, particularly in the summer
- Integration of student courses with faculty research opportunities
- Greater interdisciplinary integration, particularly around environmental issues
- Facilities to support research in animal health, reproduction, calving diseases, new feed sources and nutrition, farm yield, and similar areas that affect the productivity and economic success of Vermont’s dairies
• An emphasis on novel value-added agricultural opportunities
• A doubling of the dairy herd, with construction of new farm facilities
• Community partnerships

Coincidentally, President Fogel recently (February 2008) announced establishment of a UVM Office of Sustainability, and a commitment by UVM to become a carbon-neutral institution. We applaud the recommendations of the committee and their foresight in identifying areas which align with Institutional priorities and state needs. We believe that these objectives can be met through a common vision that includes new facilities for research and teaching that includes on-farm energy generation, nutrient export from the farm, and student experiential learning opportunities, particularly through for innovative interdepartmental activities and public-private partnerships.

In summary, we believe we have developed a concept which:

• Is aligned with the research and instructional priorities of CALS and UVM
• Is economically feasible within current base funding constraints (that is, known sources of federal, state and general fund support to the College), with conservative estimates of revenues from projected farm operations,
• Realistically identifies needed financial investment for infrastructure, the return-on-investment break-even point for the Institution, philanthropic support, and public grant funding, and private sector investment,
• Broadens the research horizons of CALS faculty, students in experiential learning programs, and UVM faculty as a whole,
• Is environmentally sound and economically sustainable,
• Consciously addresses how CALS strengths can best serve the needs of Vermont and our agricultural community,
• Illustrates the common vision of the College, projects the image of the University, and provides the inspiring vision that can attract philanthropic support.

3.0 Projected Activity Areas for Farm Utilization

The January 28, 2008 committee report presented a detailed 22-page assessment of opportunities for UVM farms utilization (Appendix I). Below we summarize the key recommendations of the committee and append the report for a more detailed justification and assessment of financial opportunities.

3.1 Enhancing the Student Experience

Both the Horticultural Farm (“Hort Farm”) and the Miller Farm (also known as the “Spear Street Farm”) were seen to present opportunities to enhance the UVM student experience.
3.1.1 **Plant-centered Courses.** The Hort Farm has an excellent collection of ornamental trees and shrubs selected for adaptation to cold Vermont winters. The western third of the 97 acre complex has been dedicated for cultivation and trials employing organic practices. The Hort Farm is used by the student government-sponsored club “Common Ground” which operates as a CSA (Community Supported Agriculture) operation. Despite these advantages, the Hort Farm is considerably under-utilized for student instructional activities. One of the principle reasons for this situation is that courses currently taught through CALS during the academic year do not coincide with the growing season. There is a considerable opportunity for the Hort Farm to be utilized as a living classroom for student instruction if our departments were to shift some of their courses to one (or more) mandatory summer term(s) for their majors, and we can devise a facile system to transport students to the Hort farm at reasonable cost. In addition, a suite of additional new courses, certificate programs and internships could be offered in the summer months (for UVM students, students at other Universities throughout New England, K-12 teachers, and the non-degree student community-at-large), particularly if these courses are structured around environmentally-sound practices. Examples of potential new courses include specialty crops, fruit production, soil health management, weed ecology and weed suppression, no-till agriculture, agricultural financial management, marketing and entrepreneurship, renewable energy systems, medicinal plants, pest suppression, pasture management, biofuel crop management, cold hearty plant landscaping for Vermont gardens, and landscape design for storm water and waste water management. The CALS faculty cite a prime opportunity to capitalize on the Vermont cache and sustained “localvore” movement by offering a Summer Institute which could be entitled “The Vermont Center for Sustainable Food Systems” or “The Vermont Summer Institute for Agroecology and Profitable Multifunctional Landscapes”. This is a virtually unexploited national market with only one other competitor (UC Santa Cruz) and no current competition in New England. Faculty also noted the opportunity for undergraduate student internships linked to faculty research projects and long-term (eg., 10 year duration) data collection regarding ecological impacts of agricultural practices.

