

Homegrown Feed, Food & Fuel



The Market Potential of Farm-Scale Oilseed Crop Products in Vermont

Executive Summary

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**Vermont Sustainable Jobs Fund
Vermont Biofuels Association**

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PREFACE

This report is a work in progress. Growing sufficient quantities of oilseed crops for biodiesel production and/or livestock meal in Vermont is very new, although some farmers have grown soybeans for the feed value for quite some time. But as the price of diesel, No. 2 heating oil and livestock feed continues to rise due to global forces outside of our control, more and more farmers, communities, policy makers and entrepreneurs are beginning to explore opportunities for the local production of oilseed products for local use.

Up until now, much focus has centered around how best to grow, harvest, dry and store oilseed crops. Less has been known about the market demand for organic and non-organic livestock meal, food-grade oil and/or locally produced biodiesel. **This report provides important market data and analysis that will be of use to farmers, policy makers and entrepreneurs who are interested in further exploring the opportunities for various oilseed products.**

As part of this research project, we have created an *Enterprise Budget* to assist farmers in making important economic decisions about whether or not to go into the oilseed crop business, based upon current market prices and known variables. An example of the budget is included in the Appendix and an Excel file of the Enterprise Budget document is available for download on various websites (e.g. www.uvm.edu/~uvmext, www.vsjf.org, www.vermontbiofuels.org).

Additional research is already underway to improve harvesting, drying and storing techniques, to explore the economic feasibility of a mobile seed crushing and biodiesel production unit, and to continually improve on-farm biodiesel production processes to meet ASTM standards. Our intention is to continue adding to this document as more information becomes available, through additional field and demonstration trials and as the State Line Farm, Borderview Farm, and other facilities come online.

We encourage feedback and comments on this report so that we can continue to improve its usefulness and continue to add to the body of knowledge that is developing in Vermont about oilseed crop products.

Thank you for your on-going interest and support for exploring the potential of home-grown feed, food and fuel in Vermont.

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I. EXECUTIVE SUMMARY

The Vermont Sustainable Jobs Fund and Vermont Biofuels Association commissioned this oilseed crop market potential and economic feasibility study in order to explore whether Vermont farmers could sustainably, economically, and competitively produce some portion of Vermont's liquid fuel and livestock feed demand. We were also interested in the requirements for and characteristics of small-scale, Vermont-made biofuels for local use, as an alternative to industrial-scale biofuel production.

Project partners hired Emily J. Stebbins, a graduate student, and Dr. Robert Parsons, an Agronomist and professor, from the University of Vermont's Department of Community & Applied Economics, to analyze the market demand and co-production potential for livestock feed, food-grade oil, and biodiesel fuel derived from oilseed crops grown in Vermont. This report also borrows heavily from the data and analysis collected by Dr. Vern Grubinger and Dr. Heather Darby at UVM Extension over the past two growing seasons.¹

Although farmers and biodiesel enthusiasts have been excited about the potential for these products, the full extent of the equipment, capital, and acreage needed to successfully grow, harvest and process these crops has been unknown. Determining the economic feasibility for farmers of such activities is vitally important at this early stage. Discussions with over a dozen farmers who are at various stages of growing and processing oilseed crops have indicated that market and economic viability data and decision-making tools would be of great value.

► ***Finding 1: Vermont is a net importer of oilseed products and co-products***

Vermont meets most of its demand for oilseed co-products and substitutes through importation. In addition to food-grade vegetable oil, Vermont farms and businesses import over 100,000 tons of livestock meal², 78.6 million gallons of diesel fuel, and 147 million gallons of No. 2 heating oil per year.³ Demand for fuel is expected to remain strong, and to continue to increase in the short term. Furthermore, volatility and increases in the price of crude oil are expected to continue to raise the prices that farmers and consumers pay for liquid fuels, fertilizers, and livestock feed.

The 2002 USDA census indicates that only about 51,000 bushels of soybeans were harvested from 1,562 acres in Vermont, and most were roasted whole and fed to dairy cows. The production of oilseeds in Vermont for fuel or food-grade oil is now taking place at a small-scale and on an experimental basis on several farms.

1 Grubinger, Vern. May 17, 2007. "On-Farm Oil Seed Production and Processing." UVM Extension, Final Report to the Vermont Sustainable Jobs Fund. Funded, in part, by the U.S. Department of Energy.

