ISSUES AND OPTIONS IN NORTHWEST BIOENERGY: CANOLA FOR BIODIESEL

CASCADIA CARBON INSTITUTE

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October 19, 2007

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Issues and Options in Northwest Bioenergy: Canola for Biodiesel

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Executive Summary

Northwest legislators wish to encourage a true regional biodiesel industry in which Northwest feedstocks are used to make biodiesel for Northwest consumption. However, the slow rate of progress toward this goal seems to have surprised many stakeholders.

It is essential that policymakers and others involved with the nascent biofuel industry have at least a basic understanding of Northwest agriculture, which is unusual compared to that of Midwest energy-producing states. Geography, climate, and large-scale irrigation projects have all contributed to the evolution of the Northwest's agriculture industry into one of the most valuable in the country.

Failure to accurately understand the capabilities of the Northwest's agriculture could lead to over- or under-investment in key components of a true Northwest-based biofuel industry, and could interfere with effective policymaking decisions.

Encouraging in-state oilseed production has proved difficult to address through legislation in Washington, while Oregon's tax structure has simplified legislative efforts to encourage in-state production of biodiesel feedstock oils. Idaho's activities in this regard have been minimal.

Northwest oilseed production is faced with a range of challenges and opportunities, including the following.

•Nearly all Northwest crops are more valuable than canola in most years, making farmers less likely to choose canola or other oilseed crops for purely economic reasons.

•There is a narrow canola price window within which both canola production and biodiesel production from canola oil are profitable or attractive.

•Oilseed crops cannot replace "money" crops in most areas of the Northwest, but they do have significant value as rotation crops. Depending on market conditions, canola may be more valuable than currently popular rotation crops in dryland areas.

•As rotation crops, canola and mustards also have significant indirect value as they can reduce pesticide use, reduce soil erosion, reduce the need for field burning, improve soil quality and can simplify reduced-tillage farming methods.

•Regional canola oil production capability is much more limited than some biodiesel industry leaders appear to realize. In Washington, for example, only under very unusual circumstances can state agriculture reasonably be expected to produce even 16 million gallons per year -- about 15% of Washington's biodiesel production capacity.

•Removing land from CRP, or developing new or marginal land, would release far more greenhouse gases into the atmosphere than the biofuel produced from the land could possibly offset, and would destroy additional non-economic (or less-directly economic) values provided by the land.

•It also seems unlikely that most CRP ground could profitably support other crops for three years between canola crops, as necessary to allow for the required rotation of canola.

Although these challenges are significant, it is possible to develop a true, sustainable, Northwest-grown canola biodiesel industry. This report makes several recommendations toward this goal.

CCI actively pursues education for policymakers, members of the energy industry, farmers, consumers, and others regarding the agronomic and environmental benefits of regionally sourced biofuels (including algae-based biodiesel), sustainable agriculture, and sustainability in general.

CCI hopes readers will consider becoming members through the organization's web site: cascadiacarbon.org .

I. Northwest Agricultural Geography

In the Northwest, high rainfall levels are generally associated with either mountainous or urban areas. With important exceptions in Washington and Oregon, the Northwest's major farming areas are primarily in drier regions east of the Cascades.

There are crucial differences between Northwest agriculture and agriculture in Midwest bioenergy-producing states. For example, in 2002, Washington farmers harvested approximately 4,900,000 acres of cropland, or about 11% of Washington's land area.[1] That year farmers in Iowa, an important biofuels state, harvested cropland totaling about 24,000,000 acres, roughly 69% of Iowa's land area.[2] Although Iowa farmers harvest nearly five-fold more land area, the total farmgate value of non-livestock Iowa farm products is only about two-fold greater than that of Washington produce. Indeed, acre for acre, the produce of both Washington and Oregon is about four times as valuable as Iowa's produce. The difference is only slightly smaller in Idaho. These observations have important implications for the Northwest biodiesel industry: even at historically average prices, Northwest crops are more valuable than energy crops.

STATE	NATIONAL $ RANK, NONLIVESTOCK PRODUCE	PRODUCE VALUE, $/ACRE
Washington	7	1089
Oregon	14	1024
Idaho	17	908
Iowa	2	253

Table 1. Value of harvested crops in Northwest states and Iowa. Data from USDA Census of Agriculture.

[1]USDA Agricultural Statistics Service (2002) Census of Agriculture: Washington. Accessed 24 January, 2007. www.nass.usda.gov/census/census02/volume1/wa/index2.htm

[2]USDA USDA Agricultural Statistics Service (2002) Census of Agriculture: Iowa. Accessed 24 January, 2007. www.nass.usda.gov/census/census02/volume1/ia/index2.htm

The importance of irrigation

Assuming appropriate soils and terrain are available, farming in the lowest rainfall regions of the Northwest, shown in red on the map below, is limited to areas irrigated with water from rivers via various irrigation projects or private surface water rights, or from deep wells. Water is drawn directly from the Columbia, Snake, and other rivers under individual permits, and from deep wells both within and along the eastern edge of the Columbia Basin Irrigation Project. In some areas, such as the area irrigated from the Odessa Aquifer, groundwater depletion is a significant concern.

