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Agriculture's Role in the Bioproducts Industry

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Special thanks to: John Flanders and Josée Bourdeau.

Symbols

The following standard symbols are used in Statistics Canada publications:

.	not available for any reference period
..	not available for a specific reference period
...	not applicable
^p	preliminary
^r	revised
x	suppressed to meet the confidentiality requirements of the <i>Statistics Act</i>
A	excellent
B	very good
C	good
D	acceptable
E	use with caution
F	too unreliable to be published

Introduction

Bioproducts are often presented as one of the potential opportunities for Canadian agriculture, offering non-food applications for agricultural products. The transformation of agricultural products into industrial or non-food products is not a new phenomenon. However, what is new is the growing demand by individual consumers worldwide for products that they know are safe, environmentally-friendly and from renewable sources.

This article provides a brief overview of the bioproducts industry in Canada and the important role agriculture plays in this growing market¹. To better understand the Canadian bioproducts industry the first survey of bioproducts firms was commissioned by Agriculture and Agri-Food Canada (AAFC) and conducted by Statistics Canada in 2004. The survey's target population included firms in Canada that used biomass and other renewable or sustainable feedstocks/materials to develop or produce bioproducts². The results of the Bioproducts Development Survey reveal some similarities across the country but also some striking regional differences.

What are bioproducts?

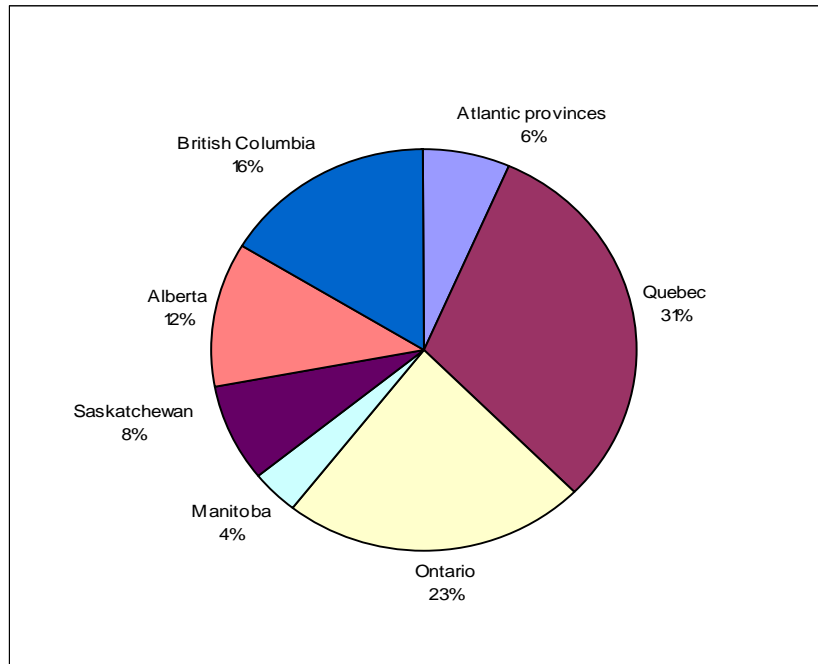
Bioproducts are non-food products developed from biomass – biological or renewable material which can come from agricultural, food, forestry, marine and industrial or municipal sources. Most people are familiar with ethanol made from corn or wheat, but bioproducts also include products such as clothing made from hemp, decking from plant fibre and plastic water bottles made from corn instead of oil. In Canada, more firms use agricultural biomass than any other source.

Who makes bioproducts and why?

Of the 232 bioproducts firms in Canada, most (70%) were located in Quebec, Ontario, and British Columbia (Figure 1). Of the bioproducts firms, 157 were small (less than 50 employees), 39 were medium (50-149 employees), and 36 were large (150 or more employees).