2 Report researcher's estimate: Table 4, Page 25.

3 U.S. Department of Energy, Energy Information Administration, Sales of Distillate Fuel Oil by End Use, Vermont.

Demand for oilseed meal in Vermont is driven by the dairy industry, with dairy cows estimated to account for approximately 97% of the market potential. Demand is particularly strong for organic livestock meals and vegetable oils, which are in short supply and command substantial price premiums. In general, the more “value added” to the end product, the higher the return per bushel or acre. The absence of genetically modified organisms (GMOs) is also an important criterion for organic feed mills and farmers, and could present additional opportunities for Vermont farmers interested in growing crops to meet this demand. Area purchasers of food and feed products expressed a willingness to buy and sometimes pay more for local co-products, provided they met quality and consistency standards and could be supplied reliably. For livestock meal, the key determinants of value are quality and consistency.

► ***Finding 2: Farm-scale production of oilseed products is technically feasible; good yields are achievable***

Production of oilseed crops and co-products is technically feasible in Vermont. Oilseed crops can grow well, and good yields are achievable given improved harvesting equipment and techniques. Crop trials from Vermont, Maine, and New Hampshire indicate that yields for oilseed crops at, or exceeding, the national average are achievable in Vermont’s climate and better agricultural soils. The primary factors necessary for consistent yields are appropriate harvesting equipment, additional experience to perfect oilseed harvesting techniques, and adequate drying and storage facilities. Custom combining could represent a new business opportunity if more farms add oilseeds to their crop rotations.

Farm-scale processing techniques can produce high-value, good-quality oilseed co-products, but further refinement and testing are needed. Thus far, the quality of the oil and oilseed meal produced at the farm scale appears promising. As much as 3 lbs per day of this meal, depending on the type of oilseed, could be included in a ration for a high-producing dairy cow. To be able to sell this meal to other farmers or a feed dealer at a competitive price however, the meal producer must be able to ensure that the meal is of a consistent quality. Further refinement and standardization of batch-processing techniques are needed, and additional, regular testing of the nutritional profile of farm-pressed meal is recommended.

In addition to proper harvesting equipment and technique, new infrastructure is needed to complete the value adding chain. Farm-scale pressing operations, including seed cleaner, storage bins, one or two expellers, and oil settling tanks, come in all sizes and price ranges. One Vermont farm spent an estimated \$30,000 (Table 14) for this set up (using a single press) with an additional \$35,000 (Table 21) to establish an on-farm biodiesel production facility with a 60,000 gallon annual capacity. From a technical perspective, these operations are relatively easy to establish, but do require careful space and site planning to ensure adequate safety measures and maximum efficiency (see note on page 77).⁴

4 These figures are highly variable, depending on whether paid labor is involved, whether new, used, or fabricated equipment is used, and how much equipment is already owned by a farmer.

► ***Finding 3: 50,000 to 90,000 acres in Vermont could be shifted to oilseed crops per year***

Given Vermont's current dairy-centered agricultural system, FFP researchers estimate that approximately 50,000 acres could be rotated to oilseed crops in any given year. However, consistent with trends over the past 40 years, Vermont's dairy herd is anticipated to decline another 18% by 2017, and by that time an estimated 180,000 acres per year (90,000 on a rotational basis) could be shifted to oilseed crops. 90,000 acres is capable of producing enough oil for over 6 million gallons of biodiesel and 78,000 tons of oilseed meal, more than sufficient to meet the total on-farm demand for distillate fuels, and as much as 50 percent of the anticipated meal demand in 2017. Of course, much will depend on the future profitability of these operations and on the cost of imported feed and fuel at that time. These are some of the key factors that will likely determine just how much of Vermont's cropland will be placed into oilseed production.

Recommendations

Further action and research related to the development and study of farm-scale oilseed crop and co-product production in Vermont is recommended.

- 1. Continue to build a network of farmers, processors, and other business owners involved in oilseed crop production, processing, distribution, and sales.** Developing and sharing local experience and expertise in oilseed production, processing, and marketing will be key factors in the success of new growers and processors.
- 2. Establish systematic processes for testing, refining, and recording results of on-farm meal production to establish consistent quality standards.** The key determinants of a livestock meal's value to feed dealers and farmers are nutritional quality and consistency. Unless quality control can be established, the price of farm-processed meal will be discounted significantly. Farm-scale processors seeking to sell their meal must establish a standard process that consistently creates a product of a certain quality. Regular testing of meal batch samples is recommended until a process is established, as well as an in situ amino acid test to establish the protein characteristics of the meal.
- 3. Investigate small cooperative enterprise models for oilseed processing and biodiesel production.** Several farmers have expressed interest in sharing investment in larger-scale oilseed-processing or biodiesel-making facilities. Dividing capital and operating costs among five to ten neighboring farms could lower barriers to entry of these markets, but the economic feasibility of such a model has not been studied in-depth.