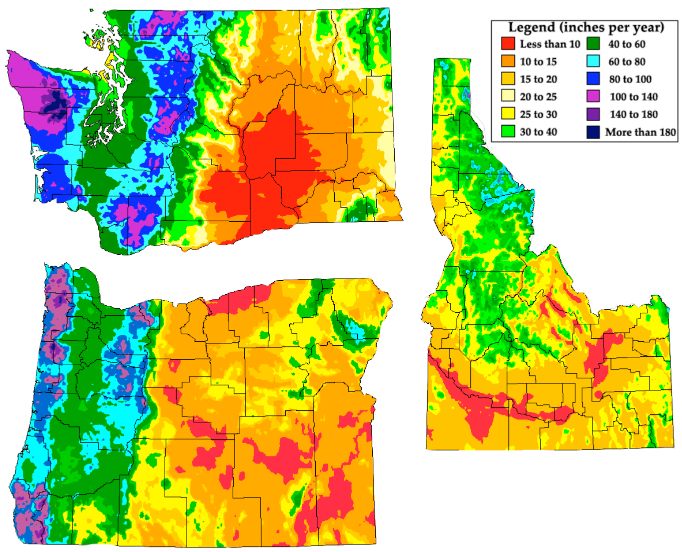

Figure 1. Annual precipitation in Northwest states. Areas shown in red receive less than 10 inches of precipitation annually. Farming in these areas requires irrigation.

Large-scale irrigation projects were first constructed over a century ago in areas such as Washington's Kittitas and Yakima Valleys, while the much larger Columbia Basin Irrigation Project was initiated in the 1930's with the construction of Grand Coulee Dam. In Idaho, large irrigation projects along the length of the Snake River were started in the early 20th Century. Opportunities for major irrigation projects are more limited in Oregon, because most of the state's farmland is far from major rivers.

Dozens of different crops are grown under irrigation in the Northwest, including apples, apricots, asparagus, beans, beets, carrots, cherries, feed corn, grapes, grass seed, hops, onions, peas, peaches, potatoes, sweet corn, vegetable seeds, and watermelon. These crops tend to yield relatively high-value produce. In addition to the availability of irrigation water, access to inexpensive electricity for processing or refrigeration influences the production geography for many crops.

The high value of irrigated crops, along with the high cost of farming irrigated ground, means that canola and other oilseeds are likely to be planted in limited amounts in irrigated areas.

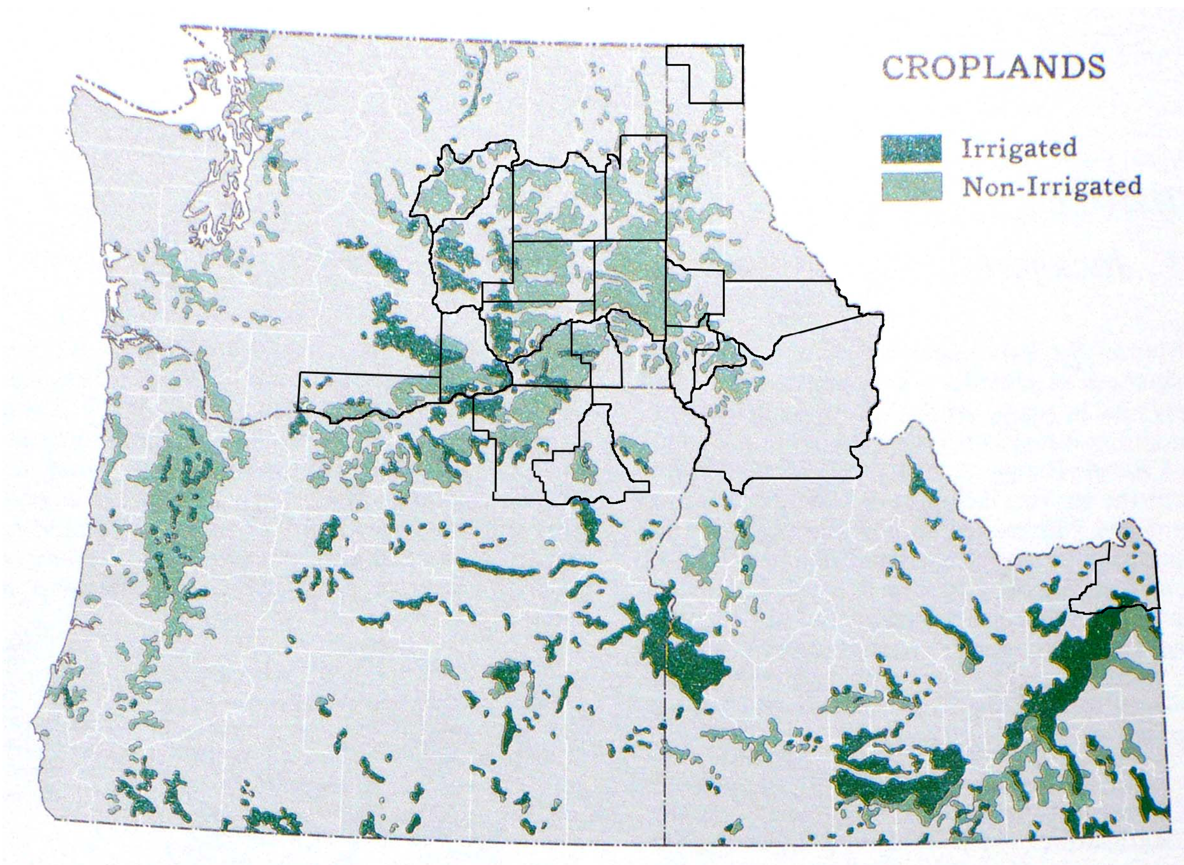

Figure 2. Irrigated and non-irrigated cropland in the Northwest states.[3] Counties that reported canola production in the 1997 or 2002 USDA Census of Agriculture are outlined in black.[4]

Non-irrigated agriculture

As shown in Figure 2 and Table 2, most of the Northwest's farmland is cultivated without the benefit of irrigation. Using special techniques, non-irrigated (also called "dryland") farming is possible at rainfall levels as low as 10 inches. In the dryland areas of Eastern Washington, wheat is the most profitable crop. Other common dryland crops include barley, dry peas, and lentils. Farms in Western Washington and Oregon gener-

[3]*Atlas of the Pacific Northwest* 7th Edition, Kimerling, A.J. and Jackson, P.L., eds. 1985, OSU Press, Corvallis, OR.