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1. New developments in the bioproducts industry will be highlighted at the World Congress on Industrial Biotechnology and Bioprocessing to be held in Toronto from July 12 to 16, 2006. This is the third time this conference has been held and the first time in Canada.
 2. Excluded from the survey were not-for-profit organizations, universities, government laboratories, hospitals, and firms that provide only services to biotechnology firms, such as contract research organizations or consulting firms.

Figure 1 Distribution of bioproducts firms by region, Canada, 2003



Data source: Statistics Canada, Bioproducts Development Survey.

Bioproducts provide revenues of just over \$3 billion a year to Canadian companies. For most of Canada’s 232 bioproducts firms, bioproducts are just part of their business activities, accounting for approximately one third of their 24,118 employees and one quarter of total firm revenues. Nearly half (48%) of Canadian bioproduct sales were derived from exports (Table 1).

Table 1 Canada’s bioproducts industry, 2003

	Number of firms	Firms entering in past 5 years	Average revenue	Revenue from bioproducts	Bioproduct revenue from exports	Most commonly used biomass
	#	%	\$ thousands	%	%	
Canada	232	34.4	51,251	26.3	47.7	Ag, Forestry, Other
Atlantic provinces	15	21.4	26,322	F	F	Forestry, Ag, Food
Quebec	72	43.1	32,492	33.5	30.9	Ag, Forestry, Marine
Ontario	53	31.4	52,516	31.2	15.1	Ag, Forestry, Other
Manitoba	9	28.0	45,533	32.1	58.6	Ag mainly
Saskatchewan	18	38.4	84,795	X	X	Ag, Manure, Forestry
Alberta	27	39.4	104,948	21.2	82.7	Ag, Forestry, Other
British Columbia	38	23.6	42,276	38.7	27.1	Forestry, Ag, Marine

F too unreliable to be published

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Note: Table value may be rounded. Percentages have been calculated based on exact rather than rounded values.

Data source: Statistics Canada, Bioproducts Development Survey.

For many Canadian firms, bioproducts is a new business activity. Thirty-four percent of firms entered the bioproducts sector within the past five years, mainly as a result of internal research and development projects.

Firms cited several benefits from their involvement in bioproduct activities. Increased sales/market share was ranked as the most important benefit. Other benefits which ranked high included developing new market niches and new products, reducing damage to the environment, and improving product value and performance.

Crops and forest products: the main inputs for bioproducts

More companies used agricultural crop and forestry biomass than other inputs in the production of bioproducts. Ninety-three firms (40%) used agricultural biomass and 76 firms (33%) used forestry products. Small and medium-sized firms were most likely to use crop biomass (41% and 54%, respectively) while large firms were more likely to employ forestry biomass (74%). Marine products, food processing products, animal manure, and municipal organic waste were seldom used by firms.

Bioproduct firms secured their main biomass input as either primary products (e.g. soybean, corn, hemp), by-products (e.g. straw, fat) or recycled products (e.g. cooking oil, industrial sludge). Firms were split almost evenly between using primary biomass inputs (108 firms) or by-products (110 firms) while only 15 firms used recycled products.

Only 18% of all Canadian firms obtained their biomass on site. Nearly 60% of firms were farther than 50 kilometers from their primary source of biomass. Large firms were more likely to source their biomass inputs on-site (approximately 40%), a finding consistent with the fact that the likelihood of using by-products to manufacture bioproducts increases with firm size.

Firms produced a variety of bioproducts

In 2003, firms reported an average of 4.5 bioproducts per firm. Sixty percent of the bioproducts were already on the market, 18% were in mid-development, and 22% were in the early stages of development.

Many types of bioproducts were under development by firms. The largest category of products was bio-chemicals, which made up 41% of all bioproducts under development or on the market.