The primary limitations for implementing such plant-centered courses are:

- Inadequate classroom and laboratory facilities at the Hort Farm’s Blasberg Building
- Outdated equipment and facilities
- Minimal staff support for instructional activities
- Inadequate funding for field plot redesign and management
- Lack of reliable transport mechanisms for students to access the Hort Farm
- Constraints of the two-semester structure, including eligibility for financial aid, and additional housing costs
We propose that these limitations can be easily overcome by:

- “time-shifting” faculty course assignments to the summer months as allowed by the current CBA
- Requiring at least one summer of coursework for specific undergraduate majors, with an optional semester off-set
- Student use fees of the Farm facilities
- Implementation of the “Summer Institute” concept, and a suite of net-new-revenue-generating courses. A MOU is required (with CE and the Provost’s Office) to establish a transparent mechanism of reliable revenue return to provide support for farm operations as well as faculty supplemental compensation.

Investment in classroom and laboratory facilities are needed at the Hort Farm to support these proposed activities. At present, we are content to request Administrative approval to implement the “Summer Institute” and time-shifted coursework concepts. Success of these efforts would warrant investment in these facilities commensurate with UVM’s reputation as a quality undergraduate institution.

We see a considerable opportunity for UVM to project its image as a leader in sustainable agricultural and environmental practices, as well as to capitalize on an untapped revenue source. Using a conservative estimate of 25 students per year enrolled in a 12 credit “Summer Institute” curriculum, we project an annual $415,000 in tuition to the University with a proposed (40%) revenue-return of $166,000 to support UVM farm operations.

3.1.2 Animal-centered Courses. The Hardacre Equine Facility (located within the Miller Farm) currently hosts a variety of ASCI equine-centered courses as well as EQUUS management program and the Horse Barn Coop (boarding of students’ horses on campus). The Miller Dairy Center is home for the CREAM program (student-run management of a 32 cow dairy) and at least five other ASCI laboratory courses which occasionally use cows housed at Miller. The Jan 28 committee report noted the opportunity for expansion of experiential course offerings using UVM large animals. It was noted that the CREAM program is a highly-praised 8-credit course, but this is a resource-intensive program that accommodates only 15 students per year. The success of this student experience lies in the intimate nature of the team-building structure of the program, which must be preserved. However, the opportunity exists to replicate the CREAM model with a series of other student cohorts addressing a variety of specific aspects of animal and farm management. In particular, we envision a suite of CREAM-like courses in areas such as animal health and reproductive management, nutrient load balance on agricultural lands and water quality preservation, value-added dairy product development and marketing, animal nutrition for unique/niche milk quality, waste management and energy production, and compost production-utilization-and-commercial-distribution, in addition to the original CREAM concept of profitable dairy operation management. It is essential that we structure these experiential learning courses in a cost-effective manner, and off-set their typically-high cost per
student with other departmental efforts which generate high student-credit-hours per faculty member (SCH/FTE).

Such experiential learning activities have the potential to generate additional revenue for farm operations through sale of value-added products (eg., compost, electricity, dairy products). We see such opportunities as highly valuable and desirable real-world training opportunities for students. However, we observe that Universities are great instructional centers but typically poor commercial business operations. Accordingly, we propose that these CREAM-like courses operate in partnership with existing successful Vermont private-sector businesses or business consortia that will ensure responsible financial stewardship and success. CALS has already pioneered such a public-private partnership in student experiential learning through operation of the “Growing Vermont” store in the Davis Center, operated by CDAE students in conjunction with oversight by a consortium of small-business owners and participation of the Vermont Agency of Agriculture. We envision that student operations for compost, animal health management, renewable energy production, or value-added dairy products would operate in conjunction with a private-sector partner experienced in the field. Revenues and risks are envisioned to be shared by the University and the private-sector partner, with financial management and market opportunity provided by the private-sector partner, and the operation of the enterprise conducted by student interns utilizing UVM farm products.

Substantial investment in entirely new facilities is necessary to implement such animal-centered student experience, as well as a restructuring of farm staff duties and faculty workload assignments. Course offerings alone are insufficient to justify such costly expenditures. However, alignment of these facilities and associated course work with Institutional priorities (such as renewable energy production, campus waste utilization, carbon neutral offsets, and associated cost savings from these initiatives) more than justifies the Institutional investment in this farm infrastructure, with the added benefit of providing student experiential learning opportunities of considerable value and visibility.