[4]2002 Census of Agriculture, USDA National Agricultural Statistics Service.

ally produce a greater variety of high-value crops, but this is limited in some areas by soil type or other factors such as urbanization.

In dryland areas rotation crops such as barley, dry peas, and lentils are typically slightly more valuable than canola, but it is still reasonable to expect that canola might be substituted for these crops in some rotations. Agricultural Economists at Washington State University will soon release a detailed analysis of these issues.

STATE	IRRIGATED HARVESTED CROPLAND	NON-IRRIGATED HARVESTED CROPLAND	TOTAL HARVESTED CROPLAND
Idaho	2,829,982	1,483,306	4,313,288
Oregon	1,415,826	1,703,558	3,119,384
Washington	1,669,928	3,224,706	4,894,634
Totals	5,915,736	6,411,570	12,327,306

Table 2. Irrigated and non-irrigated harvested cropland in Northwest states.[5]

The importance of crop rotation

Except for permanent or semi-permanent plantings such as orchards, annual crop rotation is used almost universally by farmers in the Northwest as a tool to manage weeds, erosion, and diseases. Specific strategies vary, but three-or four-year rotations are typical in most areas. Typically, one or two crops in a rotation are the “money crop,” while other crops in the rotation may earn modestly, break even, or even lose money. In Northwest dryland agriculture, wheat is usually the money crop.

Table 3 shows estimated net returns for a hypothetical three-year rotation in the Palouse region of Washington. In this example, wheat is the money crop. It is common for a farmer to grow all crops of a rotation on parts of the farm each year to manage workload and risk. Higher value rotation crops can allow longer rotations because they increase overall profitability.

[5]USDA Census of Agriculture, 2002 data.

ROTATION YEAR	CROP	NET RETURN ($/ACRE)
Y1	Dry peas (rotation crop)	(-$22)
Y2	Winter wheat (money crop)	$78
Y3	Spring barley (rotation crop)	(-$13)
--	Three-year net	$43

Table 3. A hypothetical rotation scheme for the Palouse dryland region of Washington.[6]

There is often enough flexibility in a rotation to allow farmers to plant a money crop out of sequence if the price is particularly favorable. Even so, farmers generally hesitate to break carefully planned rotations.

Increasing the value of -- or at least reducing the losses associated with -- rotation crops is a key strategy to increase farm income, and this is where canola shows promise. In addition, there are anecdotal, but consistent, reports that wheat yields increase when planted following canola. Rotation crops are chosen to provide certain features, including opportunities for weed or disease control, or to enhance soil conservation efforts. These factors can even be more important than economic factors in rotation crop selection.

II. Feedstocks for Biodiesel from Northwest Agriculture

There is considerable interest in developing a biodiesel industry in the Northwest. The ideal biofuels industry would use primarily or exclusively Northwest-grown vegetable oil, animal fats, and used frying oil as feedstocks. Northwest crops that have been mentioned for their oil production potential include canola, rapeseed, mustard, camelina, sunflower, safflower, and soybean.

[6] Baldree, Randy, Hinman, Herb (2003) Enterprise budgets for winter wheat, spring wheat, spring barley, peas and lentils in the 18-23" rainfall region of Whitman County, Washington. Farm Business Management Report #EB1970E, WSU Extension Service. http://www.wca-infonet.org/id/121392. Actual returns depend on markets, weather, and many other factors.

Canola, rapeseed, and mustard

These three closely related crops each have their benefits. For example, mustard crops can be used to manage soil pathogens and pests in certain rotations, and can result in savings of $100/acre in soil fumigation costs, among other attributes. Although mustard yields less oil per pound of seed (25-30% vs. 40-45%) than canola, it is a useful tool in certain rotations, and requires even less water than canola.[7]

Canola, whose oil can be used both as food and as biofuel feedstock, and its industrial oil-producing cousin, rapeseed, are also members of the mustard family. Canola is currently the most widely cultivated oilseed crop in the Northwest. In 2002, Idaho produced about 29,637,470 pounds of canola seed from about 29,900 acres; Oregon produced 2,406,353 pounds from 2,860 acres, and Washington produced 10,909,964 pounds from 7,776 acres.[8] At an average oil yield of 40%, these production levels amount to 1.6 million, 130,000, and 590,000 gallons, respectively, for Idaho, Oregon, and Washington.

Camelina

Camelina is another possible Northwest oilseed crop, one that can reportedly produce well even in 10-inch rainfall areas.[9] This crop requires few or no fertilizer inputs, can be sown on the surface of the soil, and is highly competitive with weeds. Research into the agronomy of this crop is ongoing. There is some question about the quality of biodiesel made from camelina, but it is reportedly generating interest among growers in Montana.[10]

If camelina is eventually accepted for widespread biodiesel production, its hardiness will be a mixed blessing. This crop could be grown in some areas once called "waste" land, but all land serves a purpose, whether cultivated or not. As with all biofuel crops, consideration should be given to whether current uses of land, for carbon sequestration, habitat, or open space, are more or less important than the possibility of producing fuel.

Although camelina is said to be relatively disease resistant, long experience has shown that it is not a good idea to grow any crop without rotation. Therefore, an additional

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[7]Collins, H., Franzen, S., & Hang, A. (2006) Biofuel Feedstocks in Washington. *Sustaining the Pacific Northwest*, *4(3)*, 1-4. csanr.wsu.edu/whatsnew/SPNW-v4-n3.pdf accessed 18 January 2007.

[8]USDA Census of Agriculture, 2002 data.

[9]Johnson, Duane, quoted in Yates, S.A. (2007) "Wheat farmer goes into the oil business." *Capital Press*, June 8, 2007.