4. Investigate the economic feasibility of a mobile oilseed press and/or biodiesel production unit that could travel site to site.⁵

5. Further investigate the range of equipment, capital and operating costs to set up and run an on-farm oilseed crop production facility. Because Vermont currently has one on-farm demonstration facility which is nearing completion and one other in the works, we cannot yet say with confidence how much equipment and capital are needed to run such a facility – either for on-farm only use and/or for revenue generation through sales off the farm. Additional data will be available in 2008 and 2009 once these two facilities are fully operational.

6. Conduct further research on the net energy savings to farmers from biodiesel production. Crop production, seed processing, and biodiesel production all require energy. Further study is required to understand the extent to which on-farm oilseed and biodiesel production processes can use renewable, farm-produced energy, to yield an even greater net energy savings to the farm.

7. Conduct further research on additional potential markets for oilseed co-products. The following potential markets for oilseed co-products were beyond the scope of this study, but should be investigated further:

- ▶ Food-grade oil sales, including analysis of Vermont’s vegetable oil consumption, future price projections, and estimation of the extent to which Vermont farmers or entrepreneurs could penetrate local markets.
- ▶ Lease of filtered, unrefined vegetable oil to restaurants, with subsequent collection by fuel processors for biodiesel production. The opportunity to use the oil for both food and fuel production is being explored in Canadian and New England markets, but has not been studied extensively in Vermont.
- ▶ Use of oilseed meal as a crop fertilizer, and comparison of the value of this end-use to the value of the meal for livestock feed.
- ▶ Use of oilseed meal as a fuel (in pellet stoves, for example) may be a viable alternative use for meal that is not of sufficient quality to use as livestock feed.
- ▶ Potential uses and markets for the glycerin byproduct of biodiesel production.
- ▶ Potential market and revenue from selling organic, non-GMO oilseeds.

⁵ VSJF, the Vermont Biofuels Association and the Sustainable Agriculture Council plan to explore the economic feasibility of such a mobile processing unit in 2008.

II. ABOUT THE FEED & FUEL PROJECT

The Vermont Sustainable Jobs Fund (VSJF) and the Vermont Biofuels Association (VBA) created the *Feed & Fuel Project* in 2006 to focus a portion of its biofuels market development work on exploring the feasibility of a farm-based liquid biofuels, livestock feed, and food-grade oil co-production systems in strategic locations around the state.

Locally owned, community- and/or farm-based biofuels and feed/food projects could generate revenue and alternative sources of livestock feed and liquid fuel for farmers, while helping to create job opportunities, localize energy production, and protect and improve Vermont's natural and social environments.

The *Feed & Fuel Project*, in collaboration with University of Vermont (UVM) Extension and Center for Sustainable Agriculture's on-going research and technical assistance to oil-seed crop farmers, could lead to improvements in Vermont's feed and fuel security over the next 10 years.

The Feed & Fuel Project in Context: The History of the Vermont Biofuels Initiative

In 2003, VSJF began to focus on developing a viable biofuels industry in the state. The type of biofuel that showed greatest promise for immediate introduction into the marketplace was **biodiesel**. With the formation of the VBA that same year, a growing interest among fuel dealers to begin supplying biodiesel, and growing concern about the impacts of climate change and peak-oil on the environment

The year 2006 brought major breakthroughs in public awareness of the problems posed by climate change and global oil depletion. Liquid biofuels—ethanol and biodiesel—are seen widely as part of the solution for reducing greenhouse gas emissions and buffering future oil shortages. The image of biofuels has been tarnished significantly, however, as industrial ethanol production in the Midwest has impacted commodity feed prices while sugar plantations for ethanol in Brazil and palm plantations for biodiesel in Southeast Asia slice through tropical rainforests. Reckless biofuel production could replace depleted petroleum reserves with depleted topsoil and exhausted forestlands, but sustainable production methods hold the promise of yielding lower emissions, renewable fuel and quality, local food.

and our fuel security, the time seemed ripe to encourage the deployment of this product.

Building Consumer Demand

To begin building consumer use of biodiesel in the state, the Vermont Biodiesel Project (VBP) was created through a partnership between the VSJF, the VBA, the Vermont Fuel Dealers Association, and the Vermont Department of Public Service. Between 2003 and 2006, the VBP focused on building the demand for and supply of commodity-scale biodiesel and building a network of biodiesel producers, suppliers, and users. Over 30 fuel dealers now carry biodiesel in the State and in 2006 nearly 1.5 million gallons of biodiesel were con-

sumed in Vermont (two-thirds by transportation fleets and one-third for home heating). After evaluating the impact of these activities over a three year-period, the Vermont Biodiesel Project partners believe that the market for commodity biodiesel has been firmly established.