3.1.3 Graduate Student Involvement in UVM Farm Operations. We anticipate two opportunities for significantly greater graduate student involvement in on-farm projects. We anticipate that the curriculum and suite of educational activities described above could comprise the basis for a graduate training grant submitted to the USDA (eg., Food and Agricultural Sciences Nation Needs Graduate and Postgraduate Fellowship Grants Program). The grant proposal could be built around the concept of recruiting graduate students to help build and participate in the curriculum, providing them training in sustainable crop systems, animal health management, or renewable energy generation, whichever we perceive as our strongest opportunity for impact. In addition, we propose that increased revenues from a greatly expanded milking herd could be used to fund net new graduate student assistantships, in addition to, or in lieu of, additional farm staff positions. These GA’s would be expected to contribute 20 hrs per week to farm operations year-round (instead of TA of courses) and engage in thesis activities for the complementing 20 hours. These “farm GAs” could provide significant flexibility to the farm staffing schedule, and provide a significant increase in the number of graduate students engaged in CALS doctoral programs. Graduate student involvement would also provide a
stabilizing influence to the envisioned CREAM-like courses by serving as the Institutional-memory and Voice-of-Experience in these enterprises.

3.2 Expanded Research Opportunities

We propose increased research utilization of UVM farms in accord with our disciplinary strengths and interdisciplinary applications. We foresee a tangible increase in extramurally-funded research utilization of the farms in the following areas:

- Animal disease management, effects of animal nutrition on milk quality characteristics, animal genetics, hormonal processes in development, and fundable other areas which are key to promote profitability of Vermont’s dairy sector,

- Ecological management, value-added niche crops, soil health and fertility, local food system optimization, and agricultural products aligned to meet consumer market demands,

- Global climate change: soil microbial processes and greenhouse gas production, plant physiological responses to climate change, ecosystem responses to climate change, invasive species range expansion, the impact of global climate change on Vermont’s agricultural sector and rural economy.

- Renewable energy opportunities: waste management and energy production, waste carbon as a valuable commodity, system design and engineering, private sector partnerships, economic assessments, ecosystem impacts, biofuel production, decentralized energy production system management

- Maximizing economic opportunity for Vermont’s agricultural sector, mainstream and value-added product opportunities, minimizing environmental impacts, mitigating and minimizing pests/weeds/disease incidence, minimizing cost of inputs and operation.

We believe that these research areas provide significant opportunity for other units at UVM (Engineering, Extension, RSERN, UVM Office of Sustainability) in addition to CALS faculty. We will leave it to those units to cite specific opportunities for their involvement at the UVM Farms with input at the next level of review. However, we note that we have already received input from members of the UVM Extension’s Center for Sustainable Agriculture who have suggested that a UVM farm may be a logical place to physically locate a new home for the Center. We have also received a concept outline for a small ruminant dairy (200 goats) that could be used to enhance teaching opportunities (a CREAM-like student cooperative) and conduct extramurally-funded research to support this emerging agricultural sector (particularly for specialty meat and artisan cheese production). We welcome consideration of such partnering efforts with sister units that align with our mission and vision, and are financially accountable.

3.3 Promoting UVM’s Commitment to Environmental Sustainability through Carbon Neutral Renewable Energy Generation.
The University of Vermont has the opportunity to address some of its current waste issues while taking a leadership role in renewable energy generation. The recent closure of the Intervale poses a significant waste management problem to UVM in two regards. The Miller Farm had previously disposed of almost 1/3 of its nutrient load by export of manure to the Intervale compost operation. In addition, UVM disposed of nearly all of its food service waste to the Intervale. There is an immediate need for UVM to find alternate means of waste disposal. It seems obvious that a common solution to these problems, as well as a step towards minimizing our carbon footprint, is to install an energy-generating waste disposal system on campus.

We propose to install a multistage anaerobic digester at the Miller Farm. The first stage of the digester would process manure from a dairy operation of “500 mature cow equivalents”, that is, approximately 350 cows in milk production with approximately 350 immature replacement animals. This unit alone would produce methane sufficient to produce 85 kilowatts per day. In addition, this unit would produce a ready source of composted material, which after being processed through a high temperature sterilizer/dryer could replace significant expenditures in sawdust animal bedding, and cedar shavings for campus landscaping.