[10]Yates, S.A. (2007) "Canola breeder has discouraging words for camelina."*Capital Press*, July 13, 2007.

consideration is whether the land could profitably support rotation crops, since it will be necessary to rotate out of camelina to disrupt disease and weed cycles.

Soybeans and safflower

Soybean is a major source of vegetable oil in the Midwest, but soybean plants do not yield well in the Northwest, making the per-acre value of soybeans even lower than that of canola. And because soybeans contain half as much oil by weight as does canola, soybeans are not likely to be a large part of the answer to biodiesel feedstock demand in the Northwest, where relatively less farmland is available. Safflower is another potential oil crop. It is tolerant of extreme weather conditions and can out-yield canola.[11] However, there is very little grower experience with this crop, which, to the extent that it is grown at all, is produced for the seed industry. In fact, so little safflower has historically been produced in Washington that the state is being used as a site to grow genetically engineered safflower for the pharmaceutical industry.[12]

Planting trials are underway in the Northwest for both of these possible energy crops.

Tallow, yellow grease, algae

Tallow, yellow grease, and used fryer oil are products of the livestock and food processing industries, and represent important sources of biodiesel feedstock in the region. In addition, some species of algae produce oil that can be processed into biodiesel. Although these animal, second-use, and aquacultural feedstocks are important, this paper focuses on first-use agricultural vegetable oils for biodiesel production. A future CCI paper may analyze these and other feedstocks.

III. Canola's Place in Northwest Agriculture

In spite of the benefits of mustard and the availability of sunflower, safflower, and other oilseed crops, canola is currently the most common oilseed choice of Northwest farmers. This is good news for Northwest biodiesel producers and consumers, as canola biodiesel is particularly useful for wintertime applications.

Canola is a relatively low-value crop compared with most Northwest crops. There is a narrow price window within which canola is an attractive crop for farmers while still

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[11]Collins *et al.*, 2006, *ibid.*

[12]Fox, J.L. (2007) "US courts thwart GM alfalfa and turf grass." *Nature Biotechnology*, April, Vol. 25, Iss. 4, p 367-368

allowing profitable biodiesel production. If the Northwest is to develop a true regional biodiesel industry, these challenges must be overcome.

The special situation in Washington

For a variety of reasons, Washington faces the greatest challenges of any Northwest state when it comes to increasing canola production, and most of our discussion of issues and options will focus on Washington.

Washington's average farmgate value is the highest of the three Northwest states; the price difference between traditional Washington crops and canola is a consequence of Washington's high-value agricultural industry. In addition, Washington's tax structure makes it difficult to extend tax incentives for canola production, while Oregon has recently adopted very favorable tax incentives for in-state canola production.[13] Meanwhile, Idaho has a very active biodiesel and canola research group at the University of Idaho, including an important brassica breeding program, and Idaho has historically produced more canola than Washington and Oregon combined. Yet Idaho's legislative efforts in support of biodiesel lag behind those of Oregon or Washington.

Figure 3 shows average farmgate prices for US canola seed (farmers generally pay for transportation to seed receiving facilities, reducing the rate of return somewhat) through 2005.[14] The historic average price is about $0.101 per pound, and represents a losing proposition for Northwest farmers. At average yields, Washington farmers can expect to gross about $300/acre growing canola at $0.15/lb; this is generally considered to be the break-even price for canola.[15]

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[13]HB2210 of the 2007 Oregon legislative session enacts, among other incentives, a $0.05/lb tax credit for canola produced in Oregon. http://www.leg.state.or.us/07reg/measpdf/hb2200.dir/hb2210.en.pdf

[14]Ash, M, Dolman, E (2006) Oil Crops Situation and Outlook Yearbook. USDA Economic Research Service. http://usda.mannlib.cornell.edu/usda/ers/OCS-yearbook//2000s/2006/OCS-yearbook-05-31-2006.pdf

[15]Painter, Kathleen, Hinman, Herbert, and Roe, Dennis (2006) Economics of Spring Canola Production in Dryland Eastern Washington. Report Number EB2009E, WSU School of Economic Sciences. www.farm-mgmt.wsu.edu/PDF-docs/nonirr/eb2009e.pdf

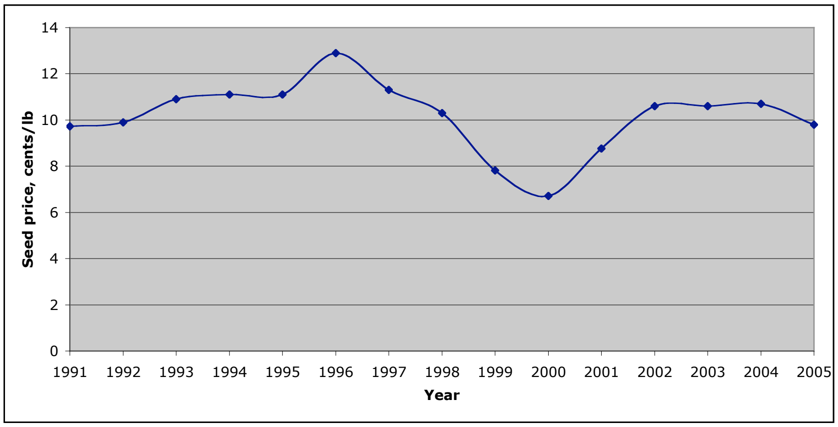

Figure 3. US Canola seed prices, 1991-2005, US cents/lb.

Prices have been above historic averages for the past year. In mid-May 2007, Washington canola growers were being offered approximately $0.13/lb for their 2007 crop. By early June the price had risen to $0.145/lb. Following the 2007 harvest, the price was about $0.16/lb, just above break-even in most areas. Prices for local delivery were higher still for early contracts on the 2008 harvest, at about $0.18/lb in September 2007.[16,17] Winter canola prices at this level can lead to returns equivalent to wheat at $6.50 per bushel.[18] However, canola establishment is more risky compared to wheat, due to the possibility of early frost or dry weather after fall planting.