Biomass as an energy source

Bio-fuels/bio-energy products were primarily being developed by large firms (150 employees or more), likely due to significant resource requirements. Agricultural biomass is especially important in the production of bio-fuels. A recent report commissioned by the Canadian Renewable Fuels Association (CRFA) notes that Canada produced just 250 million litres of bio-fuels in 2004, compared to the 12.9 billion litres produced by the United States. However, domestic production of bio-fuels could increase to over 3 billion litres by 2010 (representing 5% of total gasoline consumption) in response to new provincial and federal targets dramatically increasing demand for agricultural biomass

(CRFA 2006). Further, if all Canadian gasoline sold eventually consisted of a 10% ethanol blend, an estimated 8 to 9 million tonnes of grain would be required in ethanol manufacturing.

The world has only begun to tap into biomass as an energy source. Parikka (2004) estimates that North America is currently using only 16% of its total biomass energy potential (Table 2).

Table 2 World sustainable³ biomass energy potential and current use by region

Biomass potential	North America	Latin America	Asia	Africa	Europe	Former USSR	World
Exajoule per acre (EJ/a)							
Woody biomass	12.8	5.9	7.7	5.4	4.0	5.4	41.6
Energy crops	4.1	12.1	1.1	13.9	2.6	3.6	37.4
Straw	2.2	1.7	9.9	0.9	1.6	0.7	17.2
Other	0.8	1.8	2.9	1.2	0.7	0.3	7.6
=Potential, Sum (EJ/a)	19.9	21.5	21.4	21.4	8.9	10.0	103.8
Use (EJ/a)	3.1	2.6	23.2	8.3	2.0	0.5	39.7
Use/potential (%)	16	12	108	39	22	5	38

Note: Exajoule = 10^{18} joules

Source: Parikka M., Global Biomass Fuel Resources, 2004.

Other products developed and produced by firms included bio-pesticides/bio-herbicides, fiber composites, and bio-sensors/bio-catalysts/bio-plastics/other bioproducts. While these products have potential to impact a variety of industries, bio-pesticides show significant promise for agricultural uses. In time, these products may offer farmers alternatives with improved efficacy and reduced toxicity to traditional pesticides.

It is interesting to note that the bioproducts industry had more products on the market than in development, especially from medium and large firms. Small companies were more focused on the early stages of research and development than larger firms but even they had half of their products on the market.

It is estimated that 65% of Canadian bioproduct firms sell directly to consumers or distributors, 47% sell to other firms and 32% use their products internally⁴. Large firms were more likely to use their products internally, with 67% doing so.

3. The table estimates energy potential from biomass produced in a manner that is sustainable in the long term. Asia is over-consuming relative to its long term sustainable capacity.

4. In the survey, firms were able to select multiple responses.

Bioproducts were often just one business unit of large firms

Large firms were found to pursue bioproducts as a minor sideline or supplement to their main businesses, often using by-products from their other activities. Bioproducts were relatively more important to small firms than larger ones. Small firms employed 78% of their employees for bioproducts development compared to just 19% for large firms.

Research and development (R&D) was important to the firms surveyed. On average, just over \$1 million was spent per firm on R&D in 2003 with 40% devoted to their bioproduct programs. However, not all research generated new intellectual property. Only 31% of the firms held, or had applied for, patents or intellectual property.

Challenges and barriers to expansion

Bioproduct firms in Canada identified lack of financial capital, high cost and timeliness of regulatory approval and high price of raw materials or feedstock as the most important barriers to expansion. Regardless of firm size, the higher cost and timeliness of regulatory approval was perceived as a universally important barrier by bioproduct firms.

Small firms had their own unique set of challenges. They identified lack of adequate product standards or certification as their third most highly rated barrier. In some cases this may reflect inexperience with existing standards while in others the firms may have truly novel innovations for which appropriate standards do not exist. Although firms did not identify human resources as one of the highest barriers, small firms identified a lack of financial resources as the most important reason for not filling vacant positions.

Raising money was a challenge

Of the 232 respondent firms from across Canada, 54% attempted to raise capital in 2003. Over \$297 million was raised by the 97 successful companies but the success and amount raised varied widely by region (Table 3). Firms in Saskatchewan saw the lowest average funding at \$211,000 per firm seeking funding while those in Alberta saw the highest, at just over \$7.5 million.