We propose to use the effluent fluid from the manure digester to inoculate second-stage digesters which could process food waste from campus and the surrounding community, if such an operation is condoned by the UVM Office of Sustainability. These second stage digesters are estimated to produce an additional 175-to-200 kw per day from a daily input of 10 tons (one truck load) of organic waste. This second-stage digester can also accept yard waste (grass clippings, leaves, etc) as well as low-grade straw, hay and low value crop mass. Together these two systems could produce an estimated 2 million kwh of power per year, valued conservatively at $1.5 million per year.

We envision a third stage component to the system which will utilize the effluent material as a nutrient source for production of algae, bacteria, or some other opportunity for biomass production. Such biomass production could be augmented by collection of waste CO$_2$ and heat from the associated methane-powered electrical generator. The product of this third stage could be either clean water percolated to ground water after drip remediation through sediment, or an additional commercial product as a drip-irrigation fertilizer.

The modular design of a multi-stage digester allows for future addition of additional experimental modules to the core digester operation. Such experimental modules could be installed in partnership with private companies interested in prototype development or assessment, using UVM farms as a “proving ground” for new technology and maintaining UVM at the forefront of renewable energy technology. Future research modules could examine efficacy of alternative techniques such as anoxic pyrolysis, ultrasound disruption of cell walls, or cellulosic fermentation. We will also use this opportunity to explore options for energy efficiency and other renewable energy potentials that can be built into the new farm complex.

It would also be incumbent upon UVM to engage with suitable private-sector partners for the installation and testing of advanced prototypes for solar and wind-powered electrical generation at
UVM farm sites. UVM is in a position to compete for “Big Science” project funding in cooperation with sister Institutions (UMass, Cornell, Penn State, Rutgers, UNH) engaging in similar renewable energy operations.

3.4 Providing New Opportunities for Environmental and Economic Sustainability

The best way that CALS can assist the viability of Vermont agriculture is to conduct research that provides maximal opportunity for profitability; this includes maximizing efficiency by reducing losses due to animal care and nutrition, and by assisting development of new value-added product and marketing opportunities. Our proposed research and teaching activities are also directed at environmental best practices and renewable energy generation. CALS is committed to outreach that serves the State through economic development activities exemplified by the Ag Innovations Initiative. The premise of this program is to facilitate adoption by the private sector of innovative ideas that emerge out of University laboratories. One approach is to provide market assessment and other assistance through to licensing or a joint venture. An alternative approach is for private-sector entities to provide leveraged funding for use of University facilities in the development and/or assessment of advanced prototypes. We see the opportunity to employ approaches to work with Vermont businesses to provide economic enhancement for the state while promoting environmental stewardship and profitability of the agricultural sector.

4.0 Investment, Revenues and Expenses of the Reorganized UVM Farms Operation

4.1 Anticipated Infrastructure Investment Costs and Proposed Funding

CALS has recently obtained extramural funding to conduct a planning study (presented as Appendix II) for possible implementation of new facilities at the UVM Farms. This study will result in a recommended design for new dairy and horticultural facilities to support research and teaching, integrated with a system for renewable energy generation. Here we outline some of the projected facility needs, although we recognize the planning study will identify specific designs and needs.

4.1.1 The Multi-Stage Anaerobic Digester Complex. We envision that the anaerobic digester complex will consist of:

a) A waste input and output facility, a hoop-house structure for manure input, food waste input, input and heating device. This shed will also be the output point for material from the first-stage digester.

b) The first stage manure digester is comprised of a 31 ft by 40 ft tank with a 20 day retention time.

c) The solid output material from the first-stage digester will proceed through a 4-day high temperature sterilizer and compost dryer. This material will be used as high value compost. The liquid effluent from the first-stage digester will be used as seed inoculums to prime the second stage digesters.

d) The second stage (food waste) digester will be comprised of two additional 31 ft x 40 ft tanks (or three, depending on the food waste volume to be processed). These digesters will have an 80 day retention time.
e) Methane gas evolved from the first and second stage digesters will be processed through a scrubber to remove hydrogen sulfide and other detrimental contaminating gases. The clean methane will be fed either to an electrical generator on site.

f) The liquid effluent from the second stage digester will be used as a nutrient source for production of a biofuel crop, likely an algae or bacterial culture.

g) The effluent from this bioreactor tank will be directed to a lagoon for percolation through soil to groundwater, or could be collected for commercial distribution as a fertilizer.