Building Local Supply

Beginning in 2003, Stateline Farm in Shaftsbury began experimenting with growing canola and other oilseed crops for producing biodiesel and in 2005 UVM Extension Agronomist Dr. Heather Darby began the first canola field trials at the Borderview Farm in Alburgh. That same year several other farms planted oilseed crops and/or began producing biodiesel for on-farm use. A \$98,000 grant to the UVM Center for Sustainable Agriculture from the VSJF in the summer of 2006 helped pay for more field trials and the initial set up of a farm-scale biodiesel production facility at Stateline Farm.⁶

With interest in oilseed crops mounting in the farm community, it became clear that a comprehensive market assessment was needed for these products, as well as an evaluation of opportunities associated with the local production of oilseed crop products for local use. In the Fall of 2006, after receiving funding from the High Meadows Fund at the Vermont Community Foundation, the VSJF and VBA created the Feed & Fuel Project to focus specifically on exploring this potential.

A. Project Objectives

In order to further develop in-state production capacity of oil-seed crops and their co-products, the VSJF and the VBA created

the *Feed and Fuel Project* (FFP). The goals of the FFP are as follows:

1. Increase the amount of liquid fuel (biodiesel) and livestock feed (from oilseed crops) that is produced and consumed locally, thereby increasing the multiplier effect captured by circulating dollars in the local economy.
2. Create new revenue streams and decrease expenses for family farms, thereby encouraging additional farmland cultivation.
3. Capture the environmental benefits of biodiesel use (i.e. greenhouse gas-emission reductions) and reduced transport costs of imported animal feed and biodiesel.
4. Enhance Vermont's liquid fuel security by locally producing a portion of the State's biodiesel demand.
5. Create new or retain existing jobs in the emerging renewable energy sector, based on farms and/or in rural communities via small commercial enterprises. Although the number of jobs created may be small in the short-term (<5 years), there is a significant opportunity over the longer term. Economic modeling completed in conjunction with this project by Dr. Kenneth Mulder (Green Mountain College), Emily Stebbins (UVM), and Galen Wilkerson (UVM), estimates that biodiesel production alone can produce 25 to 100 new jobs, while high levels of oilseed production in the state have the potential of tripling the employment impact (based on 500,000 gallons/year and 2.5 million gallons/year production facilities).

⁶ VSJF Funding came from a DOE earmark secured by U.S. Senator Patrick Leahy

6. Support the local production of sustainable biofuels, thereby decreasing the environmental impacts of commodity-based biofuels production.

Because there are various co-products from oilseed crop production (i.e. food-grade oil, oil for biodiesel production, livestock feed, and glycerin), the FFP set out to explore the market and economic opportunities, infrastructure, capital and equipment needs, and production issues associated with three scales of operation:

► **Individual Farmers** – Where individual farmers are interested and have the means, there is potential to produce liquid fuel to meet on-farm needs as well as animal feed. Farmers need to understand which crop varieties are best-suited for oil for biodiesel and/or feed for livestock, as well as effective harvesting techniques. Farmers will also need capital for equipment, production facilities, and operations and to have access to an expeller (press), a seed cleaner, a dryer/aeration system, and adequate storage. There is an opportunity to assist learning by creating a network of farmers who are growing oilseed crops for on-farm use.

► **Groups of Farmers** – Some farmers may wish to share the capital cost of producing oilseed crops for biodiesel production and livestock feed. Here, an opportunity exists for growing oilseed crops on a larger scale with a regional or mobile expeller (press), roaster, and seed cleaner. Areas of exploration include recommended business and governance models, capital and shared expense requirements, and facility/operations issues.

► **Small Commercial Producers** – Some farmers may want to grow oilseed crops to use the livestock meal but not produce biodiesel, and some entrepreneurs may want to produce biodiesel but not grow oilseed crops. The FFP will attempt to facilitate connections between these two groups and provide the tools necessary for them to work together for mutual benefit. See also: Mulder, Kenneth et al. 2007, *Homegrown Fuel: Economic Feasibility of Commercial-Scale Biodiesel Production in Vermont: A Dynamic Ecological-Economic Assessment*.

B. Project Partners and Roles

The FFP is a partnership between VSJF and VBA. Several other academic and private organizations and individuals contributed research, findings, resources, and information to the project. UVM Extension and the UVM Center for Sustainable Agriculture led research on crop trials and farm-scale biodiesel production during the 2006 and 2007 growing season, while researchers at the UVM Department of Community Development and Applied Economics compiled this report and explored the current and potential markets for oilseed co-products. In addition, the Gund Institute for Ecological Economics at UVM performed simulation modeling for two commercial scale facilities (500,000 and 2.5 million gallons per year). A report of this work was released separately in October 2007.

Please see the Acknowledgments for a complete list of the many farmers, business owners, scholars, and consultants who lent their expertise to this study.