Canola in irrigated agriculture

Canola cultivation uses much less water than is required for most irrigated crops. So while it cannot be expected that canola will replace money crops in most areas and market conditions, canola may find a place as a rotation crop in virtually all areas. As regional water demand increases and environmental priorities change, it becomes increasingly important to use irrigation water efficiently, and on land irrigated by wells costs of pumping also require more efficient water use. Yet in irrigated areas, money crops tend to be the most water-intensive. This means growers in some irrigated regions are interested in new rotation crops that use less water than current rotation crops do, reducing the overall water use of a series of crops.

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[16]Lyle, Becky, personal communication September 24, 2007.

[17]One source of pricing information used by Northwest growers is http://www.unionelevator.com .

[18]Painter, K. and Roe, D. (2007) Economics of Canola Production in the Pacific Northwest. WSU School of Economic Sciences Working Paper Series, WP-2007-17. Preprint and permission to cite kindly provided by K. Painter.

Canola in dryland agriculture

Canola is a useful tool for control of some weeds, pathogens and pests, and can reduce overall pesticide usage in a rotation[19]. In some farming areas, it is particularly useful for erosion control and soil conditioning. This is because canola plants have taproots that penetrate unusually deeply into the soil, breaking up hardpan caused by past tillage and compaction from equipment, and facilitating conservation tillage cropping systems. Canola also reduces the necessity of burning fields to control pathogens. This is a particularly useful feature in areas where field burning may be criticized by non-farming organizations.

All dryland areas of Washington state, some of which are particularly vulnerable to erosion, could benefit from increased canola cultivation, as would most irrigated farmland. Meanwhile, canola itself is subject to various diseases and pests, and rotation is used to control them.[20] As a result, canola (like other crops in the mustard family) cannot be grown more frequently than once every four years in the same field. This makes canola a good candidate for use in many typical rotations.[21]

Between harvest and fuel

The production of seed meal (the residue that is left after the oil is removed) for sale as animal feed is an important part of the pressing business. At this time (Fall, 2007) Washington's oilseed presses are generally separate businesses from seed production, seed brokering/storage, or biodiesel production.

From a biodiesel producer's standpoint, at higher market prices canola becomes a less economical source of oil for biodiesel production, making it necessary to use lower-cost sources of oil or other strategies in order to produce competitively priced fuel.

Feedstock oil is by far the greatest expense in biodiesel production, comprising about 75-80% of the cost of production.[22] The average price of canola oil during the period 1991-2006 was $0.258, making the approximate average cost of canola biodiesel produc-

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[19]Collins *et al.*, 2006, *ibid.*

[20]Raymer, P.L., Auld, D.L., and Mahler, K.A. (1990) Agronomy of Canola in the United States. In: *Canola and Rapeseed: Production, Chemistry, Nutrition and Processing Technology.* Shahidi, F., Ed. Van Nostrand Reinhold, NY.

[21]WSU Extension (September 2002) Crop Profile for Canola in Washington.

[22]Van Gerpen, J., Pruszko, R., Clements, D., Shanks, B., and Knothe, G. (2005) *Building a Successful Biodiesel Business: Technology Considerations, Developing the Business, Analytical Methodologies.* Handbook distributed to participants in biodiesel workshops at University of Idaho and University of Iowa. http://www.biodieselbasics.com .

tion $2.51 per gallon. Nationally, the average ratio between canola oil and canola seed prices during 1991-2006 was 2.6.[23] At that ratio, if canola seed earned $0.15/lb at the farm gate, biodiesel production costs would total about $3.85 per gallon.

IV. Unintended consequences?

An increase in biofuel feedstock production could lead to changes in both cropping patterns and land use. Conversion of CRP or other currently uncultivated land to biofuel production should be carefully considered because the change may not be economically viable (due to the need for rotation crops to be grown in years when biofuels are not grown) or environmentally advisable (due to loss of carbon sequestration capacity or other values of non-crop vegetation).

The prospect of increased canola acreage has raised concern among producers of seeds for vegetable crops that might possibly cross-pollinate with the oilseed crop. Meanwhile, competition with food is likely to be less of a concern for Northwest oilseeds than for ethanol crops such as corn, because crops used for food are are more valuable than canola. Even at historic high prices for canola production, it is very unlikely canola will displace important food crops such as wheat.

CRP and Marginal Land

Millions of acres of Northwest cropland are not currently harvested because they are enrolled in conservation programs, because they are not profitable to farm, or for other reasons. Returning or converting some of this land to production has been suggested as an approach to increasing the state's production of biofuel feedstocks.[24]

Marginal land is land with little or no profitable agricultural use. Of course, marginal land does have environmental value, for carbon sequestration, as wildlife habitat, and as open space, for example. Some types of oilseed crops can be grown on marginal land, but great care should be taken to avoid destroying any significant nonagricultural values in the process. Moreover, it would be difficult or impossible to profitably grow the necessary non-canola rotation crops on marginal lands.

The Conservation Reserve Program (CRP) aims to reduce soil erosion on farmland. Since in 1985 about 1 million acres of Washington cropland have been enrolled in CRP

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[23]Ash, M, and Dohlman, E. (2006) Oil Crops Situation and Outlook Yearbook, May 2006. Compare Appendix Tables 24 and 25. http://usda.mannlib.cornell.edu/usda/ers/OCS-yearbook//2000s/2006/OCS-yearbook-05-31-2006.pdf

[24]Loveland, Valora (Director, Washington State Department of Agriculture), address to Northwest Biofuel Summit I, 3 November 2006, Pasco, WA.