The cost of this system will conservatively approach $5 million dollars, including systems to maximize automation of the digester (and thereby minimize labor inputs). We project this complex to generate a minimum of 2 million kwh per year; at 7 cents per kwh, this will generate $1.5 million per year ($2.3 million per year if entered into the Cow Power program). Thus, we project a University investment into this system will pay for itself within three-to-four years of operation.

4.1.2 Miller Barn Complex and Wheelock Feed Storage Bunks. Operation of an anaerobic digester using animal manure as a primary input material will require construction of a new barn facility to house dairy animals and provide automated collection of manure. This reality provides us with the opportunity to design a barn complex to meet our anticipated needs for student instructional activities and faculty research projects. ASCI faculty have indicated a need for at least 350 milking cows, plus associated immature replacement animals (an additional ~350 animals), to provide statistically-valid, scientifically-sound research to address the most pressing challenges to dairy profitability in Vermont: animal health, reproduction, nutrition, transition cow management and maximizing efficiency. A reasonable cost for modern barn design with flexible pen partitioning structure, head locks, and the option for dedicated tie stall regions is $4000 per stall. Considering the flexibility in pen partitioning we will have to incorporate into the structure for varied research protocols and teaching applications, a more likely cost incorporating this redundancy is $5000 per stall. Thus, the main barn facility will cost an estimated $3.5 million. In addition, we will need to incorporate specialized facilities for quarantine, special purpose isolation (eg, fistulation, biopsy), maternity and nursery, as well as dedicated research areas with measured feed intake. We will need to install a new milking parlor and milk room, estimated at $600,000, and may consider one robotic milking machine ($250,000) to service up to 50 cows, if this provides additional research and teaching opportunity to contrast with conventional systems. The increased number of animals to be housed at Miller necessitates procurement of all feed rations (except hay) from private vendors. The increased volume of feed cannot be accommodated in the current feed bunks, and the location of additional feed storage at Miller would exacerbate the current problem of nutrient leaching from these bunks. Thus, we propose to locate new feed storage bunks off-site, perhaps at East Wheelock, where land contours would limit nutrient leaching into the watershed.

Our initial estimate for the cost of these new animal facilities (and associated staff offices) is $5.5 million. We believe that the application of this facility for student activities, renewable energy generation, environmental stewardship and value-added opportunities for agriculture will attract the
philanthropic support of benefactors. In addition, we anticipate grant support from federal and state sources, and potential leveraged investment (or cost reduction) by vendors willing to demonstrate their products at a state-of-the-art University facility.

4.1.3 Classroom and Laboratory Facilities at the Hort Farm and Miller Farm. The anticipated courses at our Farm facilities, will require additional classroom space, conference rooms and field laboratory space. We project the cost of these two 3000-to-4000 sq ft facilities at $400-to-450 per sq ft, amounting to a total of $3.0 million.

4.1.4 UVM Dairy Product Pilot Plant. Several College stakeholders and supporters have indicated that UVM/CALS can play a significant role in future viability of Vermont agriculture by the development of value-added niche products for adoption by Vermont companies. We envision a pilot plant facility for the development and testing of new dairy products with market potential. This facility is envisioned for the purpose of prototype scale processing only. Market testing and market implementation would follow the Ag Innovations Initiative model for commercialization through a private-sector partner. We project a cost of a basic pilot plant facility and instrumentation to be $1.5 million.

4.2 The Reorganized Farm Operational Structure

Further input from CALS departments and CALS Advisors, as well as an indication of support from UVM Central Administration is needed to define what labor functions will be required for a reorganized Farm Operation. At this point we can anticipate needs for the following positions and functions:

- Farm Manager – best investment might be a faculty member to coordinate Student Experiential Learning Opportunities, interdepartmental relations, as well as farm staff direction and oversight. Must handle all procurement activities and interface with Physical Plant
- Herdsperson – all animal health and reproductive concerns
- Milking Staff
- Farm Staff for General Operations
- Staff Member for Hort Farm Oversight
- Staff Member for Digester Oversight
- Staff Member for Equine/Horse Barn Coop oversight
- Graduate Student Assistantships: create 12 new, 12-month graduate assistantships for CALS, 20 hrs farm duties and 20 hrs thesis coursework and research. Can be involved in routine farm operations (flexibility to current staffing to fill into milking, feeding and general operation), student experiential program oversight, and renewable energy project management.
- Undergraduate seasonal labor: as currently employed
• CREAM-like Student Experiences (oversight by Farm Manager and departmental faculty)