Sixty-one percent of small firms attempted to secure financing in 2003. Although they had a lower success rate, at 75%, than medium and large firms (84% and 86% respectively), they raised the most funds on average. Small and medium firms raised \$2.5 million per firm seeking funding, compared to just \$1.4 million for large firms.

Table 3 Bioproducts firms financing success by region, Canada, 2003

	Number of firms	Firms seeking funding	Percent successful	Average funding per firm seeking funding
	#	#	%	\$ thousands
Canada	232	125	77.6	2,378
Atlantic provinces	15	6	74.0	x
Quebec	72	44	86.5	3,339
Ontario	53	28	59.0	702
Manitoba	9	3	100.0	x
Saskatchewan	18	10	87.5	211
Alberta	27	12	88.5	7,507
British Columbia	38	22	71.3	1,192

Note: Percent successful includes all firms which were at least partially successful in raising funding.

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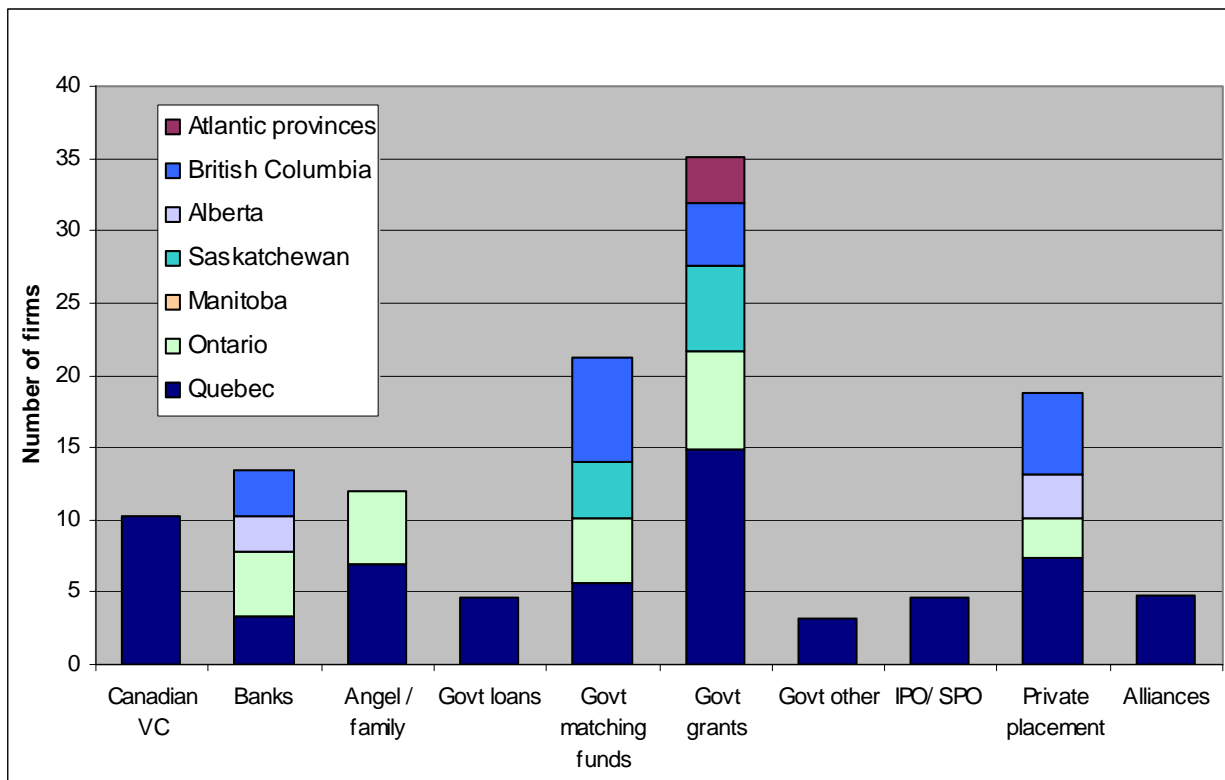
Data source: Statistics Canada, Bioproducts Development Survey.