(land enrolled in the program is often called "CRP ground"). This highly erodible land, primarily in the drier dryland areas of Washington, is set aside in 10-15 year leases in exchange for rent payments from the USDA. In the years in which wheat prices are low, rent payments exceed what the land could earn if farmed.

Since the program began, carbon has been sequestered in surface residue and in the soil of CRP ground. Soil organic carbon of 22-50 metric tonnes per hectare has been reported in the Palouse region of Washington and Idaho.[25] Even at the low end of this range, the amount of sequestered carbon is equivalent to the amount of carbon dioxide offset by some 8800 gallons of biodiesel.[26] A hectare of land in the Palouse would produce 250-500 gallons of biodiesel every four years.

Clearly, as with marginal land, caution must be used to avoid destroying more environmental value than could be generated by biofuel production on CRP ground.

Although it is difficult to imagine how CRP or marginal land can be used appropriately for oilseed production, it will eventually be possible to produce biomass for cellulosic ethanol production on both marginal and CRP land, probably with little or no tillage. It would be wise to consider how to mitigate the impact of this eventuality on wildlife, sooner rather than later.

Oilseed Production and Vegetable Seed Production

Vegetable seeds are a particularly valuable cropping choice, and canola can cross-pollinate with some vegetable seed crops, making the seed worthless. This is primarily a concern in very limited regions of Northwest states. Vegetable seed production areas are located in the northwestern-most counties and in parts of the Columbia Basin Irrigation Project in Washington, and in the Willamette Valley of Oregon.[27] The vegetable seed and oilseed industries have been working together to minimize potential problems from cross-pollination.

In Washington, for example, the Brassica Working Group, a committee made up of members of the biodiesel, oilseed, vegetable seed industries carried out a series of meetings during the winter of 2006-07 to discuss protections for vegetable crop seeds. The

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[25]Brejda, J. and 7 others (2001) Estimating Surface Soil Organic Carbon Content at a Regional Scale Using the National Resource Inventory. *Soil Science Society of America Journal* 65:842-849.

[26]Carbon dioxide is about 3.2 times more massive than soil organic carbon. About 117 gallons of biodiesel are required to offset 1 metric tonne of carbon dioxide from fossil fuels.

[27]Verhey, Steve & Horton, Denise (2006) Factors affecting canola production in the Columbia Basin. White paper prepared for the Washington State Canola/Vegetable Seed/Biofuels Working Group.

Washington Department of Agriculture facilitated these meetings, and prepared and submitted a bill to the 2007 legislature for authorization to begin the process of establishing brassica seed production districts. The bill, HB 1888, was approved by the legislature and signed by the Governor. The process of protecting the vegetable seed industry by establishing brassica seed production districts began in the Fall of 2007, and should be complete by early 2008.

Biodiesel and Food Production

Biodiesel feedstocks are agricultural (or, in the case of algae, aquacultural) products, so it is reasonable to ask what effect increases in biofuel production may have on food production. At the same time, it must be recognized that farmers have the right to grow the highest-value crops available, and to make their own choices about what crops to grow, and when.

All North American biodiesel crops are simultaneously food crops. Nearly sixty percent of the weight of canola seed, for example, is used as animal feed once the oil has been removed; seventy percent of soybeans, by weight, is used as human or animal food after the oil has been removed.

There is widespread confusion about the effect of energy crops on food prices. Most concern involves corn used to make ethanol; biodiesel has much of less of an effect on food prices. It should also be noted that it is not biofuels *per se* that might cause effects on food -- it is the demand for energy in general that may affect food prices.

Some unresolved concern about competition between food and energy crops is probably worthwhile, because it will tend to remind consumers that energy crops are only a fractional solution to our energy challenges. Conservation is a more important -- but often overlooked -- solution.

V. The Northwest's Oilseed Production Capacity

Because oilseed production depends on agronomic and business judgments by farmers, and is strongly influenced by non-oilseed market forces, an accurate projection of the Northwest's potential output is not possible, and any estimate is complicated and risky, and additional factors, such as canola's sensitivity to residual herbicides, are likewise very difficult to include. Despite the challenges and uncertainties, rough estimates are necessary in order to assess the region's potential for biodiesel feedstock production.

Our analysis focuses on Washington state, which has the highest biodiesel processing capacity in the region, and also the highest feedstock oil production potential. One

Washington biodiesel industry leader recently asserted that Washington is able to supply some 100 million gallons of oil annually for biodiesel production.[28] In reality, Washington's vegetable oil production capability is far lower.

Scenario 1: high estimate

In many ways, an upper limit to canola oil production is the most straightforward to estimate. If we view the current higher-than-average price of canola as the new norm, and the current higher-than-average value of rotation crops such as barley, dry peas, and lentils as unusual, estimates of land available for oilseed production are fairly straightforward. Table 4 shows Washington acreage devoted to rotation crops.[29]

CROP	2002 ACREAGE	1997 ACREAGE
Barley	337,483	447,039
Dry peas	81,820	133,564
Lentils	81,769	89,304
Totals	501,067	669,907

Table 4. Crops commonly grown in rotation with wheat in Washington.

Three rotation crops, barley, lentils, and dry peas, were harvested from an average total of about 585,000 acres in 1997 and 2002, while canola itself was harvested from about 10,000 acres. If canola prices continue above $0.15 per pound, and if prices for the rotation crops shown in Table 4 decline to average levels, about 600,000 acres of land are potentially available to produce canola more profitably than the traditional rotation crops. Assuming average canola yields of 2000 lbs/acre and 40% oil content as part of a four-year rotation, oil production under these circumstances would be about 16 million gallons annually.[30] This represents about 13% of the biodiesel processing capacity of Washington biodiesel manufacturers.[31]

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[28]John Plaza, quoted in Curl, Aimee, "Should it matter where your biodiesel comes from?" *Seattle Weekly*, July 18, 2007.