• Grounds and Custodial, should be managed by Physical Plant

Proposed Operating Considerations:

• We believe that we must operate the farm I/E accounts for both instruction and research using projected revenues based on the five year average of actual past income. We propose that any revenues above the projected average will be placed in a “lock box” rainy day fund, which will only be accessed when revenues fall below the projected levels. This practice should even out the substantial volatility in revenues generated from milk and animal sales.

• CALS will maintain the current levels of financial support for farm-based activities ($464,000 per year); higher commitment is not possible given the state of Federal funding, the stated priorities of CALS faculty for AES funds, and the realization that higher farm expenditures will erode our ability to pursue other opportunities for Vermont’s future.

• CALS will establish and maintain an infrastructure improvement fund to provide farm facility upgrades as indicated by the faculty to support or enable new extramurally-funded projects. We must have the foresight and resolve to establish this fund using a) a proportion of current base funds, b) a proportion of revenues generated from sale of farm products, c) a fraction of F&A returned from extramural grants, d) endowment funds, and e) a portion of energy savings after initial investment is paid off.

• All research and instructional activities on UVM farms will be leveraged on a pay-as-you-go cost-share basis, matching CALS funds with extramural grants or departmental resources for instruction. This leverage is important as a mechanism to engage departments and faculty as “shareholders” in the UVM farms, as well as a measure of use and need.

• Revenue return from tuition generated through courses that use UVM farm facilities, particularly the proposed new summer courses. Such a revenue-return model must be agreed upon with Continuing Education and the Provost.

• Projects and associated resource allocation will be made with regard to strategic mission priorities of the college and departments.

• Farm infrastructure is open to use by all faculty at UVM, with priority given to CALS faculty projects.

• The UVM farms must maintain a balanced annual budget; all new activities to come on line must illustrate a mechanism to pay for themselves

CALS must develop specific operation guidelines which will include:
- prioritization of research use of the farms
- financial co-pay leverage support from extramural grants to help support farm operations
- accountable and self-sustainable revenue contributions from farm product sales which contribute to financial support of farm operations
- mechanisms to provide financial support for new, additional graduate student assistantships and undergraduate student scholarship support
- provide guidelines/provisions for retiring research and instructional projects (e.g., defined sunset provisions at the termination of extramural funding)
- provide an infrastructure fund for continual upgrade and renewal of farm facilities
- provide a mechanism to buffer fluctuation of farm product revenues (e.g., milk prices)
- provide a safety net or exit strategy in a worst-case financial scenario.

5.0 Milestones, Needed Articulation Agreements & Authorizations

- Project Planning and Design ($25,000 Planning Grant)
- MOU with CE and Provost’s Office for Revenue Return on all summer on-farm courses and International programs
- Capital Project Listing, prioritization, BOT approval, fundraising, bonding, construction
- Local Permitting, Act 250
- MOUs with State Agencies
- MOUs with private partners for composting; energy production, alternative energy systems; value-added farm product testing, market assessment and/or commercial development.
- A balance sheet of projected revenues and expenses, once clear agreement is reached on facility design, activities, and operational structure

6.0 Final Comments

CALS seeks input from our Board of Advisors, stakeholders in the agricultural community, sister units at UVM, and state agencies for further guidance and refinement of a reorganization plan that utilizes our farms to maximize student experiential learning and as laboratories that promote and leverage extramural research activities in efforts towards farm/rural profitability and environmental stewardship. We see tremendous opportunity to work with our sister units across campus to bring a variety of
disciplinary strengths to collaborative efforts that enhance farm/rural profitability and environmental stewardship

We seek consent from Central Administration to work with the Office of Sustainability, and UVM Physical Plant, to design a renewable energy farm-based facility. We seek listing on the UVM Capital Projects list, and rank assessment in accord with the UVM BOT priorities. If favorably ranked in the Capital Priorities List, we seek capital investment funds to enable onset of construction at the earliest possible opportunity, and the consent by UVM Central Administration for CALS leadership to aggressively pursue fundraising opportunities aligned with this vision.