The number one reason cited for pursuing financing was to fund R&D. However, small firms also raised funds to repay investors and fund regulatory expenses. Medium and large firms often sought funding for production and manufacturing. Just over half of all firms cited a need for operating capital as a purpose for raising funds.

Various reasons were cited for the firms' lack of success in raising money. The most common was the lack of availability of capital, but other reasons were that the technology was not sufficiently developed or the market was unproven. The last two were particularly significant for small firms who tended to have early-stage products.

Government programs were the most commonly accessed source of funding (45% of firms seeking capital), followed by private placements (16%) and angel investors/family (15%). Financial institutions, public offerings, and alliances/collaborations were less frequently used. Quebec firms were most numerous across most categories, due in part to their number but also to their high success rate (Figure 2).

Figure 2 Sources of capital for bioproducts firms by region, Canada, 2003



Note: Some use of capital sources not captured by Figure 2 due to confidentiality and/or unreliability of data. VC is venture capital and IPO/SPO is initial public offering/secondary public offering.

Data source: Statistics Canada, Bioproducts Development Survey.

Participation in government programs

Participation in government programs by bioproducts firms was highly variable by region (Table 4). Programs supporting technology development were the most likely to be accessed, but small firms also made extensive use of loan guarantees, information and training programs.

Table 4 Bioproducts firms use of government support programs from 1998 to 2003 by region, Canada

	Firms using federal programs	Firms using provincial programs	Firms using SR&ED	Average cumulative credits per firm applying
By Region	%	%	%	\$ thousand
Canada	33.4	34.0	47.5	1,293
Atlantic provinces	41.4	28.3	28.3	3,495
Quebec	39.0	68.1	65.1	1,181
Ontario	15.3	7.9	37.6	839
Manitoba	60.5	F	64.3	976
Saskatchewan	54.3	44.6	35.9	870
Alberta	38.1	16.6	27.0	3,748
British Columbia	25.6	19.4	52.1	875

F too unreliable to be published

Data source: Statistics Canada, Bioproducts Development Survey

Firms made use of the federal Scientific Research & Experimental Development (SR&ED) tax credit program. Still, fewer than half (48%) of Canadian bioproducts firms used this program in 2003. On average, firms that applied obtained approximately \$1.3 million in cumulative credits over the 1998 to 2003 period. These tax credits ranged from less than \$1 million on average per firm in Ontario, Manitoba, Saskatchewan, and British Columbia to over \$3 million in Alberta and Atlantic regions.

Small firms were slightly more likely to use the SR&ED tax credit program but their average five year cumulative credit of just under \$800,000 was much lower than for medium and large firms' allocations of \$2.4 and \$2.6 million, respectively.

Business strategies employed

Firms viewed acquiring knowledge from other industry sources (including industry associations, competitors, clients and suppliers) and the commencement of new research and development projects as their most important business strategies. Entering product trials and/or adapting products for increased market penetration were also seen as important to the industry. Quebec was the only province where firms identified intellectual property audits as an important strategy.

Firms accessed industry knowledge through both contracts and collaborations. Thirty-six percent of firms were involved in contracts mostly with private research labs and universities. Contracts with these institutions comprised 40% and 38%, respectively, of all contracts. Thirty-five percent of bioproducts firms in Canada were involved in collaborations with other organizations in 2003.

Summary

The results from the Bioproducts Development Survey indicate that firms are generating significant sales of bioproducts at home and abroad, they are investing and working with others in research and development for new bioproducts and they have significant activities and revenue beyond bioproducts. Making better use of government programs and tax credits could further support the development of the bioproducts industry.

Continued interest in agricultural biomass as the primary input for bioproducts may assist Canadian farmers to diversify their market options. Locating new bioproducts firms close to the agricultural biomass inputs may also provide rural communities with new development opportunities.

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