[29]USDA Agricultural Statistics Service (2002) Census of Agriculture: Washington. www.nass.usda.gov/census/census02/volume1/wa/index2.htm

[30] $585{,}000\ acres \times 2000\ lbs\ seed/acre \times 0.4\ lbs\ oil/lbs\ seed \div 7.4\ lbs\ oil/gallon \div 4\ years/canola\ crop$

[31]We estimate Washington biodiesel production capacity to be 125 million gallons, based on National Biodiesel Board and published data.

To avoid disease, canola should be grown only every fourth year in the same field, but if canola were grown every year on all non-wheat dryland acreage, canola oil production could reach as high as 60 million gallons, still only about half of Washington's biodiesel processing capacity. Such widespread production of canola is actually not possible because of canola's sensitivity to residues from herbicides used in some wheat cultivation systems, so 16 million gallons is the most appropriate estimate for Washington's maximum production.

This estimate depends on the replacement of *all non-wheat dryland rotation crops* in Washington with canola as frequently as possible under sound agronomic practices. *This is not a realistic expectation,* but it does help set the upper limit of possible Washington canola oil production.

Scenario 2: medium estimate

If canola were attractive enough to farmers to replace a combination of lentils and dry peas (the lowest-value crops listed in Table 4) in rotations, canola plantings of perhaps 80,000 acres seem possible. This scenario assumes canola would replace lentils or dry peas once in some four-year rotations, resulting in the production of up to 8.8 million gallons of canola oil, or approximately 7% of Washington's biodiesel processing capacity. This is a realistic possibility, but it depends on a particular combination of market conditions for canola, as well as for wheat, lentils, dry peas, and other rotation crops.

Scenario 3: low estimate

Canola plantings in Washington depend on market pricing, and canola is historically undervalued compared to other Washington crops. Canola acreage in 1997 and 2002 averaged 10,000 acres, and the resulting oil production could be expected to be roughly 1,100,000 gallons. This is 0.9% of Washington's biodiesel production capacity, and is the closest to current production levels of any of the estimates discussed here. This volume is also similar to the current oilseed crush capacity of in-state presses.

Other Northwest states

It is much more difficult to estimate canola production potential in Oregon and Idaho than in Washington. For example, wheat is less commonly grown in rotation with the crops shown in Table 4 in Oregon, because the wheat-growing regions of Oregon tend to be drier than those of Washington or Idaho. This limits Oregon's canola production potential unless canola replaces wheat, an important money crop, to some extent. In Idaho, the rotation crops shown in Table 4 are limited to the Palouse region. Both Oregon and Idaho have considerably less non-irrigated farmland than Washington has, and most of the canola production is assumed by this report to occur in non-irrigated regions.

According to the USDA Census of Agriculture, Idaho's average canola production in 1997 and 2002 was about 12,000 acres, or potentially 1.3 million gallons of oil. In Oregon, average canola production in the same years was about 4,500 acres, or potentially 500,000 gallons of canola oil. Oregon's legislature has taken aggressive action to encourage oilseed production; it will be interesting to watch the effect of this legislation on oilseed plantings.

Summary

Compared to its vegetable oil production capability, Washington's biodiesel processing capacity is vastly overbuilt. Even our most optimistic estimate of Washington canola oil production is dwarfed by current in-state biodiesel production capability. As a result, the only possible way to supply all of Washington's biodiesel processors is to import feedstock oil from outside the state or outside the country. Feedstocks imported from outside of North America are very likely to be more environmentally damaging than continued petrodiesel use, and will have no effect on our dependence on foreign oil.[32,33]

VI. Encouraging Northwest Oilseed Production

Although Washington and the other Northwest states have much less agricultural bioenergy production capacity than Midwest states such as Iowa, it is possible -- and desirable -- to develop a true Northwest biodiesel industry. Such an industry will use regionally produced animal fats, oil from algae, second-use oils, and farm-raised oils such as canola oil. The primary requirement for the production of regional vegetable oils is that canola be sufficiently profitable for farmers compared to other crop choices.

The challenge is that canola prices sufficiently high to attract farmers may make biodiesel production unattractive for biodiesel producers. Biodiesel manufacturers can choose to use lower-cost feedstocks to subsidize their use of Northwest-produced oil. However, non-North American biodiesel feedstocks carry significant environmental costs that are impossible to fully mitigate.

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[32]This problem has been widely reported. See, for example: Rosenthal, E., (2007) "Once a dream fuel, palm oil may be an eco-nightmare." *New York Times*, 31 January 2007.

[33]Verhey, S. (2006) "Biodiesel plant won't help nearby farmers." *Capital Press*, 23 May 2006. http://www.capitalpress.infømain.asp?Search=1&ArticleID=25127&SectionID=75&SubSectionID=&S=1

In order to develop a true Northwest biodiesel industry, special measures are necessary. Some of these measures can be facilitated by government, some by the industry as a whole, and some by individual players within the industry.

Branding and standards

Consumers are increasingly seeking local agricultural products, and until very recently motor fuel was not a product that could be sourced locally. Now it is. Branding and customer education can help consumers choose regionally-grown canola/rapeseed biodiesel as the premium product that it is. In addition, the topic of energy offers a good opportunity to educate consumers about agricultural and environmental issues in general.

Also of interest is the fact that neither canola, rapeseed, nor mustard can be produced in tropical regions, so that consumers can be confident that biodiesel from these sources does not contribute to the serious problem of tropical rainforest conversion to palm oil or soybean plantations.

Because the properties of canola/rapeseed biodiesel can be analytically differentiated from biodiesel from other sources, state governments could use these properties in incentive programs, including specifications for the type of biodiesel to be used under state contracts and by state vehicles.

Field - Food - Fuel

Competition with food is less of a concern for biodiesel than with corn-based ethanol, but biodiesel made from vegetable oil that has previously been used for frying is clearly the most sustainable and food-friendly option. An integrated system that used Northwest-grown canola for frying, then converted the used oil to biodiesel would be the best possible use of all resources. However, this particular approach is discouraged by Federal biofuel tax credits, which are greater for so-called agri-biodiesel made from first-use oils, and by Washington State purchasing policies, which require biodiesel to be made from first-use oil.

State programs that encouraged the use of Northwest-grown oil in the food processing industry, followed by the conversion of the used oil into biodiesel, would be very helpful.

Certification

In order for consumers to have confidence in the origin of Northwest-labeled biodiesel, a certification program will be necessary. An organization such as the Cascadia Carbon Institute could provide certification services to Northwest oilseed presses and biodiesel producers, distributors, and consumers, or state governments could each set up their own programs.

Regardless of how certification is carried out, Northwest states could assist the development of a true regional biofuel industry by making certification a requirement for fuel sold as a Northwest-grown product.

Incentives to farmers

Incentives aimed at encouraging biodiesel production do not necessarily reach farmers, and so cannot address the problem of the low value of canola compared to other Northwest crops. In addition, because canola is sometimes worth more in other parts of North America than it is in the Northwest, farmers sometimes find it more profitable to send their seed out of the area for processing.

Market prices above the break-even point are the simplest incentives for farmers to produce canola, and canola prices have recently reached this level.

Challenges to oilseed presses

The availability of regional oilseed pressing capacity is obviously essential to the development of the industry. The sale of meal is an important part of the profitability equation for oilseed presses, but meal prices have not kept pace with the recent increase in seed and oil prices. Shipping of canola to out-of-state oilseed presses has the negative effect of facilitating importation of seed meal as a backhaul. This seed-out-meal-back cycle is self-perpetuating once it is established, and may be partly responsible for the surprisingly low meal prices compared to seed and oil prices.

Carbon credits

Carbon credits represent a possible source of revenue to support a true Northwest agro-biofuel industry. To the extent that the use of biodiesel replaces the use of petrodiesel, less fossil carbon dioxide is released by biodiesel. Estimates vary, but the chemistry of a typical biodiesel molecule from canola oil -- 1 atom of fossil carbon from methanol + 18 short-cycle non-fossil carbon atoms -- indicates a fossil carbon reduction of about 94% compared with fossil diesel. Each gallon of biodiesel replaces about 8.5 kilograms of fossil CO_2, so about 117 gallons of biodiesel offsets 1 tonne of CO_2. The amount of the offset is slightly lower if the lower energy content of biodiesel is taken into account.

The energy necessary to bring biofuel or biofuel feedstocks to the Northwest reduces the carbon credit value of those fuels. The Cascadia Carbon Institute is taking steps to accumulate biofuel- and agriculture-related carbon credits and use them to support the Northwest biofuel industry.

Cascadia Carbon Institute Advisory Board

CCI is grateful to its Advisory Board members, who have reviewed this document. Any remaining errors are the responsibility of the authors. The views outlined in this document are not necessarily those of Advisory Board members.

Jim Baird, Baird Orchards

Jim is a long-time farmer in the Ephrata and Royal City areas, and has a long-standing interest in sustainable agriculture. This year he converted his entire organic orchard operation to Northwest-grown B99 biodiesel, the first orchard in the state to do so. He is also working to establish a permaculture demonstration project on Royal Slope.

Steve Benning, Spokane Hutterian Brethren

The Spokane Hutterian Brethren have been growing canola since 1998. Their canola acreage has ranged up to 1,000 acres in years when the price has been favorable. Steve is past President of the Washington Canola Commission.

Gaylin Davies, McKay Seed

Gaylin has been involved in Eastern Washington agriculture for over 20 years. He joined McKay Seed, a Moses Lake company that specializes in canola and other oilseeds, in 2005. His responsibilities include contracting for canola oilseed production as well as canola planting seed production, and he is active in the Washington Canola Commission.

Atul Deshmane, President, Whole Energy
Kevin Kuiper, Director of Marketing , Whole Energy

Atul has spent the last decade as a business planner, engineer, and manager, and has helped to launch two clean transportation and energy companies. He has consistently focused on the development of alternative fuels. Kevin also has long experience in the alternative fuels industry, particularly in feedstock and fuel acquisition and marketing.

Ron Dunning, Touchet Seed & Energy

With over two decades of experience in agriculture, including operating a successful irrigation company, Ron founded Touchet Seed & Energy which owns one of a small number of oilseed presses operating in Washington.

Ted Durfey, Natural Selection Farms

Beginning in 2002, Ted has received federal and state funding to carry out variety trials on canola cultivars, to produce a feasibility study on biofuels in his area, and to construct an oilseed pressing facility. His oilseed press was the first to begin operation in the state.

Becky Lyle, EarthBourne Resources, Inc.

Raised in the San Fernando Valley of California, Becky became a member of a fourth-generation family farming operation near Ritzville, WA in 1985. As a Ph.D. candidate in the Entomology department at Washington State University in Pullman, she met her husband Chris, a "real farmer", and drove combine that summer -- and ever since. Farm life proved a greater allure than academia, so she left Pullman and moved to Ritzville permanently. The family farm consists of both irrigated and dryland ground, producing a variety of crops, including canola, bluegrass seed, dry peas, barley, potatoes, and wheat

Bill Warren, Warren Farms

Bill grew up on the family farm in Columbia County. His farm produces crops from apples to wheat -- including canola. He has a long-time interest in conservation tillage, and is past president and executive board member of his local Farm Co-Op and the Columbia/Blue Mountain Farm Bureau. After obtaining $102,000 in USDA grant and local matching funding, he oversaw completion of a biodiesel feasibility study, and his Pacific Agri-Energy group is a recipient of funding from the Energy Freedom Act.